Bringelly Brickworks and Quarry Expansion

ENVIRONMENTAL IMPACT STATEMENT

Volume 1

PREPARED FOR: Boral Bricks Pty Ltd

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BORAL

BRINGELLY BRICKWORKS

Environmental Impact Statement

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Date 5 September 2013

This report has been prepared for Boral Bricks Pty Ltd in accordance with the terms and conditions of appointment for Bringelly Brickworks dated 7 Janury 2013.

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APPENDICES (VOLUME 2)

GLOSSARY OF TERMS

AADT	Average Annual Daily Traffic
ABS	Australian Bureau of Statistics
AEP	Annual Exceedence Probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHMP	Aboriginal Heritage Management Plan
ANZECC	Australian and New Zealand Environment Conservation Council
ASS	Acid Sulphate Soils
BoM	Bureau of Meteorology
CBD	Central Business District
CBNTCAC	Cubbitch Barta Native Title Claimants Aboriginal Corporation
CC	Camden Council
C&D	Construction and demolition
CEMP	Construction Environmental Management Plan
CHAR	Cultural Heritage Assessment Report
CLEP 2010	*Camden Local Environment Plan 2010*
CLM Act	*Contaminated Land Management Act 1997*
CO	Carbon monoxide
$CO_{2\text{-}e}$	Carbon dioxide equivalent
CPW	Cumberland Plain Woodland
DA	Development Application
dBA	Decibels
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation (now OEH)
DGRs	Director General's Environmental Assessment Requirements

GLOSSARY OF TERMS

DoS	Degree of Saturation
DP&I	Department of Planning and Infrastructure
DTM	Digital Terrain Model
EC	Electrical Conductivity
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ENV	Existing Native Vegetation
EP&A Act	*Environmental Planning & Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2010*
EPA	Environment Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPI	Environmental Planning Instrument
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater dependent ecosystem
GIS	Geographic Information Systems
GLC	Ground level concentration
Greenhouse gas	Greenhouse Gas
Growth Centres SEPP	*State Environmental Planning Policy (Sydney Region Growth Centres) 2006*
Ha	Hectares
HCl	Hydrogen chloride
HF	Hydrogen fluoride
ICNG	NSW Interim Construction Noise Guideline

GLOSSARY OF TERMS

INP	NSW Industrial Noise Policy
L_{A1}	The noise level which is exceeded for one per cent of the sample period.
L_{Aeq}	Energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment.
$L_{Aeq, period}$	The overall L_{Aeq} noise level measured over the assessment period.
LCC	Liverpool Council
LEP	Local Environmental Plan
LGA	Local Government Area
LoS	Level of Service
m	Metres
Major Development SEPP	*State Environmental Planning Policy (Major Development) 2005*
MHRDC	Maximum Harvestable Right Dam Capacity
Mt	Million tonnes
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measures
NES	National Environmental Significance
NHMRC	National Health and Medical Research Council
NO	Nitric oxide
NOW	NSW Office of Water
NO_x	Oxides of nitrogen
NO_2	Nitrogen dioxide
NPW Act	*National Parks and Wildlife Act 1974*
NV Act	*Native Vegetation Act 2003*
NW Act	*Noxious Weeds Act 1993*
OEH	NSW Office of Environment and Heritage

GLOSSARY OF TERMS

OEMP	Operational Environmental Management Plan
PAD	Potential Archaeological Deposit
PEA	Preliminary Environmental Assessment
PM_{10}	Particulate matter up to ten micrometers in size
POEO Act	*Protection of Environment Operations Act 1997*
PRP	Pollution Reduction Program
RBL	Rating background level, a measure of typical background noise levels.
RBM	Relevant Biodiversity Measure
RH	Relative humidity
RMS	Roads and Maritime Service
SEPP 33	*State Environmental Planning Policy No. 33 – Hazardous and Offensive Industries*
SEPP 2007	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*
SEPP 55	*State Environmental Planning Policy No. 55. – Remediation of Land*
State and Regional Development SEPP	*State Environmental Planning Policy (State and Regional Development) 2011*
SEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
SO_2	Sulphur dioxide
SSD	State Significant Development
SWGC	South West Growth Centre
t	Tonnes
TEC	Threatened ecological community
TLALC	Tharawal Local Aboriginal Land Council
Tpa	Tonnes per annum
TSC Act	*Threatened Species Conservation Act 1995*

GLOSSARY OF TERMS

TSP	Total Suspended Particulates
uS/cm	microsiemens per centimetre, a measure of electrical conductivity
VENM	Virgin Excavated Natural Materials
VOCs	Volatile Organic Compounds
WMP	Waste management plan
WM Act	*Water Management Act 2000*
WSP	Water Sharing Plan
$\mu g/m^3$	Micrograms per cubic metre

STATEMENT OF VALIDITY

This Environmental Impact Statement has been prepared in accordance with relevant requirements of the *Environmental Planning and Assessment Act 1979* and *Environmental Planning and Assessment Regulation 2000*.

Title	Environmental Consultant	Project Director; Acting Associate Business Director
Name:	Lauren Dykes (key author)	Brad Searle
Qualifications:	BUrbanEnvPlan (Hons), BSc; MPIA CPP	BSc (Hons) Environmental Science
Address:	Hyder Consulting Level 5, 141 Walker Street Locked Bag 6503 North Sydney NSW 2060 Australia	
In respect of:	Bringelly Brickworks, Environmental Impact Statement	
Applicant name:	Boral Bricks Pty Ltd	
Applicant address:	Level 39 AMP Centre 50 Bridge Street SYDNEY, NSW, 2000	
Proposed development:	Expansion of the existing quarry operations and brickmaking facilities at the Boral Bringelly Brickworks, as well as ancillary works associated with the expansion, as outlined in Section 5.2 of this Report	
Land to be developed:	Lot 11 in DP 1125892, as outlined in Section 5.1 of this Report	
Environmental Assessment:	An environmental impact statement is attached, which investigates potential impacts on the following: land resources, noise, traffic and transport, air quality, water resources (including groundwater and surface water), biodiversity, heritage, waste, greenhouse gases, visual, hazards, social and economic aspects of the surrounding environment.	
Declaration:	Pursuant to clause 6(f), Part 3, Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*, I declare that this Environmental Impact Statement (EIS): Has been prepared in accordance with the requirements of the *Environmental Planning and Assessment Act 1979, Environmental Planning and Assessment Regulation 2000*, and the Director General Requirements (SSD 5684) dated 24 December 2012. Contains all available information relevant to the environmental assessment of the development to which this EIS relates; and Contains information that is neither false nor misleading.	
Signature		
Name	Lauren Dykes	Brad Searle
Date	13 September 2013	

EXECUTIVE SUMMARY

Introduction

Hyder Consulting (Hyder) has prepared this Environmental Impact Statement on behalf of Boral Bricks Proprietary Limited (Boral, the proponent) to assess the potential environmental impacts of an increase in production at the Bringelly Brickworks and continued extraction of the Quarry (the project site) to meet the anticipated demand for its brick products. Boral currently carries out quarrying and brick making activities at the project site, which lies on the northern border of the Camden LGA on Greendale Road, Bringelly.

The project is a State Significant Development (SSD) under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Clause 8 *State Environmental Planning Policy (State and Regional Development) 2011* (State and Regional Development SEPP).

Bringelly Brickworks currently operates within an approximate 29.25 hectare development footprint. The current consent on the site permits quarry extraction of up to 200,000 tonnes per annum, and brick production of up to 160,000 tonnes per annum. Operations undertaken within this development footprint comprise the following:

- A crushing and manufacturing plant.
- Stockpiling areas.
- A product storage and delivery area.
- An active quarry, which contains total resource yield of approximately 4.43 million tonnes of Bringelly shale.

Project Approval is sought for the increase in production at the brickworks and continued extraction of raw materials, but over a larger extraction area (quarry footprint). The key proposed operational parameters are noted:

- Extraction of raw material from the site in the order of 200,000 tonnes per annum (no change to current extraction consent) through continued extraction from the existing quarry area (current consent) to a maximum depth of 30 metres, as well as expansion of the quarrying operations over an additional 20.75 hectares (to a total of 30.65 hectares) with extraction to a maximum depth of 30 metres.
- Brick production in the order of 263, 500 tonnes of bricks per year (increase of 103,500 from current consent).

This EIS has been prepared by Hyder on behalf of the proponent to support an application for approval for the continuation of operations on the project site, as described in Chapter 5.2 of this EIS. It has been prepared in accordance with the Director General's Requirements (DGRs) issued on 24 December 2012 by the Department of Planning and Infrastructure (DP&I).

Site description and context

The Boral Brickworks is located on Lot 11 in DP 1125892 comprising an area of 385.55 hectares. The northern part of the property (the project site) is currently occupied by a clay quarry and brick manufacturing plant and is owned by Boral. The project site is approximately 56.75 hectares in area. It is located within the Camden Local Government Area and is approximately 55 kilometres southwest of the Sydney Central Business District.

The project site is currently used for quarrying, brick production and associated activities. The brickmaking facility along with various administration buildings, a finished bricks storage yard, staff car park and internal road network is generally contained within the northern part of the

project site, and is set back approximately 200 metres from Greendale Road. The southern portion of the project site, adjacent to Thompsons Creek, is leased for the agistment of stock and grazing.

Strategic context and project need

Boral has operated two brick-making plants in Sydney at Badgerys Creek and Bringelly for over 40 years. With the current uncertain economic conditions and the recent downturn in residential housing activity, Boral has reviewed market demand against its bricks production capacity in NSW. Following this review, Boral 'mothballed' operations at Badgerys Creek, effective from 30 March 2012. Mothballing the site gives Boral the option to review its commercial position at a future stage and, if market conditions and business needs allow, recommence production. While the Badgerys Creek operations are mothballed, it is proposed that the Boral Bringelly Brickworks will supply the Sydney market. This operational consolidation will require an increase in the manufacturing process (i.e. the number of bricks produced) at Bringelly to meet anticipated demand.

The project site is located within the South West Growth Centre (SWGC) and forms part of the Lowes Creek and Bringelly precincts. These precincts are designated for future residential and employment uses under the Draft Sydney Metropolitan Strategy (released for exhibition in March 2013). The site occupied by the brickworks and extraction area is identified for employment lands. It is anticipated that significant urban growth will occur in this area over the next 30 years.

The proposed continuation of quarrying and brick making activities at the project site would utilise existing surface infrastructure and facilities, with no requirement for upgrade. The use of existing infrastructure including the brick making facility would provide an economically viable means of extracting, processing, manufacturing and transporting valuable shale and sandstone resource as bricks and pavers.

Alternatives considered

Alternative options considered for the project include:

- *Location and depth of extraction*: Given the availability of more readily accessible resources across the site, it is not economically viable to extract material deeper than an average of 30 metres. The locations of the proposed cell expansion areas have been chosen based upon a series of environmental constraints and geological considerations. The location of proposed cells will target the required resource, whilst avoiding significant vegetation, flood prone land, and environmentally sensitive areas such as Thompsons Creek.
- *Use of the project site*: the option of ceasing quarrying and brick production on the site in favour of another use was considered. This option would leave the remaining valuable resources on site, rather than being productively used, and is not considered to have economic or social merit given that the site is already operating a well-regarded business, with strong future potential given the recovering housing market in the greater Sydney region.
- *Importation of all raw materials*: this option would have positive biodiversity, Indigenous heritage, water quality and noise impacts as the quarry footprint would not expand any further than its current extent and extraction campaigns would cease. However, the negatives include increased costs of importing material, sterilisation of a unique shale colour, lack of control over supply, increased heavy vehicle movement and noise associated with these.
- *Do Nothing*: this option would involve Boral continuing to operate the Bringelly Brickworks site until it meets the current brick production thresholds stipulated in the 1991 consent,

which according to Boral forecasts, will be reached towards the end of 2013. Without consent to increase brick production at their Bringelly Brickworks, Boral will be unable to respond to market demands for additional bricks, particularly in the current situation with their second brickworks at Badgerys Creek being in a mothballed state.

Project description

Project Approval is sought for operations on the site involving the continued extraction of raw materials, over a larger extraction area (quarry footprint), and brickmaking activities, at a higher production rate. Key features of the project include:

- Extension of the extraction areas to include an additional 20.75 hectares (to a total of 30.65 hectares) with extraction to a maximum depth of 30 metres. Extraction rates at approximately 200,000 tonnes per annum will remain unaltered from the current consent.
- Brick production in the order of 263, 500 tonnes of bricks per year (increase of 103,500 from current consent).
- Construction of a 4.5 metre high noise bund along the northern property boundary, from the existing driveway to the proposed new driveway location (200 metres long x three metre flat top with a 21 metre wide base and 1:2 batter slopes).
- Construction of a 4.5 metre high noise bund along the northern boundary of the quarry operations (362 metres long x 3 metre flat top with a 21 metres wide base and 1:2 batter slopes).
- Importation of raw materials required for brickmaking in the order of 96,000 tonnes per annum.
- Extension to the existing clay preparation building and a small area of the brick manufacturing plant near the kiln exit.
- Addition of two recycled water storage tanks.
- Construction of a new driveway to the east of the existing alignment.
- Upgrading of the existing bio-cycle sewage treatment plant.

Rehabilitation

The rehabilitation strategy addresses the long-term rehabilitation of the site and how environmental issues will be managed over time. The key areas addressed were the management of erosion and sedimentation, and wind-borne dust generated during the life of the quarry.

It is proposed that rehabilitation will be completed in three stages, in line with the stages of quarrying activities. The conceptual final landform will comprise a central water management storage area, one void, as well as the brick manufacturing plant and non-hardstand areas, such as the noise bunds, dams and old raw stockpile areas.

Statutory approvals

Commonwealth Legislation

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) came into effect in July 2000 and requires the approval of the Commonwealth Minister for the Sustainability, Environment, Water, Population and Communities for actions that may have a significant impact on matters of National Environmental Significance (NES). Approval from the Commonwealth is in addition to any approvals under NSW legislation.

The project is not anticipated to affect matters of NES under the EPBC Act and as such a Referral to the Minister for Sustainability, Environment, Water, Population and Communities is not required.

NSW Environmental Planning and Assessment Act 1979

Under Clause 8 of the *State Environmental Planning Policy (State and Regional Development) 2011* (State and Regional Development SEPP), development is declared to be State Significant Development (SSD) for the purposes of the EP&A Act if, among other provisions, the development is specified in Schedule 1 or 2 of the State and Regional Development SEPP.

The total extractable resource at the Bringelly Brickworks site is 7.9 million tonnes. The existing Bringelly Brickworks (an extractive industry for the purposed of the EP&A Act) and the proposed modification to increase production will involve an expansion of the extraction area so that the operation will extract from a total resource of more than five million tonnes and the operation would therefore meet the criteria in clause 7(1)(b) of Schedule 1 for SSD. The project is therefore subject to the provisions of Part 4 of the EP&A Act with the Minister being approval authority.

Environmental Planning Instruments

A range of Environmental Planning Instruments (EPIs) created under the EP&A Act provide further detailed guidance and regulation for the development at a state, regional and local level.

In accordance with 75J of the EP&A Act, in deciding whether or not to approve the carrying out of a project, the Minister may (but is not required to) take into account the provisions of any EPI that would not apply to the project if approved. As this is discretionary, a range of EPIs have been considered in this EIS, including:

- *State Environmental Planning Policy (State and Regional Development) 2011.*
- *State Environmental Planning Policy (Sydney Regional Growth Centres) 2006.*
- *State Environmental Planning Policy No.55 – Remediation of Land.*
- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007.*
- *Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No. 2- 1997).*
- *Sydney Regional Environmental Plan No.9 Extractive Industries.*
- *Camden Local Environment Plan 2010* (CLEP 2010).

A discussion on these EPIs and the applicability to the project is provided in Section 7.1 of this EIS. The project is defined as ‘extractive industry’ (which is permissible with consent) and ‘industrial activities’ (which is prohibited) under the CLEP 2010. Section 106 of the EP&A Act allows for the continuation of a use for which development consent was granted before the commencement of a provision of an EPI having the effect of prohibiting the use. In addition, Section 89E (3) specifies that development consent may be granted despite the development being partly prohibited by an environmental planning instrument.

Licensing

A series of scheduled activities are currently included in the existing Environment Protection Licence (EPL) 1808. Consultation will be undertaken with the EPA to determine whether a modification to the existing EPL is required as a result of the proposed extension to the Bringelly quarry and brickmaking facility.

Consultation

Statutory and Other Relevant Agencies

In preparing this EIS, the DGRs have been addressed as required by Clause 75F of the EP&A Act. The key matters raised by the Director-General for consideration in the EIS are outlined in Appendix A of the EIS.

The proponent has undertaken consultation with key local and State Government agencies as specified in the DGRs during the preliminary design phase and preparation of this EA. The key agencies that Hyder and Boral have consulted include:

- NSW Office of Environment and Heritage (OEH).
- NSW Office of Water (NOW).
- Environment Protection Agency (EPA).
- Liverpool City Council (LCC).
- Camden Council (CC).

Community Consultation

The focus of the community consultation has been to develop targeted land owner consultation and engagement to discern the position of the site's key stakeholders in respect to the operations, as well as to the project itself.

The community consultation initiatives have been under implementation since July 2012 and have included a perception audit, distribution of written information, one-on-one and group briefings, and an open site inspection opportunity.

Aboriginal Consultation

As Aboriginal objects would be impacted by the project (refer to Section 7.9 and Appendix L of this EIS), comprehensive Aboriginal consultation in accordance with the *Interim Community Consultation Requirements for Applicants* (DEC 2004) is currently being undertaken. This consultation was completed prior to commencement of archaeological test excavations.

Environmental assessment

Land resources

The potential impacts of the proposed works on land resources are not considered to be significant. Many of the potential land use impacts are related to soil erosion and sedimentation issues, which would be effectively managed through the implementation of appropriate mitigation measures.

The existing operation demonstrates the ability to co-exist within a variety of environments with minimal impact and it is anticipated that the proposed operations would integrate effectively with both existing and future planned land uses in the area for the life of the project.

Noise

The Noise Assessment undertaken for the project site reveals that a number of residences to the north and east of the project site may be affected by noise from the proposed operation. Noise modelling of various stages during the life of the proposed operation has shown that mitigation measures would be required in order to satisfy the noise criteria at noise sensitive locations. With these measures implemented, it is predicted that noise from the site would generally comply with the Industrial Noise Policy (INP) noise criteria.

It is considered that with careful regard to noise during planning and operation of the quarry and brick making facility, and with proper implementation of the noise mitigation measures recommended, the proposed operations could proceed without excessive adverse noise impact on existing development in the surrounding area.

Traffic and transport

A Traffic Impact Assessment was undertaken in respect of the project to assess the potential impacts of the project on traffic and transport. The assessment determined that there would be minor increases in traffic generation as a result of the increased truck movements and staff numbers that form part of the project. The increase in traffic generation is considered to have a negligible impact on the performance of the Greendale Road and The Northern Road. The boundary between the Camden and Liverpool LGA falls on the centreline of Greendale Road, and both Councils have an agreement in place that Liverpool Council undertake all road maintenance on Greendale Road, while Camden Council provide half of the funding towards the maintenance or any upgrading. The cumulative traffic impact of the Bringelly Brickworks expansion project and other developments on Greendale Road would not be significant.

Air quality

An Air Quality Impact Assessment was undertaken as part of the EIS. Maximum predicted pollutant Ground Level Concentrations (GLCs) at identified sensitive receptors were compared against relevant guideline values. The modelling results show that odour, hydrogen fluoride, gaseous chlorine, sulphur dioxide and sulphuric acid were below the stated assessment criteria at the discrete sensitive receptors for both isolated and cumulative predicted GLCs

The dust modelling results indicated that Total Suspended Particulate (TSP) GLCs and dust deposition met the assessment criteria for all modelled scenarios. The results show that minimal incremental impacts from the proposed operations would arise at nearby sensitive receptors. Therefore, it is unlikely that the existing PM_{10}, TSP or dust deposition levels at any sensitive receptor would be significantly changed. There are no exceedances of the total (cumulative) 20-hour average PM_{10} criterion of 50 $\mu g/m^3$ for the stages. These dust generation levels are highly conservative, as the effect of the precipitation rate (rainfall) in reducing dust emissions was not applied in the modelling of dust generation, in addition to vegetative buffers that exist around the perimeter of the site.

Surface water

The potential water quality and management impacts associated with the project are focused on the increased potential for sediment laden runoff to enter nearby waterways due to the increased area of surface disturbance on the project site and lengthened duration of the existing quarrying activities.

Water balance modelling was undertaken as part of the EIS and is detailed in Section 7.6 and Appendix I to the EIS. The modelling shows that the proposed development will result in an increase of disturbed area and changes to the existing catchments. This will in turn cause higher volumes of runoff into the quarry storage (quarry pit). However, through expansion of the quarry, the utilisation of redundant voids will present opportunities for capture and retention of increased runoff volumes. Therefore, the combined capacity of water storages on the project site, including current and proposed will be sufficient to contain runoff and maintain authorised discharges to Thompsons Creek at current levels.

It is not anticipated that the project would have significant impacts on surface water on the project site or in the surrounding waterways subject to the maintenance and augmentation of appropriate mitigation measures as detailed in Section 7.6 of the EIS.

Groundwater

Potential impacts of the project on groundwater resources can be mitigated. The groundwater impact assessment undertaken by Golder Associates (2013) indicates that the project does not pose a high risk to the groundwater regime because local surface water features are essentially isolated above the groundwater level, and any potential impacts from the quarry pit deepening and related drawdown are likely to be sufficiently small to be unnoticeable.

As the aquifers around the project site are very low yielding and of low quality, there is currently no groundwater source development within the project site. The potential for future development of these groundwater sources is minimal; therefore, the identified risks to the groundwater source are considered to be low. Based on the available information, there are no registered bores within the project site. There are no registered bores located within the modelled zone of drawdown (one-metre drawdown).

There are no high priority groundwater dependent ecosystems (GDEs) springs within the project site. The quarry operation will therefore be not expected to impact on high priority GDE springs. The National GDE Atlas lists South Creek as a GDE (category 'Reliant on surface expression of groundwater'). Groundwater withdrawal from open cut quarrying is predicted to have no impact to South Creek.

To address the potential groundwater impacts as a result of the project activities, Boral will adopt a combination of preventative actions and management options to reduce the likelihood of adverse impacts occurring and to mitigate those risks. Management and mitigation measures will be implemented as required.

Biodiversity

Vegetation at the project site and surrounds is highly modified and fragmented as a result of historical clearing due to agriculture and quarry activities. The biodiversity values of the proposed quarry footprint are mostly limited to non-certified areas that lie south of the existing project footprint, with the majority of this being exotic dominated vegetation. The project would result in the loss of native and exotic vegetation, including Cumberland Plain Woodland, a Critically Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1995* (TSC Act); however, these impacts of species loss are accounted for in a comprehensive biodiversity offset strategy.

The project may have the potential to impact on some fauna species, however a seven part test was prepared for each of these species and it was concluded that impacts would not be significant, as there were no threatened species, populations or communities found to be subject to likely significant impacts as a result of the project.

Aboriginal heritage

Two isolated finds (low archaeological significance) and one area of potential archaeological deposit (PAD) with an associated isolated find were identified within the area of proposed impact. A test excavation was completed to accurately assess the archaeological significance of the area of PAD and associated isolated artefact. Preliminary results of the test excavation demonstrate the site to be of low archaeological significance (this will be confirmed upon finalisation of the test excavation report). It is noted that an additional isolated find (low archaeological significance) was identified just outside the area of proposed impact and would not be impacted by the proposed quarry expansion works.

As Aboriginal objects would be impacted by the project, comprehensive Aboriginal consultation in accordance with the *Interim Community Consultation Requirements for Applicants* (Department of Environment and Conservation, DEC 2004) is currently being undertaken.

Standard mitigation measures as described in Section 7.9 of the EIS would be implemented on the site to ensure that potential heritage impacts are adequately managed during quarrying activities.

Non-Aboriginal heritage

No Non-Indigenous archaeological material or areas of archaeological potential were identified during the site survey carried out as part of this heritage assessment. The assessment noted that there are no signs of cultivation or the establishment of structures within the study area. However, there may be minor visual character and amenity impacts associated with the construction of the northern noise bund. To minimise visual impacts on the unlisted Bringelly Road/Greendale Road Cultural Landscape, the proposed bund along part of the northern boundary will be grassed and then planted with a mixture of locally occurring native trees and shrubs, particularly those of the Cumberland Plain Woodland variety. Procedures for unexpected Non-Indigenous archaeological finds will be prepared should unexpected archaeological finds be encountered during works.

Waste

The main construction and demolition (C&D) waste arising from the project will be associated with the new driveway alignment, and extensions to the manufacturing plant and the clay preparation buildings. However, when considering the 4.7 million tonnes of C&D waste generated in Sydney during 2009-2009 (EPA 2010), the volume generated (14,750 tonnes per annum) would be relatively small.

The continuation and expansion of operations on the project site would result in the generation of the same types and quantities of wastes generated under existing operations. Potential waste management impacts would be minimised through the use of appropriate mitigation and management on the site.

Greenhouse Gases

An increase in the brick production process will result in an increase in the combustion of natural gas, electricity use and diesel consumption. These activities will result in an increase in greenhouse gas emissions as a result of the proposed expansion. Greenhouse gas emissions from the operational phase of the project are the largest contributor to emissions.

Total emissions for the project were estimated to increase from 23,132 t CO_2-e to 34,275.8 tCO_2-e, or .03 Mt CO_2-e per year based upon the maximum level of production. Total annual potential emissions associated with the project (.03 MtCO_2-e) represent approximately 0.37 per cent of the total emissions from the mining non-energy sector in Australia (8.1 Mt CO_2-e) and 0.004 per cent of total Australian emissions (756 Mt CO_2-e). Accordingly, the contribution of the project to Australia's annual greenhouse gas emissions is not considered to be significant.

Visual

Land uses surrounding the project site are generally characterised by rural residential development interspersed with agricultural enterprises and industry. The landscape context is characterised by cleared land, open woodland and grasslands with some remnant regrowth vegetation, particularly along Thompsons Creek.

It is expected that the overall visual character of the project site would remain largely unchanged as a result of the project. Much of the project site would be screened from surrounding receivers by existing and proposed bunding along the northern and eastern site boundaries. Visually, the site would be generally unobtrusive when viewed from surrounding properties and public roads. The project relates to an existing operation, which has been in place on the site for some 45 years. The existing operation is generally integrated with the surrounding landscape and is not out of character with existing operations. Proposed vegetated

bunds and landscape screening would assist with minimising the visual impacts of the project site upon the surrounding area, as land uses change into the future.

Hazards

Hazards identified as having the potential to pose a risk to the human or built and natural environments associated with the continuation of operations at the site include bushfire, refuelling of vehicles and plant, the storage of fuel and chemicals associated with quarrying and brick production, stockpile areas and the potential for contaminated surface runoff.

The hazards identified are not considered to represent a significant constraint to the project provided appropriate mitigation measures are implemented, as described in Section 7.14 of this EIS.

Socioeconomic

The proposed increase in brick production will provide employment for an additional 34 people, which represents a 90 per cent increase on the existing workforce at the plant. Additionallly, the project will provide significant economic benefit through the extraction and utilisation of a regionally significant resource and the provision of local employment.

Potential social impacts of the project generally relate to visual, noise, air quality (dust), traffic and land use impacts associated with quarrying activities. The location of the project site within the SWGC means that the nature and character of surrounding development is likely to change significantly over the life of the project, becoming more urban and industrial in nature. A range of mitigation measures have been recommended throughout the EIS that consider the changing nature of the site surrounds. Mitigation measures would be implemented as appropriate to ensure potential social impacts are minimised.

The location of the site within the SWGC provides a ready market for the brick products produced at the site. This market proximity would ensure that transport costs and impacts related to greenhouse gas emissions, noise and congestion would be minimised.

The quarry and brick making facility has been operating on the project site for the last 45 years without significant conflict. An ongoing communications program targeting the local community in conjunction with the proposed mitigation measures would seek to ensure that the project provides social benefits through the provision of ongoing local employment without placing additional strain on community or social infrastructure or resulting in unacceptable impacts upon general amenity.

The residual socioeconomic impacts of the project are considered to be generally positive, given the minimal noted impacts upon amenity as a result of the existing operation and the substantial contribution which the project stands to make in economic terms.

Cumulative impacts

The cumulative impacts of the project have been considered with respect to the impacts associated with the continuation of operations in the context of existing surrounding development as well as in relation to other approved projects in the region.

Mitigation measures have been recommended throughout this EIS to minimise impacts associated with the project. Provided these mitigation measures are adopted, the project would have negligible cumulative impacts.

Project justification

The proposed continuation and expansion of operations on the project site has been considered in the context of the principles of Ecologically Sustainable Development (ESD) and is considered to be generally consistent with these principles. The project is not expected to result in significant environmental impacts provided that the environmental management measures recommended in the EIS are implemented. The project stands to provide significant economic benefit through the extraction and utilisation of a regionally significant resource and the provision of local employment.

Conclusion

Potential environmental impacts resulting from the project have been identified and measures have been recommended throughout the EIS to manage impacts to within acceptable levels. The project would be operated to meet existing environmental standards and the environmental performance of the project would be monitored to ensure achievement of these standards.

Undertaking the project in the manner proposed is justified taking into consideration potential biophysical, economic and socio-cultural implications.

1 INTRODUCTION

This chapter provides the relevant background to the project including the site and planning history, and context of the project approval process. The structure of the report is outlined to enable a broad understanding of the scope of the environmental assessment in relation to statutory requirements.

1.1 PROJECT NEED AND OVERVIEW OF STATE SIGNFICANT DEVELOPMENT APPLICATION

Bringelly Brickworks is located at 60 Greendale Road, Bringelly, operating within an approximately 29.25 hectare development footprint. Operations undertaken within this development footprint currently comprise the following:

- A crushing and manufacturing plant.
- Stockpiling areas.
- A product storage and delivery area.
- An active quarry, which contains total resource yield of approximately 4.43 million tonnes of Bringelly shale.

Boral has operated two brick-making plants in Sydney at Badgerys Creek and Bringelly for over 40 years. With the current uncertain economic conditions and the recent downturn in residential housing activity, Boral has reviewed market demand against its brick production capacity in NSW. Following this review, Boral mothballed operations at Badgerys Creek (halting production but maintaining the facility for future use) effective from 30 March 2012. Mothballing the site gives Boral the option to review its commercial position at a future stage and, if market conditions and business needs allow, recommence production. Should this occur, the higher production limit at Bringelly will allow flexibility to meet increases in market demand, the ability to manufacture different products at the two plants (Badgerys Creek and Bringelly) without affecting the production rates, and provide operational spare capacity.

While the Badgerys Creek operations are mothballed, it is proposed that the Boral Bringelly Brickworks will supply the Sydney market. This operational consolidation will require an increase in the manufacturing process (i.e. the number of bricks produced) at Bringelly to meet anticipated demand.

The current consent on the site permits quarry extraction of up to 200,000 tonnes per annum, and brick production of up to 160,000 tonnes per annum. In order to meet anticipated market demand following the mothballing of the Badgerys Creek quarry and brickmaking facility, Boral is now seeking to increase brick production at their Bringelly brickworks to 263,500 tonnes per annum of bricks – which represents an increase of 103,500 tonnes per annum. Plant machinery required to process/manufacture bricks will continue to operate within the approved 24 hours per day operating hours. The increased brick production will require extraction of clay from a larger resource area totalling approximately 30.65 hectares.

The Director General of the Department of Planning and Infrastructure (DP&I) issued Environmental Assessment Requirements known as Director General Requirements (DGRs) for this State Significant Development Application on 24 December 2012, a copy of which is provided at Appendix A. This report assesses the potential environmental impacts associated with the project, and addresses the requirements provided in the DGRs.

1.2 BACKGROUND OF BORAL BRICKWORKS

1.2.1 THE PROPONENT

The proponent of the project is Boral Bricks Pty Ltd, a fully owned subsidiary of Boral Limited.

Boral is Australia's largest building and construction materials supplier. It produces and distributes a broad range of construction materials, including:

- Quarry products.
- Cement.
- Fly-ash.
- Pre-mix concrete and asphalt.
- Building products, including clay bricks and pavers, clay and concrete roof tiles, concrete masonry products, plasterboard, windows, and timber.

1.2.2 PLANNING AND OPERATIONAL HISTORY

The Bringelly Brickworks has been in operation since 1968. In its original form, it had the capacity to process approximately 51,500 tonnes of bricks per annum. In 1991, the proponent undertook to upgrade the facilities with new technology and increase production to ensure the continued economic viability of the site due to the age of the manufacturing plant and machinery.

To date, the Bringelly Brickworks facility has been operating under an approval granted by Camden Council on 13 September 1991 (Council ref. DA 91/1194) which permits (among other things) quarry extraction up to 200,000 tonnes per annum and brick production up to 160,000 tonnes per annum. Section 5.2 of this report details further information regarding the infrastructure and operations to which the 1991 planning consent relates.

1.3 ENVIRONMENTAL ASSESSMENT PROCESS

This State Significant Development (SSD) is an application under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Division 4.1 provides for development to be declared SSD either by a State Environmental Planning Policy (SEPP) or by order of the Minister. The Minister is generally the consent authority for SSD.

Under clause 8 of the *State Environmental Planning Policy (State and Regional Development) 2011* (State and Regional Development SEPP), development is declared to be SSD for the purposes of the EP&A Act if, among other provisions, the development is specified in Schedule 1 or 2 of the State and Regional Development SEPP.

Clause 7 of Schedule 1 of the State and Regional Development SEPP relates to extractive industries and states (emphasis added):

> *7 Extractive industries*
>
> ***(1) Development for the purpose of extractive industry that:***
>
> *(a) extracts more than 500,000 tonnes of extractive materials per year, or*
>
> ***(b) extracts from a total resource (the subject of the development application) of more than 5 million tonnes, or***
>
> *(c) extracts from an environmentally sensitive area of State significance.*

(2) Subclause (1)(c) does not apply to extraction:

(a) by a public authority in maintenance dredging of a tidal waterway, or

(b) in maintenance dredging of oyster lease areas, or adjacent areas, in Wallis Lake.

(3) Development for the purpose of extractive industry related works (including processing plants, water management systems, or facilities for storage, loading or transporting any construction material or waste material) that:

(a) is ancillary to or an extension of another State significant development project, or

(b) has a capital investment value of more than $30 million.

(4) This clause does not apply to development for the purpose of extractive industry or extractive industry related works that is part of a single proposed development if any other part of the development is State significant infrastructure

The total extractable resource at the Bringelly Brickworks site is 7.9 million tonnes. The existing Bringelly Brickworks (an extractive industry for the purposes of the EP&A Act) and the proposed modification to increase production will involve an expansion of the extraction area so that the operation will extract from a total resource of more than five (5) million tonnes and the operations would therefore meet the criteria in clause 7(1)(b) of Schedule 1 for a SSD.

Under Section 78A of the EP&A Act an application for SSD must be accompanied by an Environmental Impact Statement (EIS). In accordance with the *Environmental Planning and Assessment Regulation 2000*, the Director General is to issue environmental assessment requirements (DGRs) in relation to the proposed statement and the EIS must be prepared in accordance with these requirements. Following a test of adequacy, the EIS is placed on public exhibition for a period of not less than 30 days and the applicant must give consideration to submissions made. A submissions report may then be prepared by the applicant for assessment by the DP&I with a recommendation for determination. The DGRs for the Bringelly Brickworks project are provided in Appendix A of this EIS.

1.4 PURPOSE OF THIS REPORT

This report has been prepared by Hyder Consulting Pty Ltd on behalf of the proponent, in order to seek planning approval for the expansion and continuation of operations at the Bringelly brickworks and quarry.

This EIS has been prepared pursuant to the DGRs for the project (issued on 24 December 2012, Appendix A), in accordance with the requirements in Clause 6 and 7 of Schedule 2 of the EP&A Regulation.

The purpose of this report is to:

- Explain the nature of the works and activities comprising the project.
- Assess the potential environmental impacts of those works and activities on the physical, social and economic environment (having regard to both current and future land use).
- Identify mitigation measures to be implemented to minimise and manage potential impacts associated with the project.
- Justify the proposed development, including suitability of the project site and whether the proposed development is in keeping with public interest.

The key recommendations and management measures described in the report have been incorporated into Chapter 8 of the Report. This outlines the proponent's commitment to environmental management and would form a key component of any conditions of approval issued for the project.

1.5 STRUCTURE OF THIS REPORT

Table 1-1 outlines the structure of this EIS and provides a summary of the content.

Table 1-1 EIS Structure

Chapter	Content
Chapter 1	Project background, information about the proponent, location, planning history and environmental assessment requirements.
Chapter 2	A detailed description of the project site and surrounding area linked to the project.
Chapter 3	An overview of the formal consultation undertaken, throughout the application process, with relevant agencies, stakeholders and community groups.
Chapter 4	An outline of the project alternatives, and consequences of not proceeding with the proposed development.
Chapter 5	An overview of the project description, including proposed activities and locations.
Chapter 6	An assessment of environmental risk apportioned to each environmental issue identified by the DGRs. This informs the environmental assessment.
Chapter 7	An assessment of environmental impacts and consequent measures to address or mitigate these impacts. This section covers: ▪ Field and desktop studies. ▪ Environmental implications. ▪ Cumulative impacts on the existing environment. ▪ Possible residual effects. ▪ Environmental safeguards and mitigation measures.
Chapter 8	A summary of the cumulative environmental impacts associated with this project.
Chapter 9	A summary of the environmental management measures, procedures and commitments, and the resultant residual impact.
Chapter 10	A justification for the proposed development and conclusion to the report.

1.6 PROJECT TEAM

The project team for the preparation of this EIS is outlined in Table 1-2.

Table 1-2 EIS project team

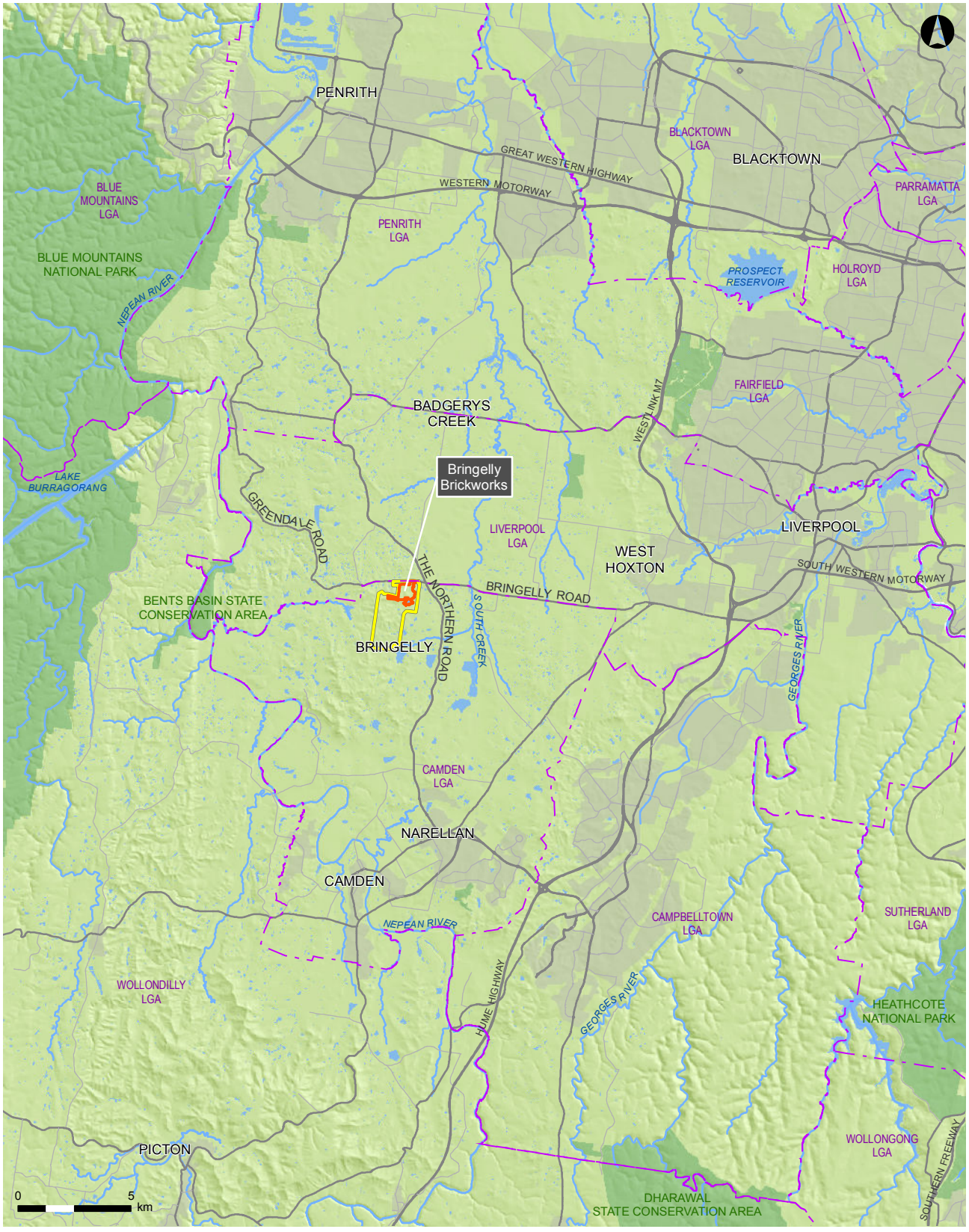
Role	Responsibility
Proponent	Boral Bricks Pty Ltd.
EIS preparation (including the technical assessment of traffic, surface water, visual, greenhouse gas, rehabilitation, biodiversity, hazards, socioeconomic and waste).	Hyder Consulting
Aboriginal and Non-Indigenous heritage	Artefact Heritage
Noise and air quality	Wilkinson Murray
Groundwater	Golder Associates
Technical peer review	Linchpin Environmental, Element Environment

2 SITE ANALYSIS

This chapter provides an overview of the project site and regional context, a description of the physical characteristics of the project site and the location of project components across the site. The chapter also outlines the existing and future surrounding land uses, in order to provide an understanding of how the project fits within the regional and local context.

2.1 SITE LOCATION AND CONTEXT

The Boral Brickworks is located on Lot 11 in DP 1125892 comprising an area of approximately 385.55 hectares. The northern part of the property (the project site) is currently occupied by a clay quarry and brick manufacturing plant and is owned by Boral Limited. The project site is approximately 56.75 hectares in area. It is located within the Camden Local Government Area and is approximately 55 kilometres southwest of the Sydney Central Business District. Figure 2-1 shows the regional context of the site.



LEGEND

- Project site
- Property boundary
- LGA boundary
- Major roads
- Minor roads
- Watercourses
- National Parks

Map scale: 1:250,000 at A4

DATA SOURCES
Boral, LPI

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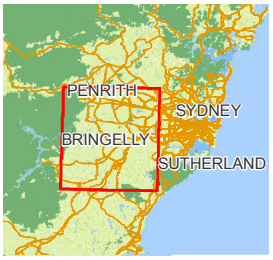


Figure 2-1: Regional context plan

2.2 OVERVIEW OF PROJECT SITE

The project site is currently used for quarrying, brick production and associated activities. The brickmaking facility along with various administration buildings, a finished bricks storage yard, staff car park and internal road network is generally contained within the northern part of the project site, and is set back approximately 200 metres from Greendale Road. The southern portion of the project site, adjacent to Thompsons Creek, is leased for the agistment of stock and grazing.

The underlying topography of the operational footprint on the project site is relatively flat, and the land generally slopes to the south and east toward Thompsons Creek. Existing quarrying activities in the northern portion of the site have substantially altered the natural landform, with various voids and elevated stockpiles present in the active, north-western part of the project site. Current active quarry areas have involved removing material below ground level from RL86 down to RL66. Other significant landforms on the site include the raw material stockpiles to the south of the buildings and manufacturing plants, unusable materials stockpiles along the western boundary of the existing quarry pit and various stormwater management structures (sediment basins and dams). Refer to Section 5.1 of this report for a detailed discussion on the existing project site layout.

2.3 SURROUNDING ENVIRONMENT

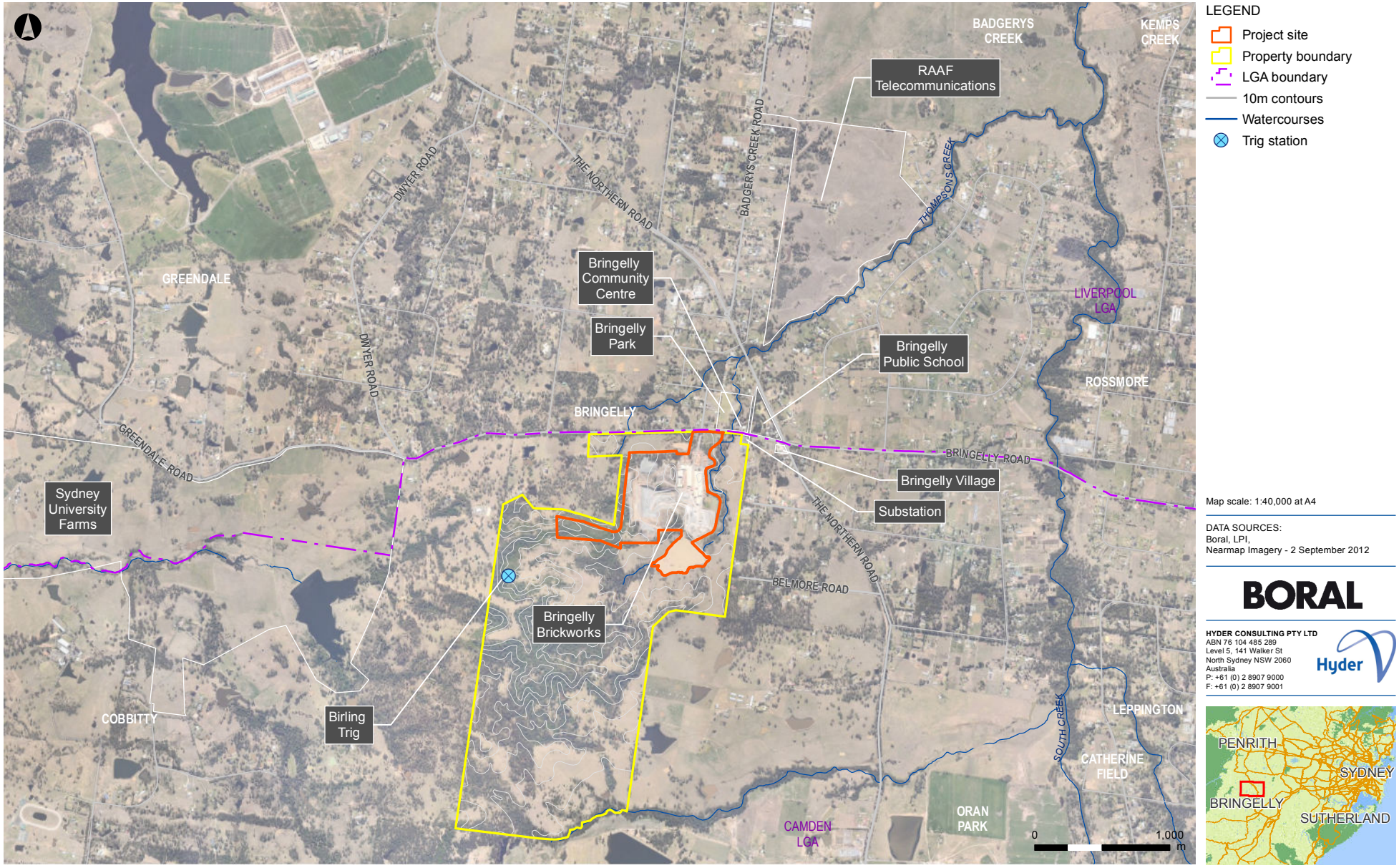
2.3.1 EXISTING ENVIRONMENT

The surrounding area is characterised by agricultural land and fragmented rural residential development. Open grazing land interspersed with woodland is located to the west and south of the project site, with rural residential development located to the north (on the other side of Greendale Road) and east of the site, extending towards The Northern Road.

In addition, the following land uses are within close proximity to the site:

- Sydney University Farms campus is approximately five kilometres west of the site along Greendale Road, which is used for teaching and research.
- Bringelly Public School, which is approximately 500 metres to the east on the corner of The Northern Road and Greendale Road.
- Small retail shops approximately 500 metres to the east on the corner of The Northern Road and Greendale Road.
- Bringelly Community Centre, approximately 200 metres to the east, located at 5 Greendale Road.
- Bringelly Park (used by Bringelly Sports Club) borders the western boundary of the Bringelly Community Centre.

Figure 2-2 shows the project site location including surrounding land uses.



LEGEND

- Project site
- Property boundary
- LGA boundary
- 10m contours
- Watercourses
- Trig station

Map scale: 1:40,000 at A4

DATA SOURCES:
Boral, LPI,
Nearmap Imagery - 2 September 2012

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Figure 2-2: Site location plan

Date: 29/08/2013 Path: \\HC-AUS-NS-FS-01\jobs\AA005667\L-GIS\A_Current\B_Maps\EIS\AA005667_EIS_F002-2_SiteContextPlan_r3v1.mxd
Created by : DD
QA by : UOD

2.3.2 FUTURE LAND USE

The project site is located within the SWGC and forms part of the Lowes Creek and Bringelly precincts. These precincts are designated for future residential and employment uses under the Draft Sydney Metropolitan Strategy (released for exhibition in March 2013). The site occupied by the brickworks and extraction area is identified for employment lands. It is anticipated that significant urban growth will occur in this area over the next 30 years.

3 CONSULTATION

This chapter outlines the consultation undertaken in respect to the project, and includes a summary of the community, stakeholder, agency and Aboriginal consultation that has been undertaken to date.

3.1 OVERVIEW

In developing the project for the Bringelly Brickworks site, Boral has undertaken thorough consultation with both the community and government agencies and stakeholders, to clearly articulate the project parameters and obtain feedback on the project.

3.2 COMMUNITY CONSULTATION

The focus of the community consultation has been to develop targeted land owner consultation and engagement to discern the position of the site's key stakeholders in respect to the operations, as well as to the project itself.

The community consultation initiatives have been under implementation since July 2012 and have included a perception audit, distribution of written information, one-on-one and group briefings, and an open site inspection opportunity. These initiatives are detailed below.

3.2.1 PERCEPTION AUDIT

The perception audit commenced with the distribution of notification letters to residential properties facing onto Boral's landholding to the immediate west, north (Greendale Road) and east (Loftus and Belmore Roads) as well as the Bringelly Public School. The letters informed the residents of the project and allowed for opportunities to discuss the project with Boral directly in face-to-face discussions.

The consultation has been ongoing through the preparation of the EIS, and feedback from the consultation process has been taken into consideration. Most landowners within a 250 metre radius of the project site raised few issues with regard to Boral's brickmaking and quarrying activities at the Bringelly site.

The main issues raised by the community were:

- Noise – Resolved in Section 7.3 of this report.
- Traffic – Resolved in Section 7.4 of this report.
- Dust – Resolved in Section 7.5 of this report.

A program of landowner consultation would also be undertaken in the future as quarrying activities progress at the site.

3.3 STAKEHOLDER AND AGENCY CONSULTATION

In addition to targeted community consultation, Boral has met and consulted with a range of stakeholders and agencies as detailed in Table 3-3.

Input from agencies and the community have been considered in the scoping of the environmental assessments and specific issues raised are addressed in this EIS.

Table 3-3 Summary of stakeholder and agency consultation undertaken to-date

Date	Stakeholder	Description	Where addressed in EIS
18 January 2013	Department of Planning and Infrastructure (DP&I) and Camden Council	Boral hosted a site visit with key representatives from the Department of Planning and Infrastructure (DP&I), as well as Camden Council. The site visit included a walkthrough of the current operational buildings and structures, a survey of the proposed quarry expansion area and an outline of the current operational constraints and risks. Consultation with DP&I has been ongoing throughout the environmental assessment process, with regular updates provided to DP&I on the progress of the EIS.	Chapter 5 and Chapter 6.
	NSW Office of Environment and Heritage (OEH)	Written correspondence was provided to OEH on 27 February 2013 presenting the proposed approach to the Aboriginal Cultural Heritage Impact Assessment and Community Consultation process. OEH advised telephonically that as the proposed Bringelly quarry and brickmaking facility expansion is a SSD project, OEH would need to provide comments to DP&I who in turn could provide advice as the consent authority. DP&I confirmed in writing (email) that Aboriginal consultation would need to be in accordance with the *Interim Community Consultation Requirements for Applicants* (DEC 2004) (refer to Section 3.2).	Section 7.9 and Appendix L.
	NSW Office of Water (NOW)	Written correspondence was provided to NOW on 27 February 2013 requesting advice from NOW on: ▪ The proposed groundwater assessment approach; and ▪ The suitability of the proposed locations for monitoring bores to establish baseline groundwater data for the preparation of the EIS. A written response was received from NOW on 17 April 2013 advising that: "*The site is located within the mapped extent of the Sydney Basin Central Groundwater Source, which is not a highly productive groundwater source"* NOW also advised that they do "*not routinely provide advice on the design and development of monitoring programs as part of the investigations for major project Environmental Assessments. Instead, proponents are directed to the many hydrogeological consultants that can capably undertake the required work. Provided the selected*	Section 7.7. and Appendix J.

Date	Stakeholder	Description	Where addressed in EIS
		hydrogeological consultant follows the scope of the Director-Generals Requirements as presented above, the potential impacts of the project on the groundwater systems in the vicinity of the site should be adequately addressed. Golder Associates have been appointed as specialist hydrogeological consultants to assess the potential impacts of the proposed Bringelly quarry and brickmaking facility expansion project on the local groundwater regime and quality. Golder Associates in collaboration with Boral and Hyder Consulting developed an approach to groundwater monitoring and have undertaken a groundwater assessment that addresses the DGRs.	
20 November 2012	Environment Protection Agency (EPA)	Consultation with the EPA has been ongoing throughout the EIS process. Boral met with the site's EPA officer to discuss various site issues, as well as the preparation of the EIS. Issues discussed included noise, air quality and water quality.	Noise – Section 7.3 and Appendix E. Air quality – Section 7.5 and Appendix G. Water quality – Section 7.6 and Appendix I.
04 April 2013 24 April 2013 30 April 2013 3 May 2013 22-23 May 2013	Liverpool City Council (LCC)	Written and telephonic correspondence with LCC around the proposed approach and data request to calculate ongoing road maintenance contributions.	Section 7.4 and Appendix F.
14-15 May 2013	Camden Council (CC)	Written and telephonic correspondence with CC around calculating an appropriate road maintenance contribution including: ▪ Planned maintenance works on Greendale Road. ▪ Capital value for planned maintenance works.	Section 7.4 and Appendix F.

Date	Stakeholder	Description	Where addressed in EIS
		▪ Maintenance contributions that Camden Council have recently prescribed on other projects. Camden Council also attended a site visit with DP&I on 18 January 2013.	
	Department of Trade and Investment, Regional Infrastructure and Services, Mineral Resources	Ongoing consultation in relation to the exploration licence and the mining lease for the site.	Section 7.1.2.

3.4 ABORIGINAL COMMUNITY CONSULTATION

As Aboriginal objects could be impacted by the project (refer to Section 7.9 and Appendix L), comprehensive Aboriginal consultation in accordance with the *Interim Community Consultation Requirements for Applicants* (DEC 2004) has been undertaken.

Public advertising occurred in regional and local newspapers to seek registration of interested Aboriginal parties in April 2013. Aboriginal land councils and individuals were invited to register their interest to be involved in determining the significance of Aboriginal objects and places, for the project. Following site survey, a Cultural Heritage Assessment Report (CHAR) was prepared, outlining the results of the site survey and providing an assessment of the impacts and proposed mitigation measures for archaeological sites and cultural places within the project area. The draft CHAR was provided to Aboriginal stakeholders in August 2013 for review and comment and will be provided to the DP&I prior to determination of the EIS.

Following the submission of the EIS and post determination, an Aboriginal heritage management plan (AHMP) would be prepared. The AHMP would set out specific mitigation and management outcomes arising from this assessment including details of further archaeological investigations and of continued consultation with the Aboriginal community. The AHMP would also outline protocols to be taken if there are unexpected finds in the course of future works.

4 PROJECT ALTERNATIVES CONSIDERED

This chapter outlines a number of alternatives considered by the proponent in relation to the carrying out of the project, including the consequences of not proceeding.

4.1 ALTERNATIVES CONSIDERED

A number of alternatives were considered in relation to the project regarding the location and depth of extraction, the continued use of the site as a quarry and brickmaking facility without expanding operations, the option to cease quarrying and import all raw materials for the brickmaking process and consideration of alternative uses for the site.

4.2 DO NOTHING

The 'Do Nothing' option would involve Boral continuing to operate the Bringelly Brickworks site until it meets the current brick production thresholds stipulated in the 1991 consent, which according to Boral forecasts, will be reached towards the end of 2013. Without consent to increase brick production at their Bringelly Brickworks, Boral will be unable to respond to market demands for additional bricks, particularly in the current situation with their second brickworks at Badgerys Creek being in a mothballed state. The 'Do Nothing' option would have significant implications on Boral's brickmaking business with subsequent flow-on effects for the local and regional economy. This option is not considered to have economic or social merit.

Not proceeding with the proposed increase in brick production, which also involves the expansion of the quarry, is likely to have the following implications:

- Loss of employment opportunities for the additional 38 personnel, including contractors for campaigns, who would be employed with the proposed increase in brick production.
- Failure to satisfy increasing demand for brick products, particularly with the predicted increase in urban development within the South West and North West Growth Centres as well as the greater Sydney region.
- Indirect impacts to local businesses, particularly those such as the service stations, cafés, and other various small businesses within the area that service both permanent and transient workers to and from the site and would benefit from an increase in personnel employed at the site.

4.2.1 CEASE QUARRYING AND BRICKMAKING OPERATIONS

Cessation of extraction and rehabilitation of the land for a 'future industrial use' would be in keeping with the intent of the Metropolitan Strategy. This option would leave the remaining valuable resources on site, rather than being productively used and is not considered to have economic or social merit given that the site is already operating a well-regarded business, with strong future potential given the recovering housing market in the greater Sydney region. This option would also result in:

- Loss of 38 permanent jobs and a significant reduction in work for 10 contractors used primarily during clay extraction campaigns.
- A shortage in brick product in the Sydney region and possibly further afield which could result in an increase in brick prices and therefore the cost of building.
- Impacts on local businesses that benefit from trade from Boral's Bringelly Brickworks personnel.

Rehabilitation options are many and varied and could include the retention of voids and utilisation for water storage or as sites for industrial development. Alternatively, the site could be rehabilitated and levelled to allow its subdivision and later use for industrial development. Whilst this would be in line with the current intent for future land use as expressed under the Metropolitan Strategy, this would not allow for full utilisation of resources existing on the site, does not comply with the current zoning and would pre-empt future land use and development in the surrounding area. The loss of significant resource existing on the site would also have implications for the construction industry and potentially the cost of housing.

4.3 IMPORT ALL RAW MATERIALS

The option to cease the extraction of raw materials for brick production from the on-site quarry and import all materials from external suppliers has been considered. This option would have certain positive biodiversity, Aboriginal heritage, water quality and noise impacts as the quarry footprint would not expand any further than its current extent and extraction campaigns would cease; however, there are a number of other negative impacts related to this option including:

- Substantially increased costs of importing raw materials in comparison to sourcing raw material by on-site extraction of clay. On-site extraction of shale is required to ensure Boral is able to continue to produce bricks at a price that is competitive.
- Loss of a unique colour of brick as the Bringelly shale has unique colours that are not found in other quarries in the Sydney region.
- Sterilisation of a valuable natural resource if the extraction of Bringelly shale ceased.
- Lack of control of raw material supply which can result in delays in production and significant financial implications.
- Increased number of heavy vehicles using the local road network, required to deliver all raw materials to the Bringelly brickworks site.
- Increase in noise levels from additional heavy vehicles entering and exiting the site.

For these reasons the importation of all raw materials is not viable and is an option that will not be pursued by Boral.

4.3.1 VARY THE LOCATION AND DEPTH OF EXTRACTION

There were two alternatives considered in relation to the location and depth of extraction:

- Extraction from deeper geological units from within the existing pits (stages 1-4 in Figure 5-3).
- Location and scale of proposed future cells.

Considerable shale and sandstone resources have been identified through historic and recent (April 2013) core drilling logs and include Bringelly Shale and local sandstone. Bringelly Shale is the primary raw material of the brick making process and was found to extend to a depth of at least 30 metres. The extraction of shale and sandstone from within deeper geological units would restrict the potential environmental and associated impacts of quarrying to a smaller footprint. It is expected that in order to extract resource from within deeper geological units and to penetrate the dense sandstone, alternative extraction techniques such as blasting may be required. At this stage, given the availability of more readily accessible resources across the site, it is not economically viable to extract material deeper than an average of 30 metres; however, this option may become viable at some point in the future, beyond the thirty year life of the project.

The locations of the proposed cell expansion areas have been chosen based upon a series of environmental constraints and geological considerations. The proposed cell expansion has been chosen to target the required resource, whilst avoiding significant vegetation, flood prone land, and environmentally sensitive areas such as creek lines, with a setback to Thompsons Creek proposed at a minimum of 40 metres. The proposed cell expansion represents the most economically viable and environmentally sustainable location for quarrying to take place over the next 30 years.

4.4 PREFERRED OPTION

The Bringelly quarry and brickmaking facility is situated in an ideal location to service the construction industry associated with the future urban development needs for residential and employment growth forecast in the immediate area. To meet the current and forecast demand for brick products in Sydney's south west as well as the greater Sydney area, allow flexibility in manufacturing operations and provide a variety of brick products, Boral is proposing to increase brick production at their Bringelly Brickworks and expand their quarrying operations (presented in detail in Chapter 5). This would also result in a doubling of the number of employment opportunities on site and would provide revenue to the State of NSW. The consequences of not increasing brick production at Boral's Bringelly Brickworks would therefore be a loss of these significant economic and social benefits.

5 PROJECT DESCRIPTION

This chapter describes the project parameters, including the project objectives, the activities for which project approval is sought, details of the construction and operational phases of the project and relevant existing environmental controls. Rehabilitation works proposed as part of the project are also outlined.

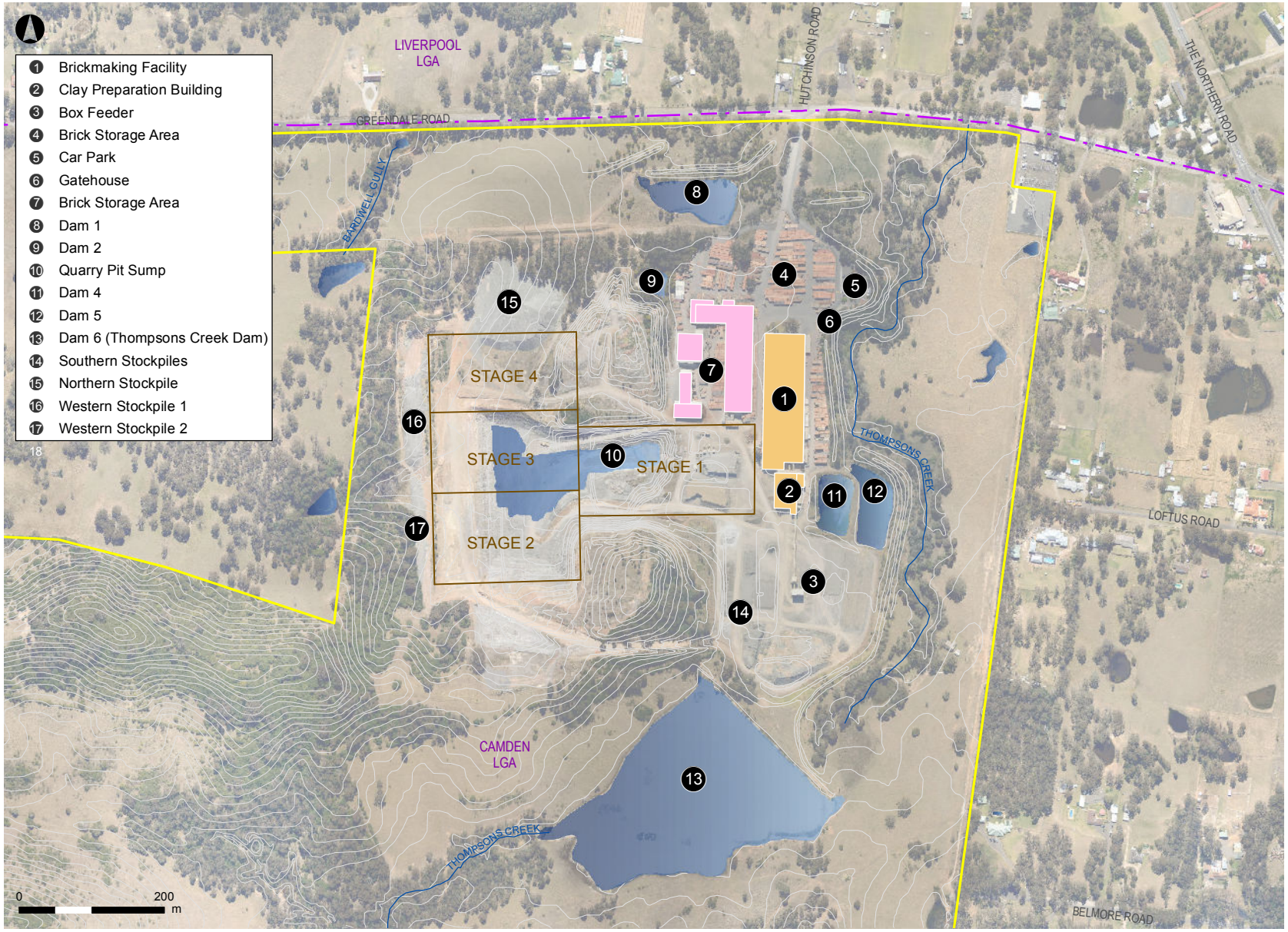
5.1 EXISTING DEVELOPMENT

The existing operations on the project site involve the quarrying of shale for the production and packaging of bricks and their dispatch to offsite locations. Key features of the project site are shown in Figure 5-3, which portrays the operational footprint including the following:

- Access driveway.
- Staff parking.
- Gate house and office.
- Administration area.
- Quarrying area indicating the four quarry pits (Stages1 – 4 as approved in the 1991 consent).
- Raw material stockpiles.
- Overburden and unusable material stockpiles.
- Water storage and sedimentation basins.
- A brick factory (brickmaking and packaging facility).
- A bricks finished goods storage yard (brick product storage area).

Access to the Bringelly Brickworks site is from Greendale Road. Entry to the brickmaking facility is restricted with a secure, manned gate house adjoining the visitor car park. Areas south of the project site on the same property (Boral owned land) are currently leased to other users for the purposes of stock agistment.

Quarrying activities have previously been focused in the northern portion of the project site within the approved extraction area with quarrying depth ranging from a few metres to a maximum of approximately 20 metres (from RL86 down to RL66). Quarrying activities at the site currently extract approximately 120,000 tonnes per annum of shale for brickmaking purposes. Supplementary material and off-site sources of clay, shale and non-clay materials (up to 96,000 tonnes per annum) are trucked to the site as required.



LEGEND

- Property boundary
- Existing Development Consent 1991
- Brickmaking facility
- Brick storage facility
- LGA boundary
- 2m contours
- Watercourse

Map scale: 1:8,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012

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Figure 5-3: Existing site layout plan

As evident in Figure 5-3, the central and eastern portions of the existing quarry (the deepest section) capture the majority of the stormwater runoff from the operational quarry. These portions of the quarry function as a stormwater basin, temporarily holding stormwater in-between active periods of quarrying, prior to it being pumped to other stormwater basins for treatment and discharge. This is discussed further in Section 7.6 of this report.

Extracted shale, which is comprised of a mixture of usable and unusable (overburden and other e.g. rock/sandstone) material as well as imported raw material is temporarily stockpiled on site prior to its use in the brickmaking process. Approximate areas of stockpiles are summarised below with the locations indicated in Figure 5-3:

- S stockpiles (Ref # 15) – 4.64 hectares: The main brickmaking facility stockpile area, including a blend of imported and local raw materials ready for use.
- N stockpile (Ref # 16) – 1.18 hectares: Useable raw material extracted on site, which will be used over the next two years.
- W stockpile 1 (Ref # 17) – 0.36 hectares: Unusable material extracted onsite to be used in the construction of the two 4.5 metres high noise bunds.
- W stockpile 2 (Ref # 18) – 0.19 hectares: Unusable material extracted onsite to be used in the construction of the two 4.5 metres high noise bunds.

The remaining project site is occupied by the brickmaking facility (including primary feeder and box crusher), storage yard, gate house, administration office, internal access roads, ancillary buildings and vacant pasture land.

5.2 THE PROJECT

Approval is sought to extend the extraction area (quarry footprint), and increase production of the brickmaking activities. Key features of the project include:

- Extraction of raw material from the site in the order of 200,000 tonnes per annum (no change to current extraction consent) through continued extraction from the existing quarry area (current consent) to a maximum depth of 30 metres, as well as expansion of the quarrying operations over an additional 20.75 hectares (to a total of 30.65 hectares) with extraction to a maximum depth of 30 metres.
- Brick production in the order of 263, 500 tonnes of bricks per year (increase of 103,500 from current consent).
- Construction of a 4.5 metre high noise bund along the northern property boundary, from the existing driveway to the proposed new driveway location (200 metres long x three metre flat top with a 21 metre wide base and 1:2 batter slopes).
- Construction of a 4.5 metre high noise bund along the northern boundary of the quarry operations (362 metres long x three metre flat top with a 21 metre wide base and 1:2 batter slopes).
- Importation of raw materials required for brickmaking in the order of 96,000 tonnes per annum.
- Extension to the existing clay preparation building and a small area of the brick manufacturing plant near the kiln exit.
- Addition of two recycled water storage tanks.
- Construction of a new driveway to the east of the existing alignment.
- Upgrading of the existing bio-cycle sewage treatment plant.

The above project details can be summarised into three key components: quarry activities, brickmaking activities and ancillary activities/works such as stockpiles and stormwater management systems. These key project components are described in further detail in the following sections, with Table 5-4 providing a summary of the differences between current and proposed operations.

Table 5-4 Summary of operations and proposed operations

Project aspect	Approved development	Proposed project
Quarrying operations		
Quarry area	9.9 ha.	30.65 ha.
Quarry production (i.e. extraction)		
Extraction volume	200,000 tpa.	No change.
Extraction rate	Two extractive campaigns per year with 25 on-site days per campaign.	Three extractive campaigns per year with 44 on-site days per campaign.
Extraction method	Dump trucks, dozer and excavator.	No change.
Material handling and stockpiling	Stockpiles contained south-east of the brickmaking plant.	No change.
Manufacturing process (i.e. brickmaking)		
Brick production rates	160,000 tpa.	263,500 tpa.
Clay preparation	Three storage bays.	Five storage bays. Extension to clay preparation buildings (approx. 47.5 m x 14 m x 11.6 m).
Dehacking	Within existing building.	Extension of building for kiln car storage (approx. 18 m x 19.5 x 4 m).

5.2.1 QUARRYING ACTIVITIES

The proposed quarrying area will expand northwards, southwards and south-westwards, covering a total surface area of 30.65 hectares to a maximum extraction depth of 30 metres. To facilitate the description of the quarrying activities, the proposed quarry area has been divided into nine cells, namely Cells A – I. Refer to Figure 5-4 for proposed quarry layout.

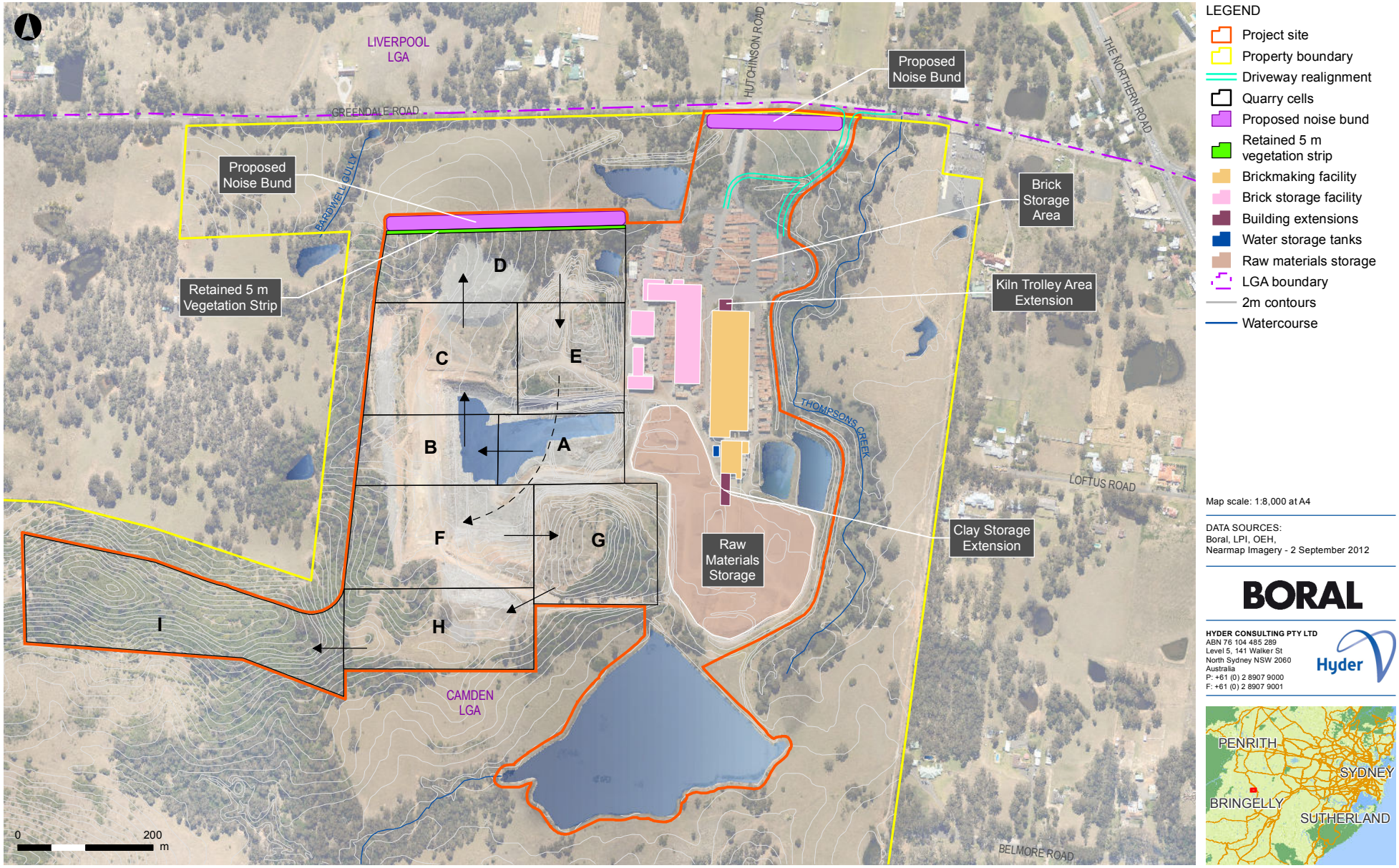

Figure 5-4: Proposed site layout plan

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The quarrying operations will typically remove material from RL86 down to a common quarry floor level of RL56 across the entire quarry footprint. As the site is not flat and includes elevated areas in Cell G and Cell D, the removal of material in these cells will be from RL117 and RL100, respectively.

Quarrying extraction activities are expected to progress on the site according to the following plan (refer to Table 5-5):

- Continued extraction of Cells A, B & C (existing pits).
- Extraction of proposed Cells D, E, F, G, H & I. There is sufficient resource on site within the total proposed quarry footprint to support raw material extraction at the maximum rate required until approximately 2043.

Table 5-5 Proposed quarry extraction area

Location	Approximate area
A	1.94 ha
B	2.13 ha
C	3.63 ha
D	3.81 ha
E	2.59 ha
F	4.14 ha
G	3.24 ha
H	3.35 ha
I	5.82 ha

Approval is being sought for continued extraction on the site, at a rate of 200,000 tonnes per annum, over the next 30 years. Quarrying activities would continue to be undertaken on a campaign basis. A campaign is a discrete quarrying event whereby material is extracted from the pits using bulk earthwork machinery, primarily dozers and excavators and is transported to stockpile areas by dump trucks where it is spread and shaped by dozers. The proposed campaigns are likely to be approximately two calendar months in duration (44 working days) and will be undertaken during standard working hours (refer Table 5-6). Although the number of campaigns will be determined by the annual demand for bricks, up to three campaigns are proposed per annum, which would provide sufficient raw material for the manufacturing of 263,500 tonnes of bricks per annum.

The establishment of a new pit generally involves the following works:

- Exploratory core drilling to a depth of 30 metres below ground surface across the proposed quarry footprint.
- Assessment of cores for suitability of material for brickmaking and to map the different material types.
- Establishment of appropriate fencing and signage around the quarry pit.
- Removal of overburden and topsoil, using removed material to either create necessary bunding on site or for rehabilitation of exhausted pits.

The process for extracting raw materials once the area has been established for quarrying involves:

- Breaking the raw materials using a dozer with ripping attachment.
- Collection of raw materials with an excavator and placement into a 40 tonne dump truck. Around two to three dump trucks are used during a single quarry campaign.
- Transportation of raw materials to the raw materials stockpile area to the south of the brickmaking facility.
- Transport and deposit of unusable material to an overburden stockpile or to exhausted pits.

As the pits increase in depth, angles of extraction would be in accordance with existing operations on the site, based on Boral's established practices and procedures and in consideration of local geology. Average batter slopes for Cells A, B and C (existing) are in the order of 1:2. The proposed future extraction will be carried out in a similar manner until the lateral limit of the quarry footprint is reached whereby the final pit profile is likely to be benched, with benches cut into three metres vertical by one metre horizontal profiles. The most appropriate final quarry pit edge profile will be determined in consultation with a geotechnical engineer and will seek to find a balance between extracting the maximum amount of raw material while doing so in a safe manner, without the risk of slumping or collapsing of the quarry pit walls.

New stormwater drainage systems and/or drainage pathways would be established in conjunction with the creation of new quarry areas (where required) and would be incorporated in the existing stormwater management system on site. This is discussed further in Section 7.6 of this EIS.

Upon cessation of quarrying in the nominated areas, Boral would rehabilitate the site in accordance with the Rehabilitation Strategy included in Appendix D of this EIS and discussed further in Section 5.3 of this Report.

5.2.2 STAGING

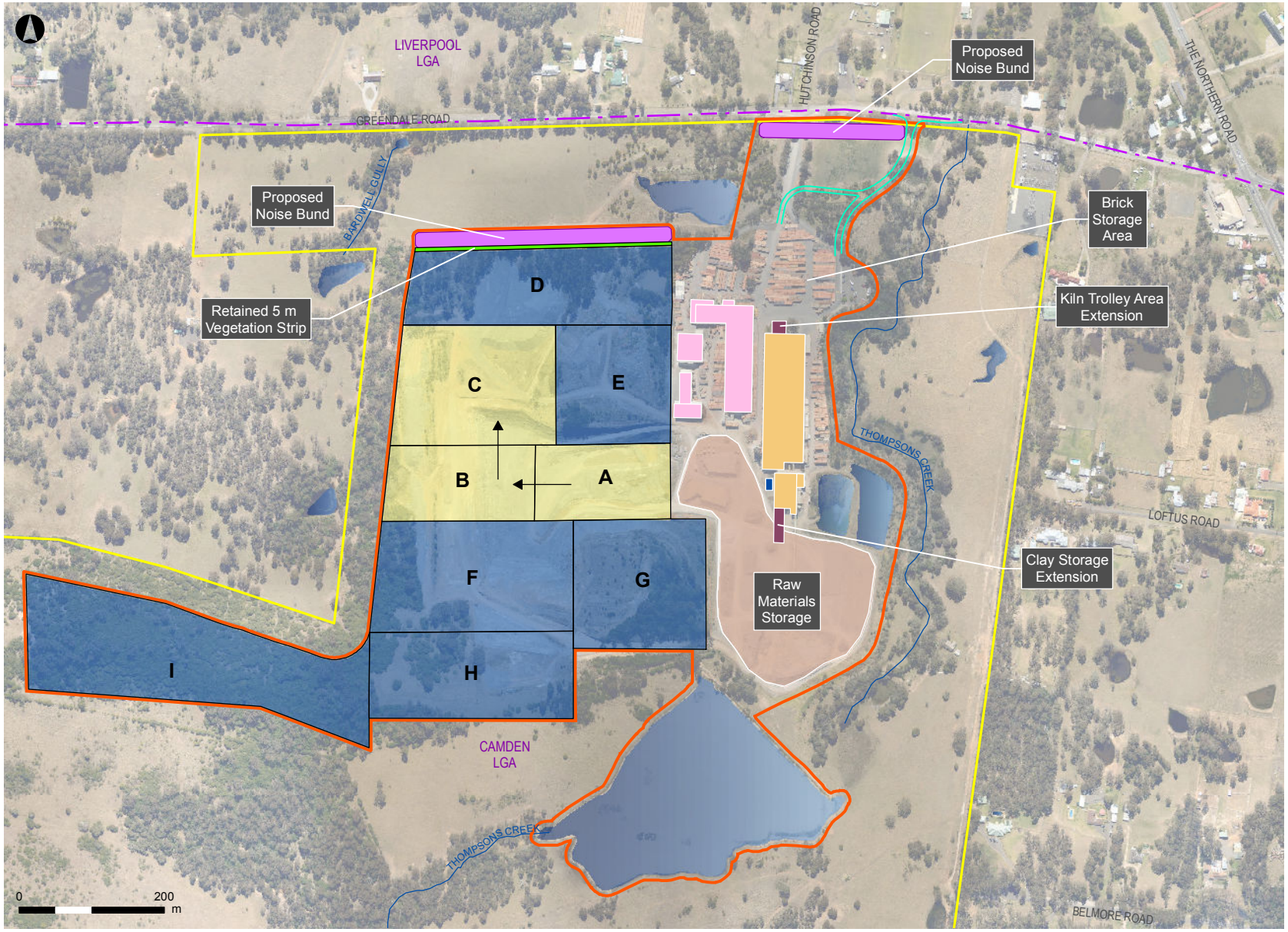
In order to explain the staging of quarrying activities over its 30 year life, the total quarry area has been divided into nine cells (quarry areas), which are defined in Table 5-6 and represented in Figures 5-5, 5-6 and 5-7. Given that the extraction of material will be based on consumer demand, it is difficult to predict an exact duration of operations within each of these nine cells. However, the sequence of the material extractions is known, and there will be approximately three cells open at any one time so as to ensure that the different types of material resources can be accessed in different places and at different depths at any time during the quarry operations. The only exception to this approach is Cell I, which covers a large enough area and has sufficient resources to allow for extraction of material at multiple depths at any one time during the life of this cell.

Each cell within the quarry will be progressively extracted on a campaign basis, starting with the active Cells A, B, C and part of F and continuing to D, E, F, G, H and finishing at Cell I (refer to Figure 5-5, 5-6 and 5-7). For example, as Cell A "bottoms out" (is exhausted/reaches 30 metres in depth), extraction will cease in Cell A and will commence in Cell D and therefore Cells B, C and D will be operational. As Cell B is exhausted, extraction will cease in Cell B and will commence in Cell E and therefore Cells C, D and E will be operational and so on.

Table 5-6 broadly summarises the three stages over the 30 year quarry life.

Table 5-6 Bringelly Brickworks proposed staging

Stage	Cells	Resource quantity
1	A, B, C	2,198,763 tonnes
2	D, E, F	2,273,969 tonnes
3	G, H, I	3,963,313 tonnes
7,989,025 tonnes		



LEGEND

- Project site
- Property boundary
- Driveway realignment
- Proposed noise bund
- Retained 5 m vegetation strip
- Brickmaking facility
- Brick storage facility
- Building extensions
- Water storage tanks
- Raw materials storage
- LGA boundary
- Watercourse

Resource extraction

- Active
- Inactive

Map scale: 1:8,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012

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Figure 5-5: Indicative Quarry staging plan - 1

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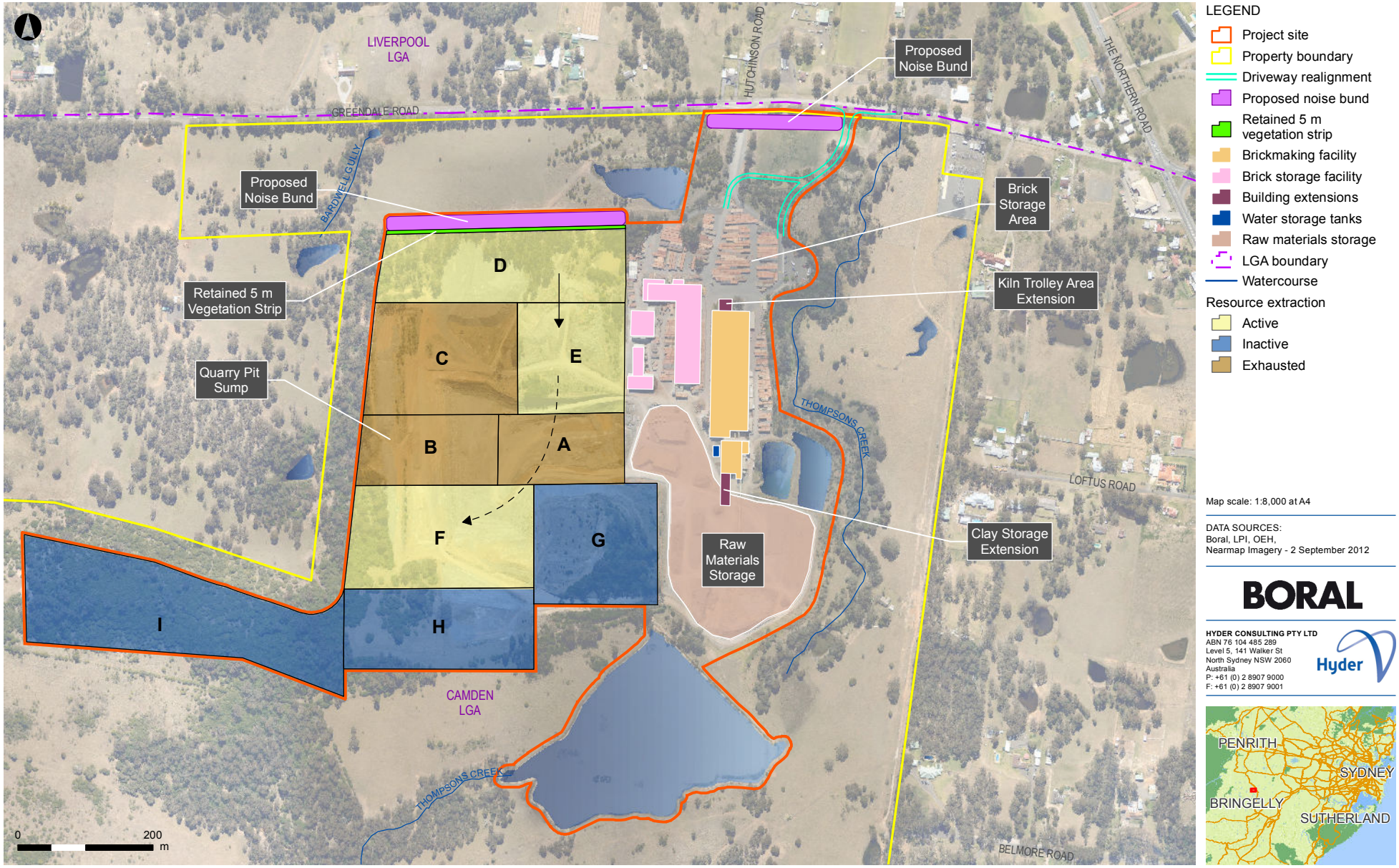

Figure 5-6: Indicative Quarry staging plan - 2

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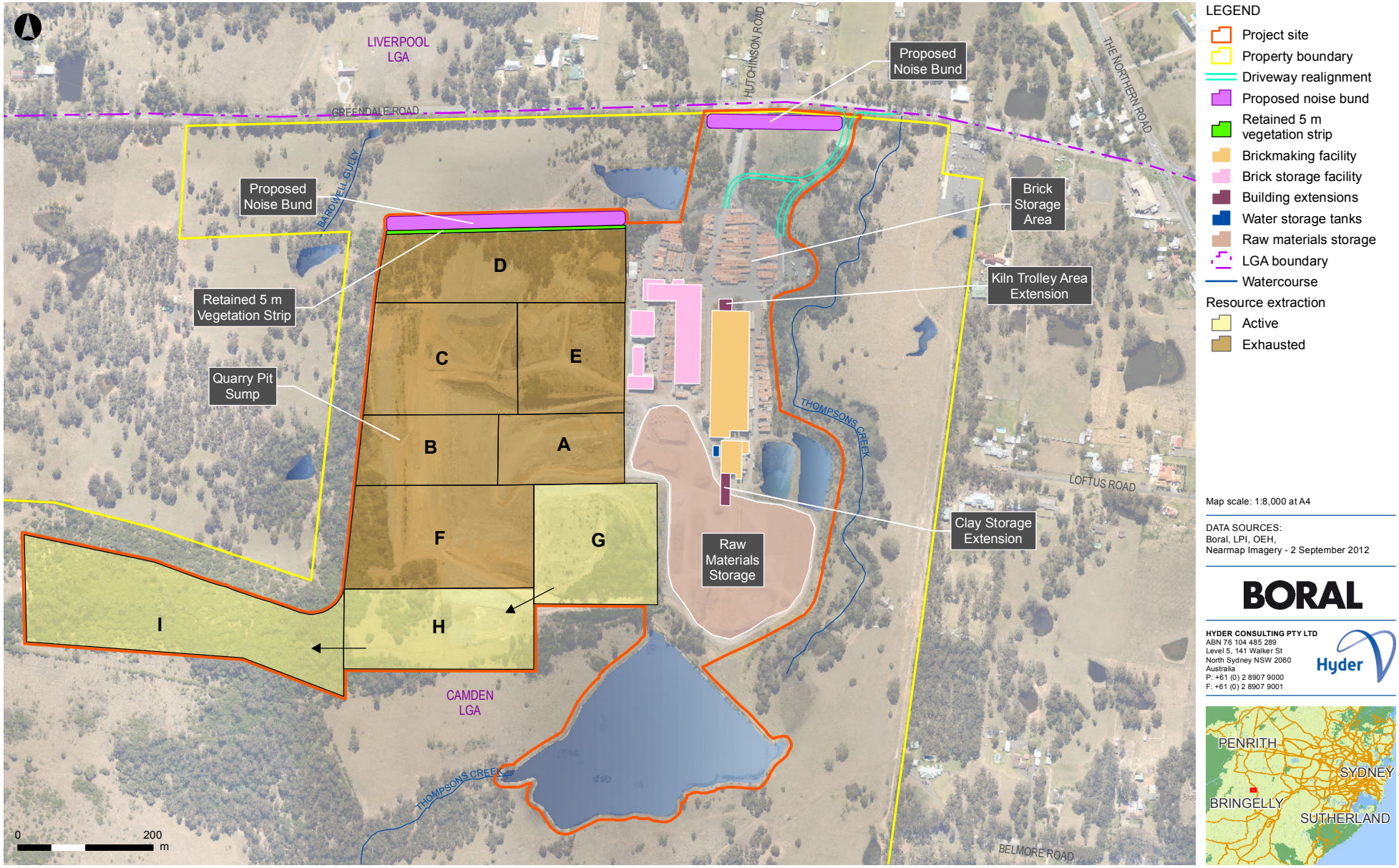

Figure 5-7: Indicative Quarry staging plan - 3

Date: 29/08/2013 Path: \\hc-aus-ns-fs-01\jobs\AA005667\L-GIS\A_Current\B_Maps\EIS\AA005667_EIS_F005-7_StagePlan3_r3v1.mxd
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5.2.3 STOCKPILES

The existing stockpile areas on the project site are described in Section 5.1 and are presented in Figure 5-3. The future stockpiling scenario is as follows:

- The raw material stockpile area situated to the south of the brickmaking facility will continue to be used for the stockpiling of raw material that is extracted on-site as well as imported material.
- Overburden, which is upper level excavated material that is not suitable for brickmaking and unusable material, which contains deeper level excavated material that is not currently suitable for brickmaking, will be used to fill some exhausted quarry pits as part of the Rehabilitation Strategy (Hyder Consulting 2013, Appendix D). Prior to Cell A being exhausted, unusable material and overburden may need to be temporarily stockpiled in the vicinity of Cell E. Once Cell A is exhausted and as other cells are exhausted, unusable material will be placed directly into exhausted cells as part of the rehabilitation process.
- Burden material found within the Bringelly Shales is mostly sandstone, siderite, calcite and some laminates. The lensing nature of these geological sequences makes the precise amount difficult to determine and can occur anywhere in the sequence.

5.2.4 BRICK PRODUCTION

Brick production at the existing brickmaking facility is planned to continue as per existing operations with an increase of throughput from 160,000 to 263,500 tonnes per annum.

The primary machinery and equipment involved in the brickmaking process include:

- Clay preparation equipment (crushing and grinding).
- Brick forming and handling equipment.
- Brick dryer.
- Gas-fired kiln.
- Brick unloading and packing machine (Dehacker).

The brickmaking process is diagrammatically represented in Figure 5-8 and Figure 5-9 and is summarised as follows:

- Mined and imported material is collected from the raw material stockpiles and is placed in the box feeder using a front end loader.
- The mined clay material is crushed from 500 millimetres to less than one millimetre through a four stage crushing process. This includes a profiled roll crusher and two sets of high-speed smooth rolls. Water is added at the pugmill to take the material from 6-10 per cent moisture content to 12-14 per cent moisture content.
- To make bricks, the crushed raw material has more water added to bring the mixture to 14-15 per cent moisture content and is then extruded. Various sands, frits and clay suspensions are applied to the column to add aesthetic appeal. The extruded column is cut into brick-sized units and fed into dryer cars on trays. The dryer cars pass through a seven-laned drying chamber over the course of three days during which the moisture content is reduced to less than one per cent. The dry bricks are stacked 15 rows high onto a refractory decked kiln car.
- The bricks are fired using kiln cars stacked with dry stock, which are fed into the entrance of a gas-fired tunnel kiln at the rate of one third car every 20-30 minutes. One kiln car

holds approximately 9,000 bricks (or 18 brick stacks) stacked with gaps between them to allow the hot air to circulate between them and fire evenly. The stock is then raised to above 1,000 degrees Celsius and cooled back to room temperature in less than two days. Waste heat is drawn from the kiln and is re-used in the dryer to dry the bricks.

- The fired stock is unloaded from the kiln car and split into brick packs by the Dehacker which also packages them before being driven along a conveyor to be transported to the finished brick storage yard for dispatch. All equipment is housed within the brickmaking facility with the exception of the conveyor and box feeder.
- As detailed above, the proposed operations would produce bricks at a rate of 263,500 tonnes per annum. Other than relatively minor equipment upgrades and modifications, the existing equipment in the brickmaking facility will remain the same, with sufficient capacity to produce bricks at the required rate; however, the increased production rate requires the following building expansions:
    - Extension to the northern end of the manufacturing building to facilitate increased kiln car movement/storage.
    - Extension to the southern clay preparation building undercover storage area that houses crushed material.
    - Two new recycled water storage tanks.

These building expansions are shown at a higher resolution in Figure 5-10. Drawings showing the proposed floor plan and elevations are included in Appendix B.

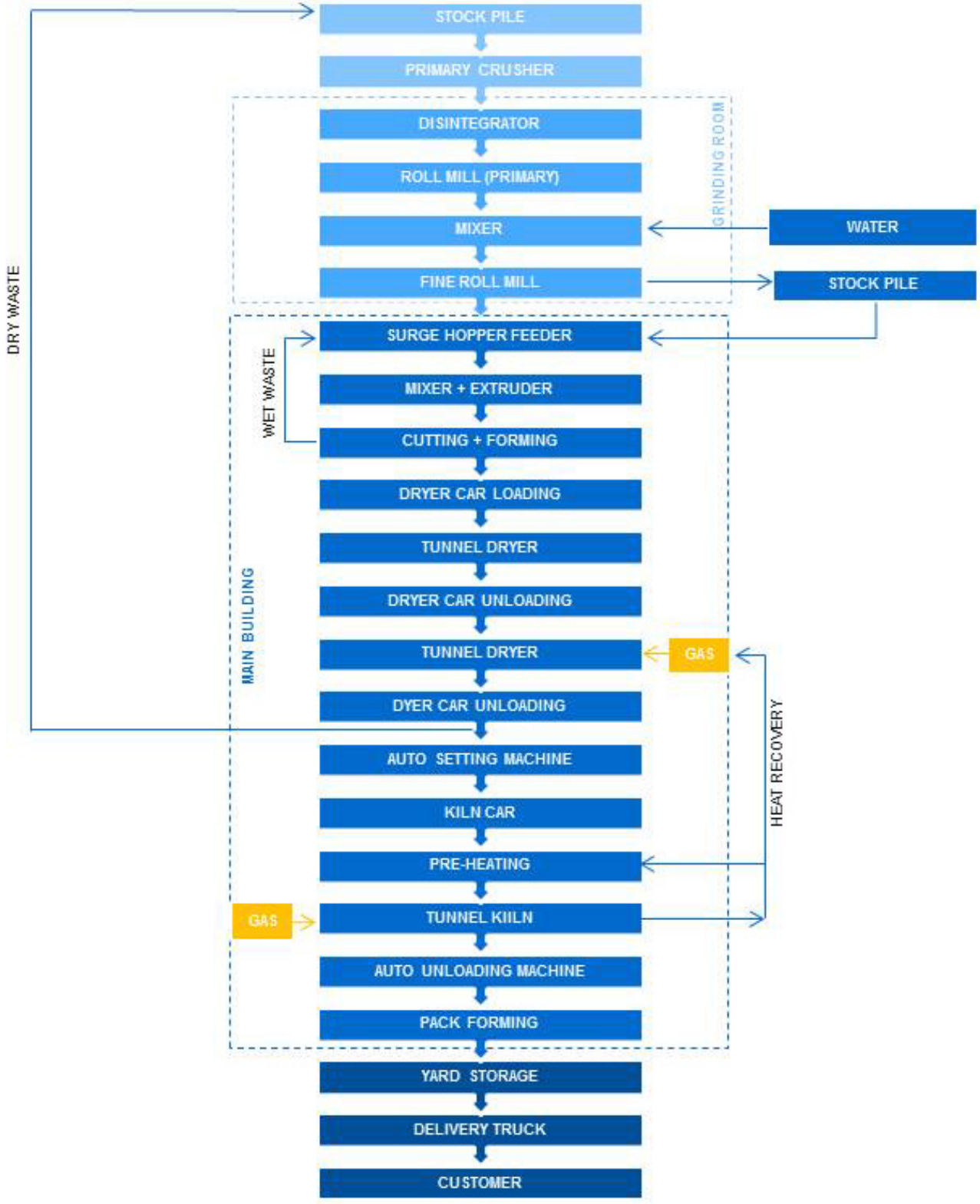

Figure 5-8 Brickmaking process concept diagram

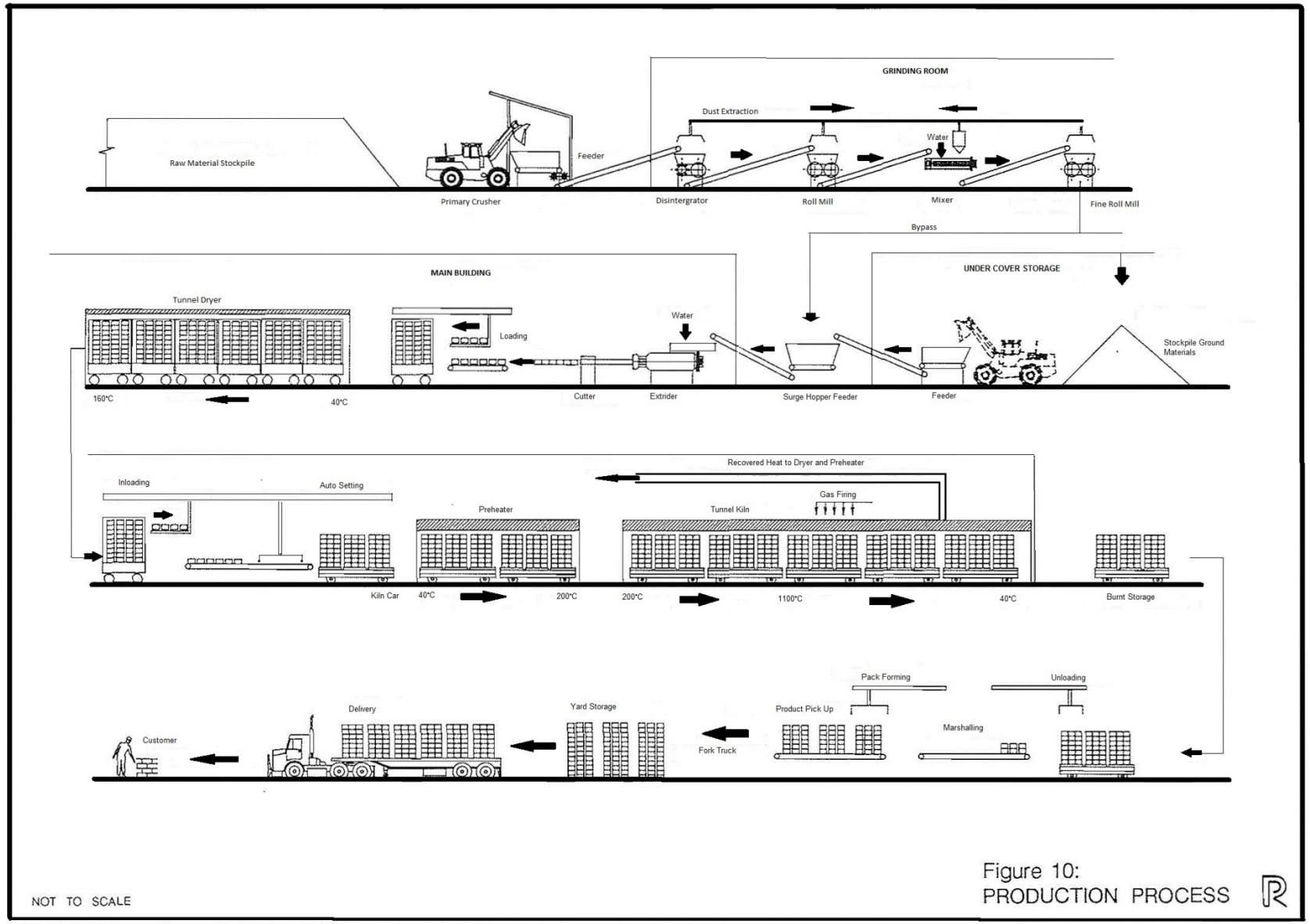

Figure 5-9 Brickmaking process concept diagram

LEGEND
- Project site
- Building extensions
- Water storage tanks

Map scale: 1:2,250 at A4

DATA SOURCES
Imagery:
NearMap 2 September 2012

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Figure 5-10: Proposed building expansions

Table 5-7 below and plans included in Appendix B provide details on the proposed building expansions outlined above.

Table 5-7 Proposed building expansion details

Building expansion	Purpose	Material/structural components	Footprint	Building height
Northern extension to manufacturing building	To facilitate increased kiln car movements for the increased brick production.	Masonry wall, metal sheeting and steel structure to keep with existing building.	659.097 m²	4 m
Southern extension to clay preparation building	To provide greater undercover storage of crushed materials.	Corrugated metal sheeting and steel structure to keep with existing building.	332.82 m²	11.66 m
Recycled water storage tanks	To store recycled water on-site for use in the brickmaking process.	High density polyethylene, 500 mm protection wall height and bund.	140 m²	2.0 m

5.2.5 STORMWATER MANAGEMENT

A Stormwater Management Plan (SWMP) was prepared for the site in 2002 (ERM). This SWMP was reviewed by Hyder Consulting and a Surface Water Management Report has been prepared for the proposed expansion project (Hyder Consulting 2013, Appendix I). The outcomes of this Surface Water Management Report are outlined in more detail in Section 7.6. A summary of the management measures for stormwater runoff proposed as part of this project is provided below.

In order to manage stormwater runoff and minimise discharges from the project site under existing operations, runoff currently draining to Dam 2 will be re-diverted to an enlarged Dam 1. The Quarry pit sump (Dam 3) will also be expanded as a result of quarry operations to ensure there is no increase in discharge frequency to Thompsons Creek.

Over the life of the project, the following changes to stormwater management would occur:

- Dam 2 will be removed following the commencement of quarrying in Cell D. Runoff from the material storage facility/area will be re-directed to Dam 4.
- The central water storage located in Cell A will be shifted to Cell B following the cessation of quarrying in Cell A and B. Water will be pumped during quarrying campaigns into Dam 4. Flocculent is added to water pumped from the quarry via a dosing pit on route to Dam 4. The majority of the sediment in the pumped quarry water settles out in Dam 4. When Dam 4 becomes full it overflows into Dam 5 where further sediment fall out takes place. When Dam 5 becomes full the water is pumped to Dam 6. The overflow between Dam 4 and Dam 5, the area from where water is pumped in Dam 5 and the discharge point at Dam 6 are also all fitted with floating sediment curtains, as an additional mitigation measure to reduce the levels of sediment entering Dam 6.
- A clean water diversion bund and swale will be constructed along the western boundary of the quarry, adjacent to Cells B, C and D to divert runoff to the north western corner of Cell D where it will dissipate into the Bardwell Gully sub-catchment.

- Total quarry operational footprint will increase from 9.9 hectares to 30.65 hectares. The volume of water management structures on the project site will increase from 406.350 mega litres to 441.870 mega litres under the final proposed developed condition.
- Dams 1, 4, 5, and 6 to have catchment areas of 10, 8.7, 2.7 and 119.9 hectares, respectively. The central quarry sump, located in Cell B will have a catchment area of 32.7 hectares.
- Boral will actively investigate and pursue opportunities for reuse of water for other beneficial purposes such as use of on-site water for dust suppression and irrigation.
- Treated effluent discharge will increase from 3,800 litres per day (area of irrigation 0.25 hectares) to 7,200 litres per day (area of irrigation 0.5 hectares).

5.2.6 INFRASTRUCTURE AND SERVICING

The site is currently serviced with reticulated natural gas, electricity and water. These existing services are expected to be sufficient to accommodate the continued and expanded operation of the quarry and brickmaking facility without the need for upgrade. Sewage produced on site is treated within a bio-cycle sewage treatment plant, with treated water irrigated to the grassed area to the north of the staff car park and east of the existing driveway.

5.2.7 ACCESS

The site access off Greendale Road is proposed to be relocated approximately 150 metres east of the existing driveway (refer Figure 5-4). A combination of relocating the driveway approximately 150 metres eastwards along Greendale Road as well as the construction of a 200 metres long, 4.5 metres high vegetated earth noise bund to the west of the new driveway location, was determined to achieve relevant noise management levels at the residential receivers to the north of Greendale Road (refer to Section 7.3 and Appendix E for further detail on the noise impact assessment). The new seven metres wide asphalt driveway (3.5 metres wide lanes) will provide access to both the brick storage area and the car park.

5.2.8 HOURS OF OPERATION

No change is proposed to the existing and approved operational hours as presented in Table 5-8.

Table 5-8 Existing and proposed hours of operation

Activities	Existing hours of operation	Proposed hours of operation
Quarrying operations, including associated vehicle movements.	6am to 6pm Monday to Friday.	No change.
	6am to noon Saturday.	No change.
	No activity on Sundays or public holidays.	No change.
Processing/manufacturing.	Unlimited (subject to compliance with noise emission levels).	No change.
Transport (truck movements and deliveries to and from the site).	6am to 6pm Monday to Friday.	No change.
	6am to noon Saturday.	6am to 1pm Saturday.
	No trucks shall queue at the entrance to the site prior to 6am.	No change.

5.2.9 WORKFORCE

There are currently 38 employees at the Bringelly Brickworks and up to ten contractors work for two to four months per annum on a campaign basis to complete the quarrying activities. The proposed workforce is forecast to increase by 34 staff, to a total of 72 employees. This increase is a result of the continued extraction and brickmaking at the Bringelly Brickworks and will likely consist of contractors, administrative staff and manufacturing and handling staff.

5.3 REHABILITATION

5.3.1 OVERVIEW

The long-term rehabilitation of the project site is of key importance, as it will determine how environmental issues (such as sedimentation and dust) will be adequately managed over time, so as to allow for the productive use of the land in the longer term. A Rehabilitation Strategy has been prepared for the site which aims to promote an integrated approach to quarry rehabilitation and management. (Hyder Consulting 2013, Appendix D). In line with the DGRs for the project, the Rehabilitation Strategy presents the proposed rehabilitation strategy for the site, having regard to the key principles in the Strategic Framework for Mine Closure, including:

- Rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria.
- Nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies.
- The potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.

5.3.2 PRINCIPLES, OBJECTIVES AND CRITERIA

Rehabilitation works proposed are focused on the management of erosion and sedimentation and the liberation of wind-borne dust during the life of the quarry. This primarily involved:

- Containing the disturbance footprint to a minimum.
- Progressive rehabilitation of final quarry pit walls involving revegetation of benches or batters (depending on the final adopted quarry pit edge landform).
- Establishing clean water divergence structures to direct clean water flows around the site thus minimising the creation of dirty water and the need for treatment.
- Stabilisation of proposed temporary unusable material and topsoil stockpiles through revegetation.
- Avoidance of creating new or larger overburden stockpiles by placing unusable material back in exhausted quarry pits.

The Rehabilitation Strategy has been developed in accordance with three key principles:

1 Least possible disturbance.

2 Erosion control and sediment management.

3 Progressive rehabilitation.

The objectives of the rehabilitation strategy are to:

- Provide a framework for site rehabilitation throughout the life of the project.
- Undertake rehabilitation activities to maintain safety and reduce hazards to persons or fauna.
- Ensure rehabilitation activities achieve a stable landform that is compatible with the surrounding land fabric. Land capability will be compatible with an agreed final land use and be consistent with land use planning requirements.
- Surface and groundwater leaving the site should not result in unacceptable water pollution offsite.
- Ensure that this strategy is consistent with other rehabilitation and offset strategies in the region.

Table 5-9 presents targets and completion criteria for the project site

Table 5-9 Targets and completion criteria for the project site

Rehabilitation aspect	Target	Performance indicators	Completion criteria
Safety	Significant hazards removed, controlled or contained.	Number of site hazards. Number of reported incidents on site.	No hazards or reported incidents on site for 12 months.
Landform stability	No significant erosion or loss of sediment from the site. No collapsing of quarry benches. No overland flows from off site into quarry.	Minimal visible rilling, slumping and other evidence of erosion. Minimal sediment deposition in drains and water retention basins. Stability of final quarry benches. No sign of slumping or collapse. Clean water divergence systems in place and not breached.	Stable landform, including quarry benches, erosion controls and drainage lines for 24 months. Compliance with EPL.
Water quality	No polluted water leaving the site.	Any water leaving the site should as a minimum, meet the EPL criteria or negotiated criteria in collaboration with regulators.	Water quality consistently meets background or EPL criteria for 24 months for discharges to Thompsons Creek.

Land function	Land function commensurate with the surrounding land fabric or at least doesn't compromise the value of surroundings. Environmental assets on site are in good health.	Land capability aligned to proposed/potential future uses and/or does not prohibit future uses. Maintenance of environmental assets currently on or within proximity to the site.	Land left in a state that does not prohibit any of the identified potential end uses of the site.
Compatibility to surrounding land fabric	Comparable to the future use of the surrounds.	Visual continuity of landscape. Consistent vegetation cover.	Visual continuity of landscape and connectivity with surrounding areas.

5.3.3 STAGING

Rehabilitation will be completed in three stages, in line with the three stages of quarrying activities proposed as part of the project. These are presented in Figures 5-11 to 5-13.

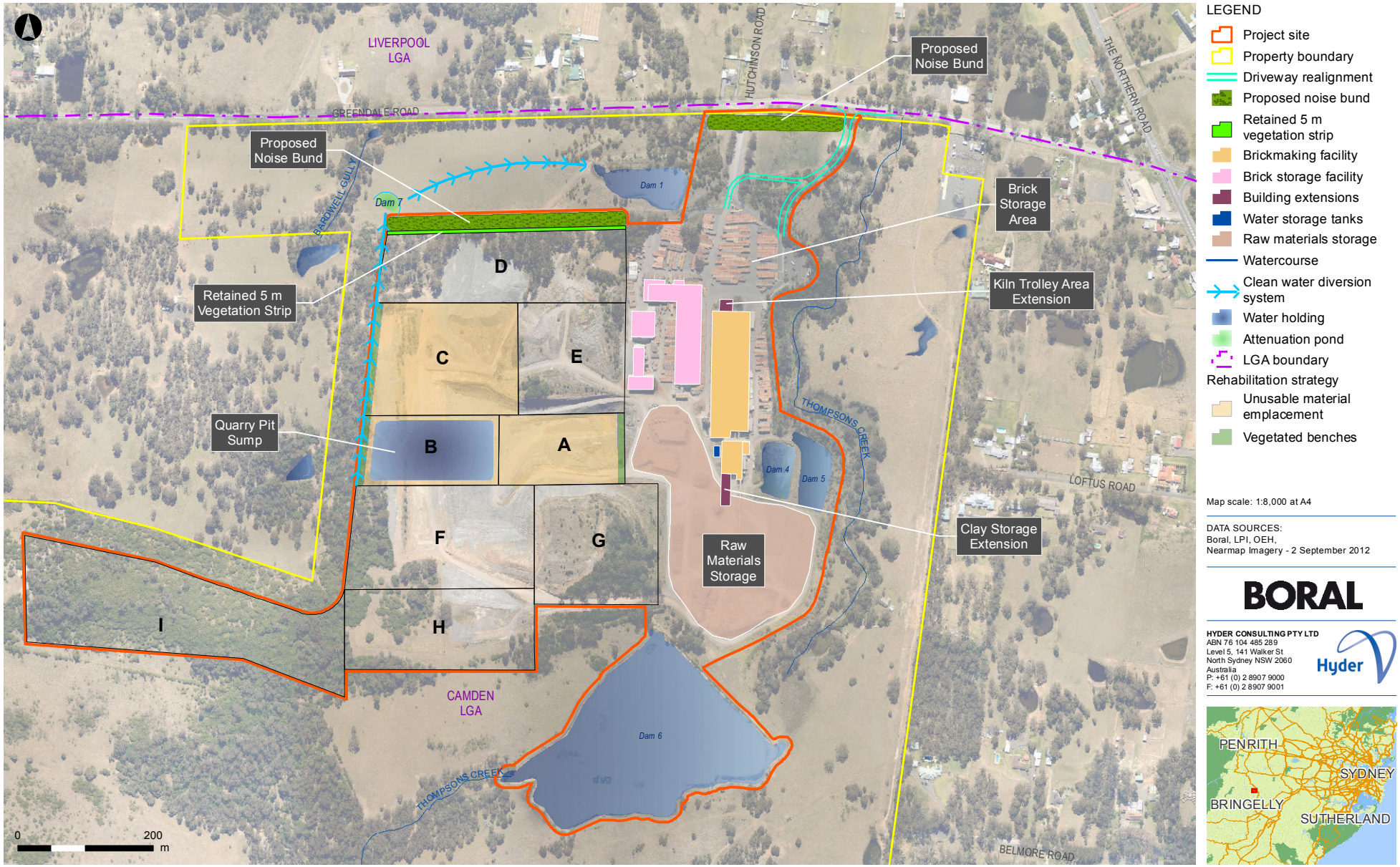
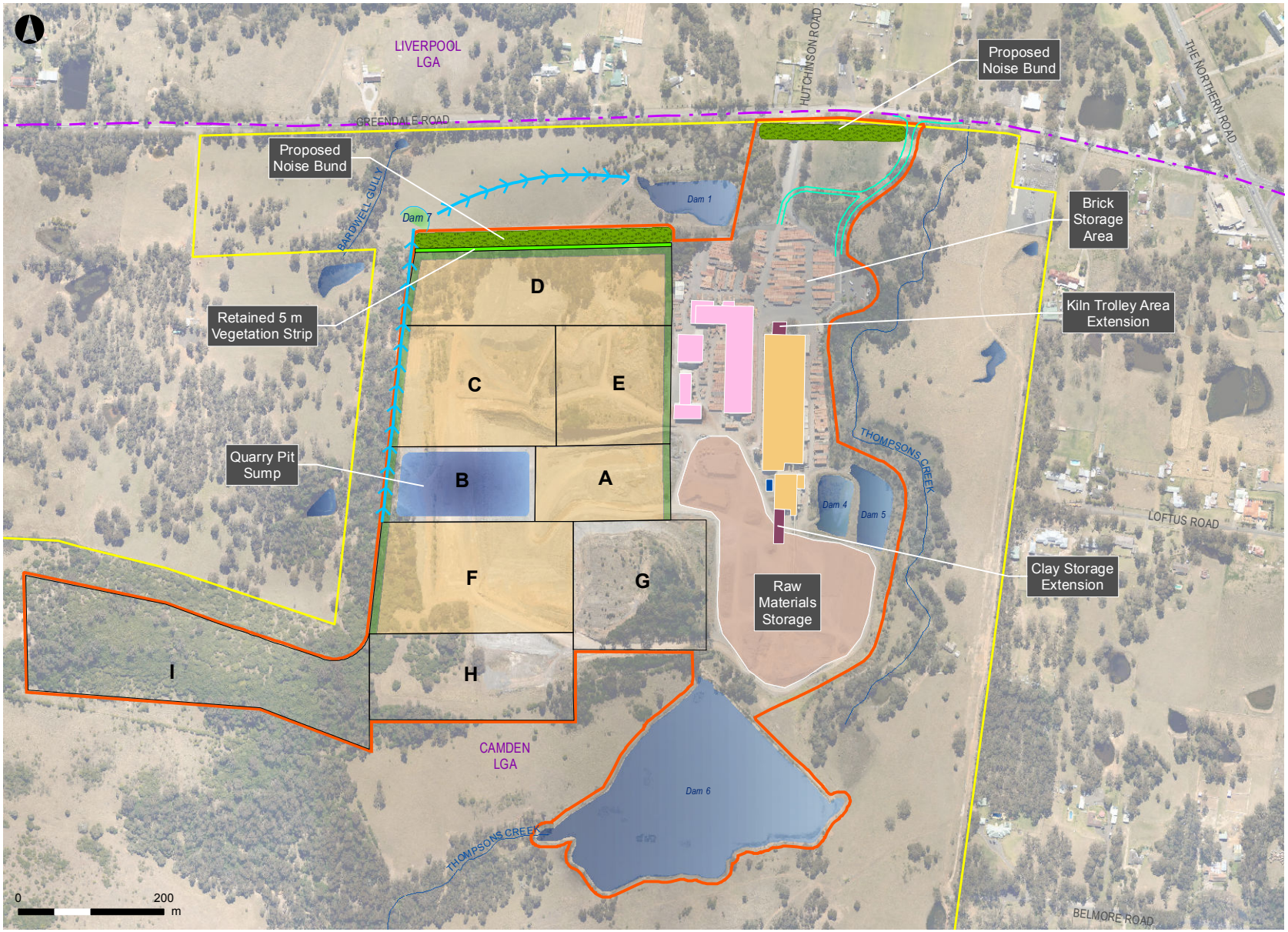


Figure 5-11: Proposed rehabilitation plan - 1



LEGEND

- Project site
- Property boundary
- Driveway realignment
- Proposed noise bund
- Retained 5 m vegetation strip
- Brickmaking facility
- Brick storage facility
- Building extensions
- Water storage tanks
- Raw materials storage
- Watercourse
- Clean water diversion system
- Water holding
- Attenuation pond
- LGA boundary

Rehabilitation strategy

- Unusable material emplacement
- Vegetated benches

Map scale: 1:8,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012

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Figure 5-12: Proposed rehabilitation plan - 2

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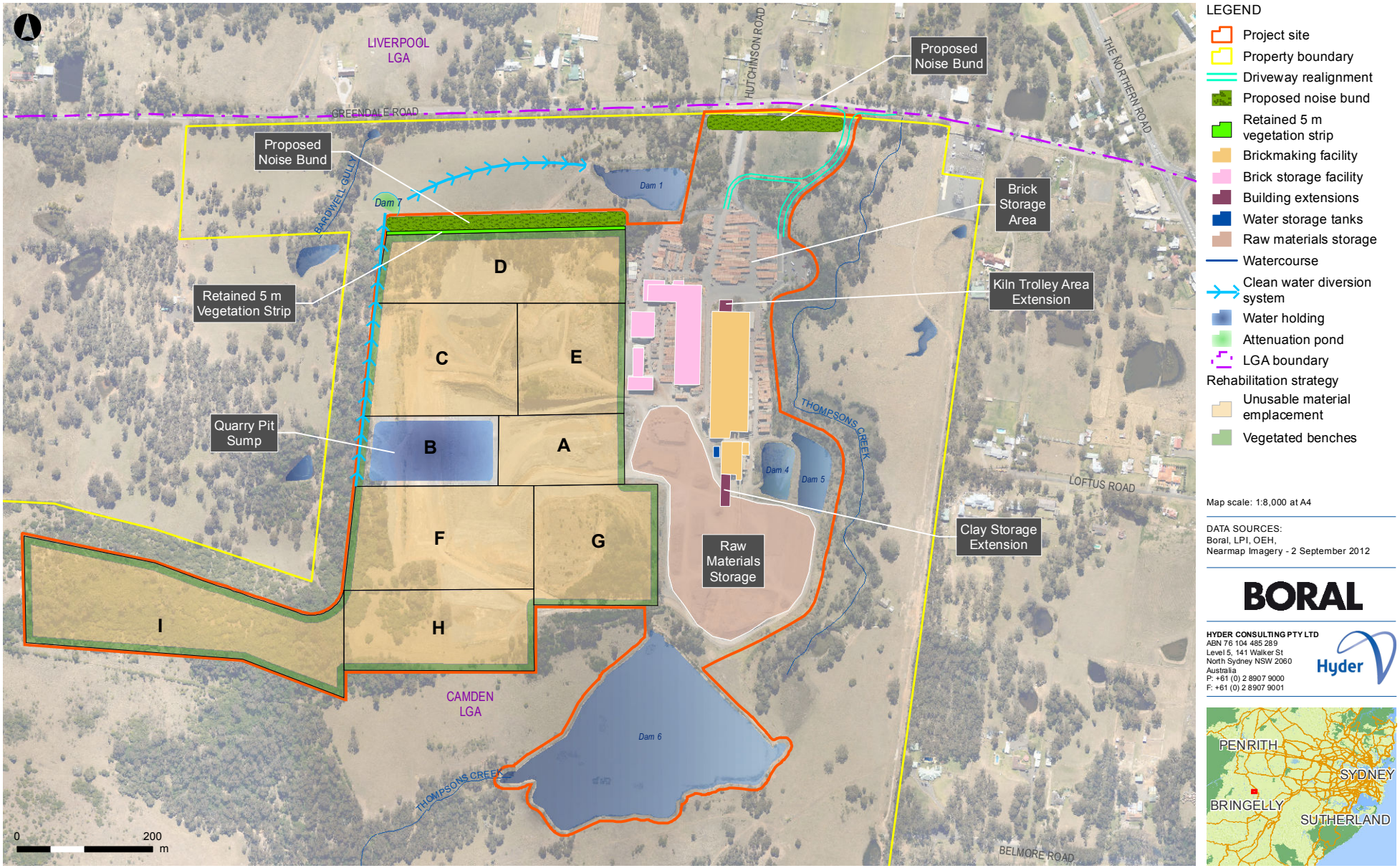


Figure 5-13: Proposed rehabilitation plan - 3

5.3.4 QUARRY PITS

Extraction of raw material from the quarry will be undertaken in three stages across nine cells (A-I) as described in Section 5.2.2. An open pit approximately 30.65 hectares in extent and approximately 30 metres deep will remain following cessation of quarry operations.

Overburden, interburden and all unusable material from each subsequent stage will be placed in the preceding void, facilitating sustainable re-use of unusable materials, minimising the disturbance footprint as additional undisturbed land is not required for the stockpiling of unusable material, and assisting with rehabilitation consistent with final land use. Cell B will become a central component for on-site water management following completion of quarrying within this cell. All other cells will remain as voids following completion of quarrying activities. The project site will remain fully fenced during extraction and following completion of quarrying, to achieve safety objectives documented within the Rehabilitation Strategy.

There are two scenarios that Boral is currently considering for the rehabilitation of the quarry pits. Under one scenario, the quarry edge will be benched to create a stable landform. Benches will be topsoiled and revegetated with a mixture of locally occurring native trees and shrubs. A bund will be created on the outer edge of the quarry bench to act as a safety barrier and to ensure that the quarry voids are internally draining. The width and height of the benches will be determined closer to the time of rehabilitation in consultation with an appropriately qualified geotechnical engineer

An alternative rehabilitation scenario that Boral is currently considering will involve establishing a batter slope of approximately 1:2 or steeper, from the base of the final void to the surrounding land surface 30 metres above. The feasibility for contour ripping at intervals along the batter will be investigated, combined with placement of topsoil within the contour channels and revegetation with appropriate, locally occurring native trees and shrubs, to establish groundcover across the final batter slope. Under this scenario a bund will be established on the outer edge of the void to act as a safety barrier.

It is noted that the floor of the quarry pit will not be rehabilitated as this area may be periodically inundated, making establishment of vegetation difficult. Table 5-10 describes the rehabilitation strategy and proposed final landform for each cell within the project site and assumes 200,000 tonnes extracted per annum.

Table 5-10 Proposed rehabilitation strategy and final landform

Cell	Rehabilitation strategy	Final landform
A	Removal of existing unusable material stockpiles along western boundary of Cell B for use in construction of noise bunds along northern boundary of Cell D and along Greendale Road extending westwards of new site entrance. Quarrying currently active. Pit used as temporary quarry stormwater basin until Cell B is exhausted. Final quarry profile established with benched or batter slope with vegetation planting. Temporary stockpiling of unusable material extracted from Cell A (that is not required for the construction of noise bunds) on disturbed areas of Cells D and E. Fencing and/or bunding at top of void, including installation of appropriate warning signs to mitigate potential safety risks to people.	Remain as final void.

Cell	Rehabilitation strategy	Final landform
B	Quarrying currently active. When Cell B bottoms out, regrading completed around pit to direct surface water drainage to Cell B which becomes the permanent quarry stormwater basin. Remaining temporary unusable material stockpile (if any) on disturbed areas in Cells D and E removed and placed in Cell A. Unusable material from Cell B placed in Cell A. Final quarry profile established with benched or batter slope with vegetation planting. Fencing and/or bunding installed at top of void, including appropriate warning signs to mitigate potential safety risks to people.	Used as quarry stormwater basin.
C	Cell C will continue to be excavated. Unusable material from Cell C placed in Cell A. When Cell C bottoms out, regrading of base of Cell C completed to direct surface water drainage to Cell B. Final quarry profile established with benched or batter slope with vegetation planting. Fencing and/or bunding installed at top of void, including appropriate warning signs to mitigate potential safety risks to people.	Remain as final void.
D	Noise bund built in one “construction” activity prior to the commencement of mining within Cell D (refer to Cell A above). Remaining topsoil stripped and stockpiled in appropriate disturbed area outside of active quarry and segregated from usable raw material stockpile area for use in rehabilitation activities, as required across the project site. 5 m strip of existing native vegetation (trees and understory) retained along northern boundary of Cell D. Remaining usable raw material from stockpiles on Cell D relocated to raw material stockpiles located south of brickworks prior to commencing excavation. Unusable material from Cell D placed in Cells A and C. When Cell D bottoms out, regrading base of Cell D completed to direct surface water drainage to Cell B. Final quarry profile established with benched or batter slope with vegetation planting. Fencing and/or bunding installed at top of void, including appropriate warning signs to mitigate potential safety risks to people.	Remain as final void.
E	Unusable material from Cell E placed in Cells A, C and D. When Cell E bottoms out, regrading base of Cell E completed to direct surface water drainage to Cell B. Final quarry profile established with benched or batter slope with vegetation planting. Fencing and/or bunding installed at the top of void, including appropriate warning signs to mitigate potential safety risks to people.	Remain as final void.

Cell	Rehabilitation strategy	Final landform
F	Remaining topsoil stripped and stockpiled in appropriate disturbed area outside of active quarry and segregated from usable raw material stockpile area for use in rehabilitation activities, as required across the project site. Unusable material from Cell F placed in Cells A, C, D and E. When Cell F bottoms out, regrading base of Cell F completed to direct surface water drainage to Cell B. Final quarry profile established with benched or batter slope with vegetation planting. Fencing and/or bunding installed at top of void, including appropriate warning signs to mitigate potential safety risks to people.	Remain as final void.
G	Remaining topsoil stripped and stockpiled in appropriate disturbed area outside of active quarry and segregated from usable raw material stockpile area for use in rehabilitation activities, as required across the project site. Unusable material from Cell G placed in Cells A, C, D, E and F. When Cell G bottoms out, regrading base of Cell G completed to direct surface water drainage to Cell B. Final quarry profile established with benched or batter slope with vegetation planting. Fencing and/or bunding installed at top of void, including appropriate warning signs to mitigate potential safety risks to people.	Remain as final void.
H	Remaining topsoil stripped and stockpiled in appropriate disturbed area outside of active quarry and segregated from usable raw material stockpile area for use in rehabilitation activities, as required across the project site. Unusable material from Cell H placed in Cells A, C, D, E, F and G. When Cell H bottoms out, regrading base of Cell H completed to direct surface water drainage to Cell B. Final quarry profile established with benched or batter slope with vegetation planting. Fencing and/or bunding installed at top of void, including appropriate warning signs to mitigate potential safety risks to people.	Remain as final void.
I	Remaining topsoil stripped and stockpiled in appropriate disturbed area outside of active quarry and segregated from usable raw material stockpile area for use in rehabilitation activities, as required across the project site. Unusable material from Cell I placed in Cells A, C, D, E, F, G and H. When Cell I bottoms out, regrading base of Cell I completed to direct surface water drainage to Cell B. Final quarry profile established with benched or batter slope with vegetation planting. Fencing and/or bunding installed at top of void, including appropriate warning signs to mitigate potential safety risks to people.	Remain as final void.

5.3.5 STOCKPILES

Stockpiles will be managed to allow rehabilitation of a stable landform as well as to ensure minimisation of double handling of materials. The majority of material in the unusable material stockpiles on the central western perimeter of the quarry (refer to W1 and W2 in Figure 5-3) will be used in construction of the two noise bunds located along the northern perimeter of Cell D and along Greendale Road to the west of the new sit access. Surplus material from all other unusable stockpile locations, including stockpiled material on Cell E will be placed in the quarry voids following the completion of quarrying of each cell.

The raw material stockpile area will be the final, non-built/non-hardstand area to be rehabilitated at the end of the quarry life. It is assumed that this area would be at or near ground level following quarry closure. Rehabilitation will involve ripping the compacted surface, placement and spreading of topsoil and establishing groundcover in the form of grass (to reduce dust generation) and providing flexibility for future land uses.

5.3.6 TOPSOIL MANAGEMENT

Soil surveys will be undertaken prior to commencement of quarrying in new cells to determine the condition of topsoils. The texture, thickness and quality of available topsoil will be described and mapped to support ongoing rehabilitation activities on the project site.

Topsoil stockpiles will be kept to a minimum with the preference being the immediate use of stripped topsoil on the final benched or batter slope profiles of the exhausted cells. Where topsoil is required to be stockpiled for an extended duration, it will be stockpile in appropriate disturbed areas outside of the active quarry area and segregated from the usable raw material stockpile areas, for use in rehabilitation activities, as required across the project site. The height of the topsoil stockpiles will be limited to two metres and they will be revegetated with temporary ground cover species, mulching, chemical stabilisers or binders if they are to remain in place for more than 30 days. A minimum of 70 per cent cover is required for both mulch and vegetative covers. The duration for stockpiling should be the minimum practical, but ideally less than 12 months.

5.3.7 VEGETATION MANAGEMENT

Rehabilitation plans will address the following revegetation requirements:

- Areas rehabilitated with native vegetation should be integrated with areas of undisturbed native vegetation, to provide connectivity and wildlife corridors.
- Native vegetation re-established at the site should be suitable for potential subsequent land use and as far as possible be compatible with the surrounding land fabric and land use requirements i.e. locally occurring, native plant species should be used in all revegetation.
- Consideration should be given when re-establishing native vegetation to accommodating threatened flora and fauna where appropriate.

Revegetation activities will generally be undertaken in spring and autumn; however, opportunistic revegetation may also be undertaken in areas ready for rehabilitation in summer or winter.

Weed control will be in accordance with mitigation strategies documented in the biodiversity technical report. The density of weeds on the site at the point of relinquishment should be no greater than the surrounding area.

5.3.8 CREEKLINES AND DRAINAGE

The project site is located within close proximity to Thompsons Creek, forming part of the South Creek catchment. Any rehabilitation plan and associated activities will consider maintenance of flow regimes within these watercourses and include measures to maintain receiving water quality. Rehabilitation plans and associated activities will also identify measures to separate groundwater into the operating and final landform.

The final quarry pit (void) may be used to retain water on site for amenity, aesthetic purposes, stormwater management and/or pollution control.

5.3.9 FINAL LANDFORM

A conceptual final landform is anticipated to consist of:

- One central water management storage area, following the completion of quarrying activities in Cell B.
- One void (quarry pit), comprised of Cells A, C, D, E, F, G, H and I.
- Brickmaking facility (roofed) and other associated hardstand areas, including carpark, brick storage areas and internal roads.
- Rehabilitated non-hardstand areas (areas not under roof or covered with asphalt and/or buildings), including the old raw material stockpile area, noise bunds located directly to the east and north of the brickmaking facility and final stormwater management structures.

The retention of voids on the site will not sterilise or preclude land at the project site from being redeveloped for other purposes in line with land use planning and policy at the time.

5.3.10 FUTURE LAND USE

Although planning is currently being undertaken to anticipate the end land use for the project site as a component of the development of this rehabilitation strategy, it is impossible to predict accurately the likely future land use at the site, given substantial changes expected to occur in the region over the next 30 years. Future land use will need to consider the applicable planning policy framework as well as the surrounding land use and environmental and market conditions at the time.

Characteristic of landforms resulting from quarrying activities, some voids would remain at the project site upon quarry closure in order to preserve options for further quarrying and other land uses. Boral intends to rehabilitate the site with the aim of creating a landform which is compatible with future land uses (most likely industrial), in line with the objectives of the *Sydney Metropolitan Strategy*, but which also retains opportunities for future extraction, if viable.

Quarry voids have successfully been rehabilitated for a range of uses including parks, water recreation, playing fields, golf courses, landfill, employment uses and continued quarrying and brickworks activities. In consideration of the alternative end uses of the site, it is important to ensure that the ultimate end use is sustainable, both environmentally and commercially. It is also important to consider possible end use options well before any filling occurs, as the type of filling method employed will determine what end use option can be achieved at the site. This is primarily related to the geotechnical stability of the final landform.

The above-mentioned possible future land uses will require more detailed investigation closer to the end of life of the quarry.

5.4 REHABILITATION ACTIVITIES AND INTERIM REQUIREMENTS

Proposed rehabilitation activities are presented in Table 5-11. The timeframe associated with each of these activities will be developed and revised regularly as part of the rehabilitation plan and aligned to the proposed future use of the project site.

Table 1-11 Proposed rehabilitation activities

Proposed actions
Commission a detailed topographical survey to provide a baseline (or update) for the rehabilitation process.
Further investigations ▪ Commission a geotechnical investigation to advise on the final quarry profile parameters e.g. batter slope versus benches and associated dimensions/design. ▪ Confirm drainage across and immediately surrounding the site. ▪ Confirm receiving water quality criteria with NSW OEH/EPA. ▪ Determine end of life land use having regard to planning controls and surrounding development.
Earthworks ▪ Stabilise voids and site slopes. ▪ Undertake necessary cut/fill works to stabilise site and create the desired end landform. ▪ Install additional water management structures as required.
Revegetation ▪ Spread clean topsoil and pasture seed on remaining exposed and stabilised areas. ▪ Plantings (as required).
Weed management
Installation of safety fencing and access points (e.g. fencing of final voids).
Preparation of survey plan and application for relinquishment.
Monitoring and review of rehabilitation performance and outcomes.

The rehabilitation of the project site will require the confirmation of the desired and agreed end use of the site. Planning controls, market conditions and surrounding land uses, in conjunction with the desired end use will inform the specific rehabilitation needs for the site.

It is recommended that a rehabilitation report be completed every five years in line with the review of the strategy to document and present progressive rehabilitation works that have been undertaken for the site. This report should present:

- Works undertaken in the preceding five years to obtain a stable landform.
- How these works align with the intended end outcome.
- Rehabilitation works that are planned for the following five years.

This five-yearly review should focus on progress towards achieving the end outcome of the project site. The rehabilitation of the site will consider the environmental assets on and in the vicinity of the project site.

6 ENVIRONMENTAL RISK ASSESSMENT

This Chapter identifies and prioritises anticipated environmental risks (positive and negative) associated with the project. Strategies to address the identified impacts are briefly outlined.

6.1 METHOD

An environmental risk analysis was undertaken to identify the key potential environmental issues or impacts associated with the project. It identifies areas where further investigation and assessment is recommended and shall be provided within the EIS.

The environmental risk analysis adopted an iterative evaluation process whereby environmental risk issues can be considered further in project design. The priority matrix described in Tables 6-12 to 6-15 guided the prioritisation process. It has been adapted from the *Australian Standard AS 4260:2004 Risk Management.* Each environmental factor (as determined by the DGRs) was assessed qualitatively and ranked between one and three based on the likelihood of occurrence and perceived consequence of effects if left unmanaged. This analysis considers the residual risk after mitigation measures are applied. Table 6-15 includes references to where relevant mitigation measures are outlined in the EIS. The summary of mitigation and monitoring measures proposed is presented in Chapter 9 of this EIS.

Table 6-12 Allocation of risk based on likelihood of occurrence

Likelihood of occurrence	Risk rating
High probability of occurring	High
Potential to occur	Medium
Unlikely to occur	Low

Table 6-13 Allocation of risk based on consequence of unmanaged effects

Consequence of unmanaged effects	Risk rating
Adverse environmental change, inter-regional implications, serious or long-term cumulative impacts, offsets not readily available.	High
Moderate adverse environmental change, regional implications, modest or medium-term cumulative impacts, offsets available.	Medium
Minor environmental change, localised implications, imperceptible or short-term cumulative impacts, offsets readily available.	Low

Table 6-14 Environmental factors priority matrix

Likelihood of occurrence	Consequence of unmanaged effects		
	3 (High)	2 (Medium)	1 (Low)
1 (Low)	4 (Medium)	3 (Low)	2 (Low)
2 (Medium)	5 (High)	4 (Medium)	3 (Low)
3 (High)	6 (High)	5 (High)	4 (Medium)

6.2 ANALYSIS

The analysis of environmental risk for issues related to the project is shown in Table 6-15. This analysis indicates the environmental risk rating for environmental factors of the project based on the analysis of potential impacts after mitigation.

Table 6-15 Project Risk Profile

Issues	Potential risks	Risk rating	Relevant mitigation measures
Land resources	▪ Soil erosion and sedimentation. ▪ Decreased water quality as a result of sediment laden water runoff. ▪ Exposure of sodic soils to runoff. ▪ Removal of vegetation resulting in rising groundwater levels. ▪ Poor drainage. ▪ Interception of acid sulphate soils. ▪ Potential disturbance of historical land contamination and future contamination through fuel storage and hydrocarbon spills. ▪ Potential for dust deposition and reduction of water quality for livestock grazing downstream.	Low	Section 7.2.4
Noise	Audible noise is likely at nearby sensitive receivers as a result of: ▪ Increase in brick production. ▪ Increase in brick deliveries (truck movements). ▪ Expanded quarrying operations.	Low	Section 7.3.9
Traffic and transport	▪ Potential to impact traffic conditions on Greendale Road and intersection performance at the Greendale Road/The Northern Road intersection as a result of an increase in trucks delivering bricks to the market and returning to the Bringelly brickmaking facility.	Low	Section 7.4.4
Air quality	▪ Potential increases to dust and particulate matter generated by the expanded quarry activities, transportation of raw material to stockpiles and subsequent processing. ▪ Emissions from the stack associated with the kiln and dryers could potentially result in localised increases in ground level concentrations of the flue gases, VOCs and metals.	Low	Section 7.5.4
Water resources –	Uncontrolled discharge of sediment laden stormwater that is pumped from the quarry	Low	Section 7.6.4

Issues	Potential risks	Risk rating	Relevant mitigation measures
surface water	pit during clay extraction campaigns and from runoff from other unroofed areas of the brickmaking facility (e.g. raw material stockpile area), has the potential to impact on surface water of Thompsons Creek in terms of: ▪ Stormwater runoff volume and frequency. ▪ Water quality. ▪ Flooding. ▪ Water access/water users.		
Water resources – groundwater	▪ Groundwater levels and flow. ▪ Impact on surface water (i.e. Thompsons Creek, Bardwell Gully or South Creek. ▪ Impact on registered bores or other groundwater users. ▪ Groundwater quality. ▪ Groundwater dependent ecosystems.	Low	Section 7.7.5
Biodiversity	▪ Species of threatened fauna. ▪ Threatened ecological communities. ▪ Aquatic habitats. ▪ Fauna habitats.	Medium	Section 7.8.5
Heritage – Aboriginal	There is evidence that there was Aboriginal occupation in the area and the potential to impact on: ▪ Archaeological values ▪ Cultural values.	Low	Section 7.9.6
Heritage – Non-Aboriginal	▪ Land use history – grazing, conservation sanctuary, quarry. ▪ Significant historical disturbance of project site.	Low	Section 7.10.4
Waste	▪ Construction waste. ▪ Operational waste.	Low	Section 7.11.4
Greenhouse gases	Increases in combustion of: ▪ Natural gas ▪ Electricity use. ▪ Diesel combustion.	Low	Section 7.12.4
Visual	Operations might be visible or partially visible from: ▪ Residential receivers to the north of the project site. ▪ Residential receivers to the east of Thompsons Creek.	Low	Section 7.13.6
Hazards	▪ Risk of potential spills.	Low	Section 7.14.4

Issues	Potential risks	Risk rating	Relevant mitigation measures
	▪ Improper use of dangerous goods. ▪ Increased associated risk of contamination.		
Social and economic	Positive benefits for the region in terms of: ▪ Employment creation ▪ Use of local business services ▪ Supply of bricks at a competitive price to the growing regions of Sydney.	Low	Section 7.15.4

7 ENVIRONMENTAL ASSESSMENT

This Chapter provides an assessment of the proposed Bringelly Brickworks expansion in relation to Section 79(c) of the EP&A Act 1979. It addresses compliance with the Director General's requirements, relevant legislative requirements, potential environmental impacts and proposed mitigation measures to address any identified impacts.

7.1 STATUTORY AND STRATEGIC PLANNING

The proposed Bringelly Brickworks expansion project is subject to both Commonwealth and NSW legislation and associated regulation and policy. These are addressed below.

7.1.1 COMMONWEALTH LEGISLATION

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* applies to the project site. This Act requires approval from the Federal Minister for the Environment to carry out a 'controlled action' where it is likely to have a significant impact on a 'matter of National Environmental Significance' (NES). Matters of NES include among other matters listed threatened species, ecological communities and migratory species.

There are no known matters of NES occurring on or in the vicinity of the project site. Therefore it is considered that referral of the application to the Commonwealth Minister for the Environment, to determine if it is a 'controlled action', is not required.

7.1.2 NEW SOUTH WALES LEGISLATION

Environmental Planning and Assessment Act 1979

The EP&A Act and the EP&A Regulation provide a framework for environmental planning in NSW. This framework includes provisions to ensure that projects which have the potential to impact the environment are subject to detailed assessment. This framework also provides opportunity for public involvement.

If a development is identified as a SSD due to scale and/or complexity under the State and Regional Development SEPP (as outlined in Section 1.3 of this EIS) they are subject to assessment under Part 4 of the EP&A Act.

Section 89J of the EP&A Act excludes the need for approvals under a number of other pieces of legislation, including:

- A permit under Sections 201, 205 or 219 of the *Fisheries Management Act 1994*.
- An approval under Part 4, or an excavation permit under Section 139, of the *Heritage Act 1977*.
- An Aboriginal heritage impact permit under Section 90 of the *National Parks and Wildlife Act 1974*.
- A bushfire safety authority under Section 100B of the *Rural Fires Act 1997*.
- A water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than an aquifer interference approval) under Section 91 of the *Water Management Act 2000*.

Exclusion of these approvals is discussed in further detail according to each respective Act.

Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the NSW Environment Protection Authority (EPA).

The principle objectives of the POEO Act (s.3) are to:

- Protect, restore and enhance the quality of the environment, while having regard to the principles of ecologically sustainable development (ESD).
- Provide increased opportunities for public involvement and participation in environment protection.
- Reduce risks to human health and prevent the degradation of the environment.
- Manage an appropriate regulatory framework for protection of the environment.
- Manage an efficient administration of environment protection legislation.
- Assist in the achievement of the objectives of the *Waste Avoidance and Resource Recovery Act 2001*.

Environment Protection Licences

An environment protection licence is required for scheduled development work and for scheduled activities and may also be issued to control the pollution of water from non-scheduled activities (POEO Act, Chapter 3).

Scheduled development work, under the POEO Act, means work at any premises at which scheduled activities are not carried out that is designed to enable scheduled activities to be carried out at the premises.

The proposed works incorporate the following scheduled activities under Schedule 1 and Section 122, of the POEO Act:

- 7 – Ceramic Works.
- 16 – Crushing, grinding, screening.
- 19 – Extractive activities.
- 29 – Mining for minerals.
- Section 122 – Pollution of any waters.

These scheduled activities are currently included in the existing Environment Protection Licence (EPL) 1808. Consultation will be undertaken with the EPA to determine whether a modification to the existing EPL is required as a result of the proposed extension to the Bringelly quarry and brickmaking facility.

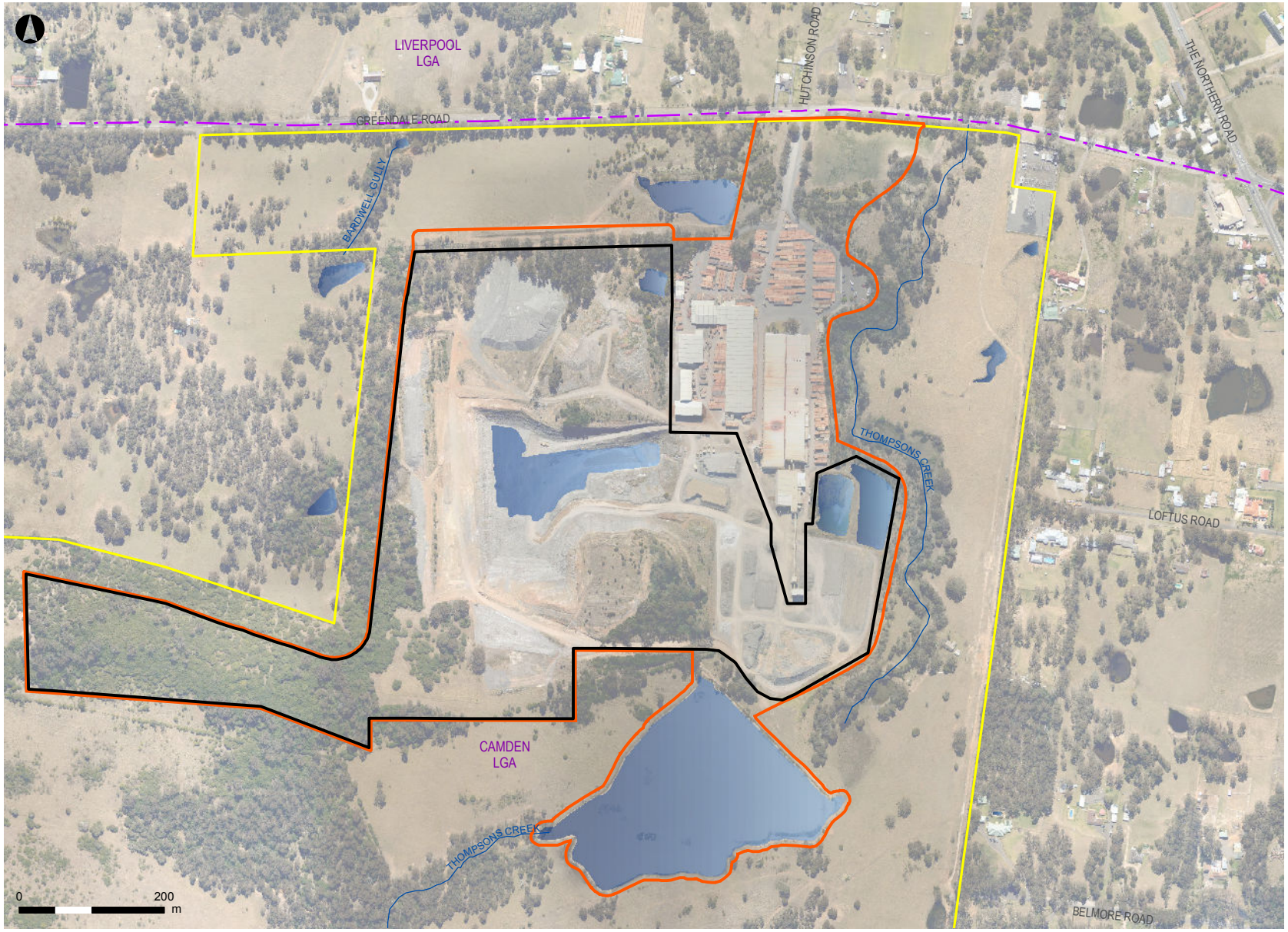
Mining Act 1992

The *Mining Act 1992* (Mining Act) is the primary legislation for regulation of mining activities in New South Wales. The objects of the Mining Act are to encourage and facilitate the discovery and development of mineral resources while regarding the need for ecological sustainable development. The Mining Act applies to commodities that are listed under the *Mining Regulation 2010*, which include clay minerals such as the clay/shale that will be extracted from the Bringelly quarry.

Clauses 5 and 6 of the Mining Act state that an authority or mineral claim is required for the mining of any privately or publicly owned mineral.

Part 5 of the Mining Act deals with mining leases and provides that any person may make an application for a mining lease over land of any title or tenure.

Before a mining lease can be granted, project approval must be obtained under the EP&A Act. In accordance with Part 5 of the Mining Act and following a favourable determination of this Development Application, Boral will apply for a new mining lease. The area that the proposed mining lease will cover is shown in Figure 7-14. If a mining lease is granted, rehabilitation and environmental performance requirements are included as conditions of the lease and supplement the conditions of the project approval.



LEGEND

- Project Site
- Property boundary
- Proposed mining lease
- LGA boundary
- Watercourse

Map scale: 1:8,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012

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Figure 7-14: Proposed mining lease

Date: 29/08/2013 Path: \\HC-AUS-NS-FS-01\jobs\AA005667\L-GIS\A_Current\B_Maps\EIS\AA005667_EIS_F007-14_ProposedMiningLease_r2v1.mxd
Created by : GC
QA by : UOD

Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) provides for the protection from clearing of native vegetation primarily within regional areas of NSW. A detailed analysis of terrestrial native vegetation that is likely to be affected by the proposed development is discussed in Section 7.8 of the EIS. Under Part 3 Schedule 1 of the NV Act, Camden LGA is excluded from the provisions of the Act. In addition, Section 89J of the EP&A Act excludes SSD applications from the requirement to obtain authority under Section 12 of the NV Act.

Section 7.8 of the EIS provides an assessment of the potential impacts of the project on biodiversity. The proposed Bringelly quarry and brickmaking facility expansion project has been sited to minimise the amount of native vegetation to be cleared. Additionally, the ecological assessment outlines mitigation measures, including offsetting that would be undertaken to minimise impacts on the ecological values of the site.

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) sets out provisions for planning and assessment of impacts on threatened species, populations and ecological communities listed under Schedules 1, 1A and 2 of the TSC Act. The purpose of the TSC Act is to:

- Conserve biological diversity and promote ecologically sustainable development.
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities.
- Protect the critical habitat of those species, populations and ecological communities that are endangered.
- Eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities.
- Ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed.
- Encourage the conservation of threatened species, populations and ecological communities through co-operative management.

The TSC Act lists a number of factors to be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats. Schedules 1 and 2 of the TSC Act lists species, populations or ecological communities of native flora and fauna considered to be threatened in New South Wales. Development applications and environmental assessments that require consent from Council or any other statutory authority are required to be assessed with regard to the purpose of the TSC Act and consideration given to the significance of any impact on listed species.

An assessment of significance has been performed for each of the species, populations and ecological communities in the vicinity of the project site that were listed in schedules 1 and 2 of the TSC Act. The outcomes of these assessments and the requirements for offsets under the TSC Act are discussed in Section 7.8 of this EIS.

All works for development and operation of the Bringelly Brickworks would be undertaken in accordance with the Minister's Conditions of Approval, issued under the EP&A Act, including requirements for the provision of offsets for impacts on threatened species.

National Parks and Wildlife 1974

The objects of the *National Parks and Wildlife Act 1974* (NP&W Act) are to conserve nature, objects, places or features of cultural value within the landscape including but not limited to:

- Places, objects and features of significance to Aboriginal people.
- Places of social value to the people of NSW.
- Places of historic, architectural or scientific significance.

The NP&W Act also aims to foster public appreciation of nature and cultural heritage and provide for management of land reserved under the NP&W Act. Under Section 85 of the NP&W Act, the Director General of the OEH has the authority for the protection of Aboriginal objects and Aboriginal places in New South Wales. Under the NP&W Act it is illegal to impact or cause the destruction of Aboriginal objects, including for the purposes of investigations, without a valid development approval or an Aboriginal Heritage Impact Permit (Section 90 of the NP&W Act and s89J of the EP&A Act).

A comprehensive assessment of both Aboriginal cultural and archaeological heritage values has been undertaken as part of the environmental assessment and is reported on in Section 7.9 of this EIS, which includes background database searches, site surveys, test pit excavations and thorough Aboriginal heritage stakeholder consultation. All works for construction and operation of the proposed Bringelly quarry and brickmaking facility expansion project would be undertaken in accordance with the Minister's Conditions of Approval, issued under the EP&A Act, including all conditions for the identification, assessment and management of impacts on potential items of Aboriginal heritage.

Noxious Weeds Act 1993

The objects of the *Noxious Weeds Act 1993* (NW Act) are:

a To reduce the negative impact of weeds on the economy, community and environment of NSW by establishing control mechanisms to:

  i. Prevent the establishment in NSW of significant new weeds.

  ii. Prevent, eliminate or restrict the spread in NSW of particular significant weeds.

  iii. Effectively manage widespread significant weeds in NSW.

b To provide for the monitoring of and reporting on the effectiveness of the management of weeds in NSW.

A weed control order may specify the following classes of noxious weed:

- Class 1 noxious weeds (State Prohibited Weeds) are plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.
- Class 2 noxious weeds (Regionally Prohibited Weeds) are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.
- Class 3 noxious weeds (Regionally Controlled Weeds) are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.
- Class 4 noxious weeds (Locally Controlled Weeds) are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.

- Class 5 noxious weeds (Restricted Plants) are plants that are likely, by their sale or the sale of their seeds or movement within NSW or an area of NSW, to spread in NSW or outside NSW.

A noxious weed that is classified as a Class 1, 2 or 5 noxious weed is referred to in the NW Act as a notifiable weed. The occupier of land must notify the local council for the land that there are notifiable weeds present on the land within 24 hours after becoming aware that the notifiable weed is on the land.

Two of the 22 exotic plant species recorded in the study area are listed as noxious weeds in the Camden Local Government Area, *Ligustrum sinense* (Small-leaved Privet) and *Opuntia stricta* (Prickly Pear). *Opuntia stricta* (Prickly Pear) and additional weed, *Senecio madagascariensis* (Fireweed) are also listed as Weed(s) of National Significance under the National Weeds Strategy (Thorp and Wilson 2012). More information is provided in Section 7.8.3. Noxious weeds will be managed in accordance with the requirements of the NW Act as discussed further in Section 7.8.5 of this EIS.

Water Management Act 2000

The object of the *Water Management Act 2000* (WM Act) is to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. Under the WM Act it is unlawful for a person to carry out a controlled activity within waterfront land, which is defined as the bed of any river, lake or estuary and land within 40 metres of a water body. However, Section 89J of the EP&A Act excludes SSD applications from the requirement to obtain authority under Section 89, 90 or 91 of the WM Act.

Irrespective of this, design and construction of the Bringelly quarry and brickmaking facility expansion will align with the objectives of the WMA and have consideration of the guidelines for controlled activities developed under the WMA to minimise impacts on water resources. Sections 7.2 and 7.6 provide a detailed assessment of the potential impacts of the project on the local water resources.

Heritage Act 1977

The object of the *Heritage Act 1977* is to promote understanding of the State's heritage, encourage its conservation, and provide for the identification, registration, protection and adaptive reuse of items of State heritage significance. Under the Heritage Act, 'items of environmental heritage' include places, buildings, works, relics, moveable objects and precincts identified as significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. State significant items are listed on the NSW State Heritage Register (SHR) and are given automatic protection under the Heritage Act against any activities that may damage an item or affect its heritage significance. The Heritage Act also protects 'relics', which can include archaeological material, features and deposits. A Non-Indigenous Heritage Assessment (Artefact Heritage 2013) was completed to assess potential impacts of the project on items of environmental heritage. The results are summarised in Section 7.10 of this EIS; the full report is included in Appendix M. Section 89J of the EP&A Act excludes the need for an excavation permit under Section 139 of the *Heritage Act 1977*.

7.1.3 STRATEGIC PLANS

NSW 2021

NSW 2021 is a 10 year State Plan that will guide NSW policy and budget decision making, in conjunction with the NSW Budget, to deliver on community priorities.

The proposed expansion to the Bringelly quarry and brickmaking facility is consistent with the principles outlined in the NSW 2021 State Plan. Specifically, the project consists of increasing brick production at the Bringelly brickmaking facility, which is located in the Sydney SWGC, which will be the primary focus of housing supply for Sydney's growing population. The strategic location of the Bringelly brickmaking facility within the Sydney SWGC, will reduce the freight requirements associated with distributing bricks long distances across NSW, and hence reducing the cost of construction materials for home builders within the greater Sydney area and in particular the growing local area. In addition, the project will allow for the continued extraction of a valuable local natural resource, which will secure the raw materials required for the production of bricks in Bringelly for the next 30 years and will therefore support the long term viability of the brickmaking industry in NSW. This is consistent with the NSW 2021 Plan's key goal of rebuilding the economy, and in particular:

- *Goal 1 - Improve the performance of the NSW economy.*
- *Goal 5 - Place downward pressure on the cost of living.*

The continuation and expansion of the Bringelly quarry and brickmaking will:

- Allow for the ongoing supply of building materials to the major growth areas of Sydney at a more competitive price than if bricks were manufactured and transported from a more distant location, therefore assisting with reducing the cost of living for new home builders.
- Support the local economy by providing 72 jobs and through the procurement of services from local businesses and through the payment of taxes.

This is a positive outcome for the people of Sydney. Accordingly project is considered to be consistent with the goals and priorities of NSW 2021.

Metropolitan Plan for Sydney 2036

The *Metropolitan Plan for Sydney 2036* is currently under review in line with the new State Plan (NSW 2021) and the recently released NSW Long Term Transport Masterplan. Notwithstanding the current review, the Metropolitan Plan for Sydney contains the following strategic directions that are aimed at addressing Sydney's challenges over the next 20 years:

- Strengthening a city of cities.
- Growing and renewing centres.
- Transport for a connected city.
- Housing Sydney's population.
- Growing Sydney's economy.
- Balancing land uses on the city fringe.
- Tackling climate change and protecting Sydney's natural environment.
- Achieving equity, liveability and social inclusion.
- Delivering the Metropolitan Plan for Sydney 2036.

The proposed Bringelly quarry and brickmaking facility expansion project is consistent with the objectives of the Metropolitan Plan for Sydney, particularly as enhances the ability to provide housing for a growing and changing population in Sydney. The project will support future residential development in new release areas. The project is therefore consistent with the *Metropolitan Plan for Sydney 2036*.

South West Subregional Strategy (draft)

The Draft South West Subregional Strategy provides a broad framework for the long-term development of the area, guides government investment and links the strategic directions of the Sydney Metropolitan Plan for Sydney 2036 to a sub-regional context. The key directions of the Draft South West Subregional Strategy are to:

- Plan for major housing growth.
- Plan for major employment growth.
- Develop Liverpool as a Regional City.
- Intensify existing areas around existing retail centres and public transport corridors.
- Strengthen centres with public transport.
- Existing transport networks to connect the SWGC to existing centres.
- Recognise and support unique rural character.
- Protect resource lands.

The proposed Bringelly Brickworks expansion project supports many of these key directions, particularly through supplying nearby urban release areas with necessary brick products, reducing freight associated with distribution of these products and also by sustainably managing construction materials and ensuring that future quarry materials are safeguarded from inappropriate development. Therefore the project is consistent with the Draft South West Subregional Strategy.

7.1.4 ENVIRONMENTAL PLANNING INSTRUMENTS

The following statutory planning instruments are applicable to the project:

- *State Environmental Planning Policy (State and Regional Development) 2011.*
- *State Environmental Planning Policy (Sydney Regional Growth Centres) 2006.*
- *State Environmental Planning Policy No.55 – Remediation of Land.*
- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007.*
- *Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No. 2- 1997).*
- *Sydney Regional Environmental Plan No.9 Extractive Industries.*
- *Camden Local Environment Plan 2010.*

Project compliance with these planning instruments is detailed in the Section below.

State Environmental Planning Policy (State and Regional Development) 2011

The State and Regional Development SEPP declares certain types of development or development on certain land to be SSD. Clause 7 of Schedule 1 of the State and Regional Development SEPP relates to extractive industries. As outlined in Section 1.3, given that the operations at the Bringelly Brickworks will extract from a total resource of more than 5 million tonnes, the operations would meet the criteria in clause 7(1)(b) of Schedule 1 for a State Significant Development (SSD). The process of preparing an EIS that accompanies the SSD application under Section 78A of the EP&A Act is detailed in Section 1.3.

State Environmental Planning Policy (Sydney Regional Growth Centres) 2006

The primary aim of the *State Environmental Planning Policy (Sydney Regional Growth Centres) 2006* (Growth Centres SEPP) is to coordinate the release of land for residential, employment and other urban development in the north west and south west growth centres of the Sydney Region. The Growth Centres SEPP identifies precinct, and corresponding planning controls relating to development within these precincts.

The project site is contained within both the 'Bringelly' and 'Lowes Creek' precincts of the SWGC. These precincts are earmarked to support Sydney's future residential, employment and other urban development opportunities, in line with the Growth Centres SEPP. The proposed Bringelly quarry and brickmaking facility expansion project will be strategically located within the growth centre, so as to provide brick products that support the level of residential and employment growth forecast in the area.

State Environmental Planning Policy No. 55 – Remediation of Land

The *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55) provides controls and guidelines for the remediation of contaminated land. In particular, this policy aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. Before determining a development application, a planning authority must consider whether the land is contaminated and be satisfied that it is suitable in its current state or will be suitable, after remediation for the proposed development.

The project does not involve a change of use of the land, but it does involve continuation and expansion of the existing operations at the site.

As discussed previously, consideration has been given to the potential for the project to disturb existing contaminated land or to result in the contamination of land. The contaminated land assessment (refer Section 7.6.2), which included investigation of contaminated land records, historical land use and ownership records, historical aerial photography and a number of site visits, concluded that it is unlikely that the Bringelly quarry and brickmaking facility expansion project would disturb contaminated land. The project site is thus considered to be suitable for the continuation of quarrying and brickmaking operations and it is not anticipated that remediation of the land would be required in order for operations to continue and expand on the site.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Extractive Industries SEPP) aims to provide proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, as well as facilitating orderly use and development of land containing these resources and to establish appropriate planning controls for these resources.

Clause 7(3)(a) of the Extractive Industries SEPP states that development for the purpose of extractive industry is permissible with consent:

- On land on which development for the purposes of agriculture or industry may be carried out (with or without development consent).
- In any part of a waterway, an estuary in the coastal zone or coastal waters of the State that is not in an environmental conservation zone.

The proposed Bringelly quarry and brickmaking facility expansion project is therefore deemed permissible with consent pursuant to Clause (7)(3) of the Extractive Industries SEPP.

Part 3 of the Extractive Industries SEPP sets out matters for consideration in relation to projects for extractive industry. These matters have been addressed in Table 7-16.

Table 7-16 Responses to SEPP (Mining, Petroleum Production and Extractive Industries) 2007

Policy	Response
a Consider: (i) The existing uses and approved uses of land in the vicinity of the development.	The proposed Bringelly quarry and brickmaking facility expansion project is consistent with the existing and approved uses of the land. The Bringelly Brickworks currently operates under a 1991 approval from Camden Council for the extraction of 200,000 tonnes of material per annum, and production of 160,000 tonnes of bricks per annum. The project consists of increasing the production of bricks to 263,500 tonnes per annum, with no change to the extraction volume. All potential impacts resulting from the proposed Bringelly quarry and brickmaking facility expansion project have been assessed in this EIS and all reasonable and feasible mitigation measures suggested to minimise any adverse effects on land or the use of land in the vicinity of the development.

Policy	Response
(ii) Whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development.	The proposed Bringelly Brickworks Expansion Project will not have a significant impact on the future preferred uses of land in the vicinity of the site. The Draft Sydney Metropolitan Strategy (released for public exhibition on 19 March 2013) identifies the Bringelly site as falling within the SWGC. This area is earmarked for significant growth over the next 20 years and will provide for a diverse array of land uses for employment and housing in the region. The project remains within an existing parcel of land dedicated to extractive industries, is not inconsistent with the current use of the land, nor will it impact on the future preferred land uses in the vicinity. The Bringelly brickmaking facility will continue to be a significant employer with an estimated 72 staff required to operate the expanded facility.
(iii) Any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses.	The proposed expansion to the Bringelly quarry and brickmaking facility is not inconsistent with current approved uses. The existing industrial nature of the site and proposed ongoing future operations at the site remain consistent with the anticipated growth in employment land uses in the area. In addition, the proximity to nearby land release areas will mean that brick production is closer to consumers.
(b) Evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii).	The project is contained within the Sydney SWGC, which will be the primary focus of employment growth and housing supply for Sydney's growing population. The strategic location of the Bringelly brickmaking facility to the areas earmarked for future urban development, will reduce the freight requirements associated with distributing bricks long distances across Sydney, and hence produce reasonably priced construction materials for consumers in the growing local area. In addition, the project will ensure the long term viability of the brickmaking industry in NSW and consequently offer stable employment opportunities.
(c) Evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	The measures proposed to avoid or minimise any incompatibility in terms of air quality, visual aesthetics, noise and water management are summarised within Chapter 7 of this EIS. These measures are considered to be adequate in alleviating any negative impacts on nearby land users and residences.

Sydney Regional Environmental Plan No. 9 Extractive Industries 1992

Since July 2009, Regional Environmental Plans (REPs) are considered to be deemed SEPPs. The aim of the Sydney Regional Environmental Plan No. 9 – Extractive Industries, is to facilitate the development of extractive resources in proximity to the population of the Sydney Metropolitan Area by:

- Identifying land containing extractive industries of significance.
- Permitting development with Council's consent for extractive industries.
- Ensuring that extractive industries can reach their full potential by not being encroached by incompatible land uses
- Prohibiting extractive industries on land which is environmentally sensitive.

The project aligns entirely with this REP, as it relates to strategically maintaining a significant extractive industry resource, which has been in operation since 1968. The project ensures that there will be sufficient clay/shale resources available to the SWGC, which is anticipated to experience significant population growth under the Metropolitan Strategy.

Camden Local Environmental Plan 2010

The site is subject to the provisions of the *Camden Local Environmental Plan 2010* (gazetted 3 September 2010), which is the primary local environmental planning instrument applicable to the site. In accordance with Section 89E of the EP&A Act, environmental planning instruments are to be taken into consideration in order to determine if a proposed development is partially or wholly prohibited under an environmental planning instrument.

According to the *Camden Local Environmental Plan 2010* (the Camden LEP), the project site is zoned as RU1 Primary Production. This zone permits a range of development including agriculture, dwellings, rural industries and extractive industries. Development that is not identified in the Camden LEP as permitted with or without consent is deemed to be prohibited within the RU1 Zone.

The existing development on the Bringelly Brickworks site was approved in 1991 by Camden Council.

Extractive industries are permissible with consent in the RU1 zone, yet the industrial activities are prohibited in the RU1 zone. As such, the development project is partially prohibited according to the Camden LEP 2010.

Whilst the brickmaking facility component is defined as prohibited, it forms an integral part of the approved development, and the use has been able to continue to apply through the gazettal of a number of environmental planning instruments that have applied to the land over time. It is therefore considered likely that the brickmaking facility would benefit from existing use rights as defined under Section 106 of the EP&A Act. In addition, Section 89E (3) specifies that development consent may be granted despite the development being partly prohibited by an environmental planning instrument.

The RU1 Primary Production Zone Objectives include:

- 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 permit non-agricultural uses which support the primary production purposes of the zone.
- To maintain the rural landscape character of the land.

The proposed Bringelly quarry and brickmaking facility expansion is consistent with the objectives of the RU1 Primary Production zone through the containment and consolidation of existing quarrying operations in the area, so as to ensure that sustainable production in the area is promoted and enhanced. The project will still allow for agistment to occur on the southern end of the project site, adjacent to Thompsons Creek.

The project remains entirely consistent with the existing operations and is only expanding extraction on land that is considered to be highly unsuitable for the purposes of primary production. The quarry expansion operations are contained to the degraded and cleared northern end of the property.

The project also seeks to protect and enhance the natural features of the area, such as:

- Avoiding the better quality Cumberland Plain Woodland to the south of the project site.
- Restricting the expanded quarry footprint a substantial distance from Thompsons Creek (at least 100m).
- Implementing a robust and practical surface water management strategy including the establishment of clean water divergence systems, dirty water treatment and water quality monitoring.
- Appropriate rehabilitation of the project site through replanting suitable, locally occurring native vegetation.

A Public Road Activity (PRA) application will be submitted to Camden Council prior to connection of the new site access road to Greendale Road, in accordance with the Council's documented procedure for the completion of new gutter crossings/driveways.

7.2 LAND RESOURCES

7.2.1 OVERVIEW

The project requires the uptake of land within Boral's property that lies adjacent to the existing active quarry. This section provides an assessment of the potential impacts on land resources, in accordance with the Director General's Requirements. Specifically, it includes a detailed assessment of the potential impacts of the project on:

- Soils and land capability (including salinisation and contamination).
- Landforms and topography, including cliffs, rock formations, steep slopes, etc.
- Land use, including agricultural, forestry, conservation and recreational use.

7.2.2 EXISTING ENVIRONMENT

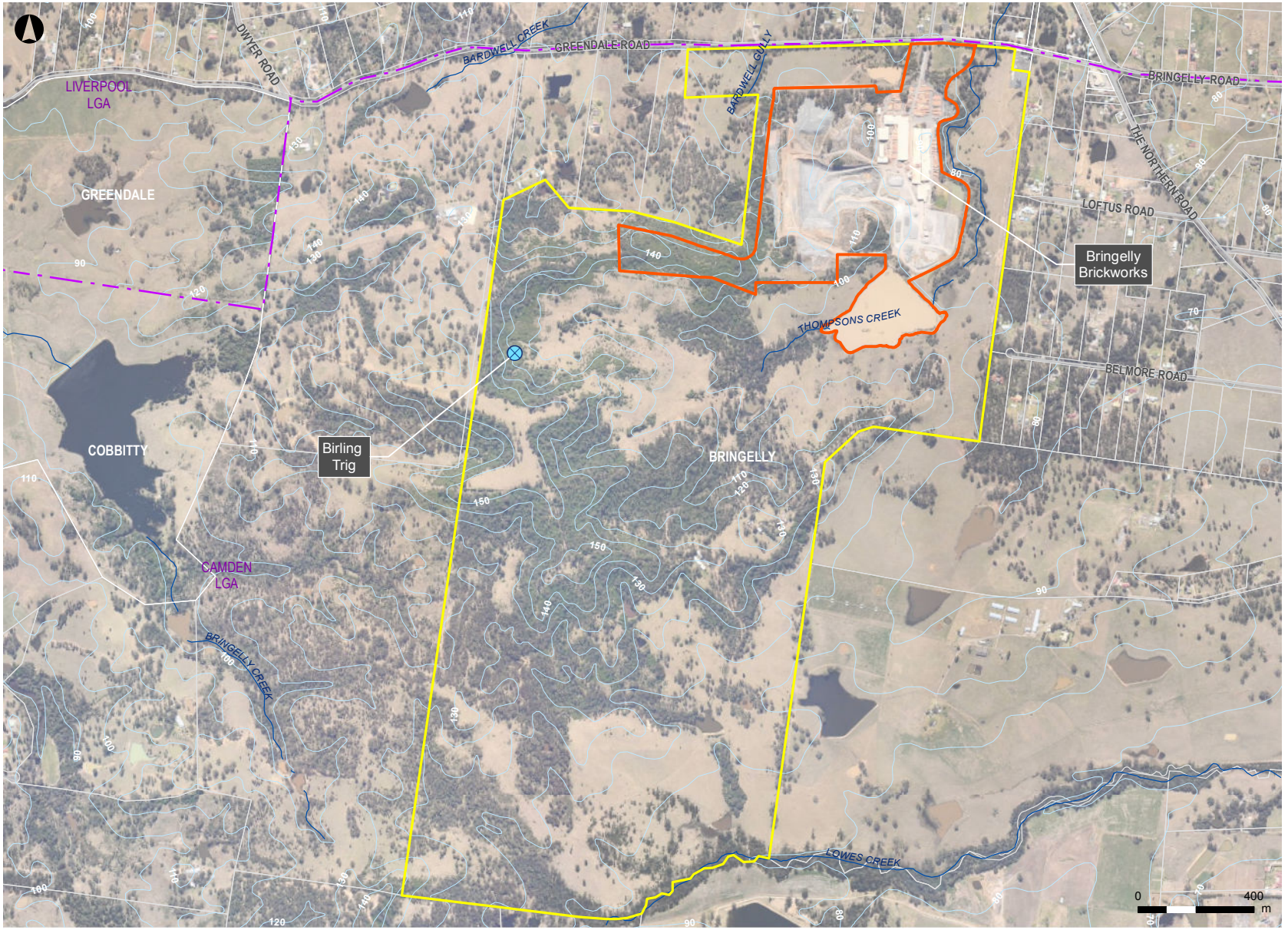
Landform

Two distinct terrain types occur in the Bringelly area. Southwest of Greendale Road, the terrain is moderately undulating to hilly, and dissected by a dense network of low order streams. Local relief is 20 metres to 40 metres, and side slopes are short (100 metres to 250 metres) with gradients of up to 27 per cent. The highest point in the district is Birling Trig (158 metres), refer to Figure 7-15.

East of Bringelly, the terrain is gently undulating and drainage densities decrease. Drainage lines with well-developed floodplains are separated by low ridges with local relief less than 20 metres and side slope lengths of 500 metres to 700 metres. Side slope gradients are less than five per cent.

The Bringelly Brickworks operational footprint is situated within the Thompsons Creek catchment at the boundary between the two terrain classes. The existing quarry operates within a prominent east-northeast oriented spur from Birling Trig. The spur has side slopes of 250 metres length to the north, with gradients of approximately 10 per cent. The existing brickworks is located close to the break of slope between the foot slope terrace of Thompsons Creek to the east of the spur.

Figure 7-15 shows the topography of the site and its surroundings.



LEGEND

- Project site
- Property boundary
- Trig station
- 10m contours
- Watercourses
- Cadastre
- LGA boundary

Map scale: 1:20,000 at A4

DATA SOURCES:
Boral, LPI,
Nearmap Imagery - 2 September 2012

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Figure 7-15: Site topography

Geological context

The Bringelly site is located within a sequence of interbedded claystone, siltstone, laminate and sandstone known as the Middle Triassic Wianamatta Group, which crops out over a wide area to the west of Sydney. The group forms the upper most part of the Permo-Triassic sequence which comprises the Sydney Basin sediments and is divided into three formations, the Bringelly Shale, Minchinbury Sandstone and Ashfield Shale. The upper unit is the Bringelly Shale, a formation dominated by claystone and siltstone with thin laminate horizons and minor sandstone. This is underlain by Minchinbury Sandstone, a three to six metres thick quartz lithic sandstone; followed by the Ashfield Shale which comprises sandstone-siltstone laminate and sideritic claystone. The Wianamatta Group is underlain by Hawkesbury Sandstone.

Site geology

Geology in the region is comprised of a mix of Triassic and Quaternary age deposits. The project site is underlain by the lower 75 metres to 150 metres of the Bringelly Shale which comprises claystone, siltstone, laminate and sandstone. The base of the sequence in this area is defined by the Cobbity Claystone, a thin (maximum six centimetres) persistent layer of weathered tuff. Alluvial sands and gravels derived from surrounding rocks are present along streams such as Thompsons Creek and Bardwell Gully.

Soils

The soil landscapes of the Penrith 1:100 000 sheet were mapped by Bannerman and Hazelton (1990). There are three different soil landscapes mapped within the area of the project site: the residual soil landscape Blacktown, the alluvial soil landscape South Creek, and the erosional soil landscape Luddenham.

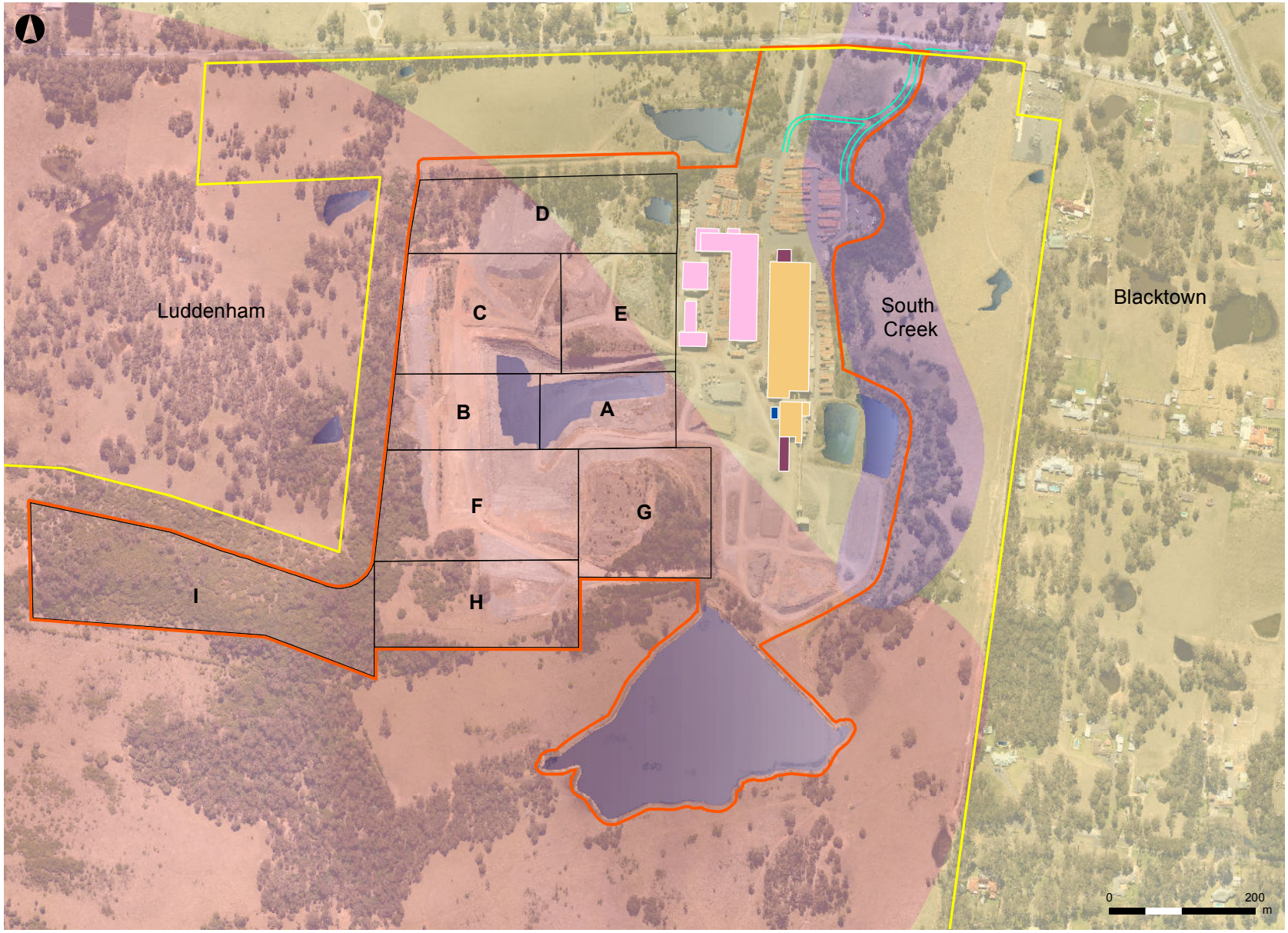
Soils generally consist of Red, Brown and Yellow Podzolic on the undulating shale hills and rises, with mainly Red and Brown Podzolic Soils on the Upper Slopes, and Yellow Podzolic soils on lower slopes. The plains include stagnant ponded areas, with mainly Yellow Podzolics on the footslopes, and Soloths on the plains. Structured Plastic Clays or Structured Loams form on the flat to gently sloping alluvial plains in and immediately adjacent to drainage lines. Red and Yellow Podzolic soils are most common on terraces with small areas of Structured Grey Clays, Leached Clay and Yellow Solodic soils (OEH, 2012).

The features and locations of each soil landscape are detailed in Table 7-17. Soil landscapes within the study area are mapped in Figure 7-16.

Table 7-17 Soil landscapes mapped in the study area (Bannerman and Hazelton 1990)

Soil landscape	Features	Location in project site
Blacktown (Residual)	Shallow to moderately deep hardsetting mottled texture contrast soils; red brown podzolic soils on crests grading to yellow podzolic soils on lower slopes and in drainage lines. Landscape is gently undulating rises on Wianamatta Group shales.	Across the northeast of the project site.

Soil landscape	Features	Location in project site
South Creek (Alluvial)	Often very deep layered sediments over bedrock or relict soils. Where pedogenesis has occurred structured plastic clays or structure loams in and immediately adjacent to drainage lines; red and yellow podzolic soils are most common on terraces with small areas of structured grey clays, leached clay and yellow solodic soils. Landscape comprises floodplains, valley flats and drainage depressions of the channels on the Cumberland Plain. Usually flat with incised channels and mainly cleared.	Along Thompsons Creek and associated riparian corridor bordering the north-eastern extent of the project site.
Luddenham (Erosional)	Shallow dark podzolic soils or massive earthy clays on crests; moderately deep red podzolic soils on upper slopes; moderately deep yellow podzolic soils and prairie soils on lower slopes and drainage lines. Landscape is undulating to rolling low hills on Wianamatta Group shales, often associated with Minchinbury Sandstone.	Across most of the west and south of the project site.



LEGEND

- Project site
- Property boundary
- Blacktown
- Luddenham
- South Creek
- Driveway realignment
- Quarry cells
- Brickmaking facility
- Brick storage facility
- Building extensions
- Water storage tanks
- Dam
- Road

Map scale: 1:8,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012
Bannerman and Hazelton 1990

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Figure 7-16: Soil types

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Created by : KC
QA by : DD

Land salinity

Salinity is known to occur in shallow soils and groundwater seepages in Western Sydney, generally associated with the Wianamatta Group shales. Salinity impacts include damage to infrastructure, vegetation dieback, erosion and waterlogging, and can be exacerbated by development or changes in surface, drainage and vegetation conditions, particularly where these are not planned for on the basis of site conditions.

The majority of the project site is classified as moderate salinity potential, with the exception of Thompsons Creek which flows in a northerly direction, adjacent to the eastern boundary of the project site and is classified as high salinity potential as shown in Figure 7-17. (DIPNR, 2003) According to Nicholson (2003) and Mitchell (2000) rivers and streams carry high salinity (EC) and high salt loads from the Upper South Creek landscape.

The project site like other soil landscapes in Western Sydney typically comprises poorly drained duplex soils, with relatively permeable loamy topsoil over a low permeability clay subsoil. As shown in Figure 7-18, soil water moves more easily through the loamy topsoil, and salt can accumulate in the sub-soil. Surface expression of salinity occurs where soil water accumulates and seeps to the surfact, and evaporation concentrates the salts; typically on lower slopes or flats. No evidence of salinity impacts was identified from an inspection of the project site.

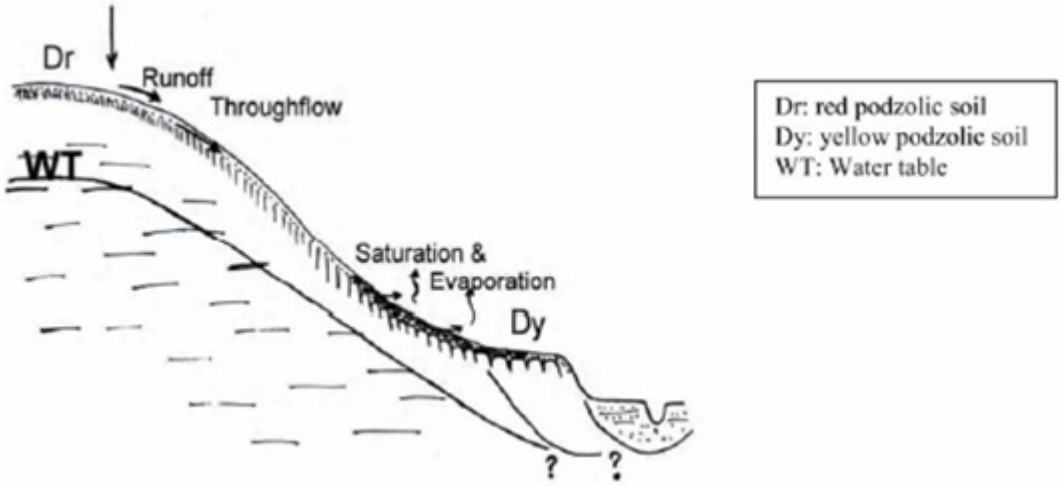

Figure 7-17 Salinity associated with shale soil landscape (Mitchell 2000)

Salinity can also arise in areas of saline groundwater discharge from deeper aquifers, Groundwater in the Bringelly Shale is typically highly saline, and this water discharges naturally along creeks and gullies. This aspect of salinity is discussed in further detail in Section 7.6.

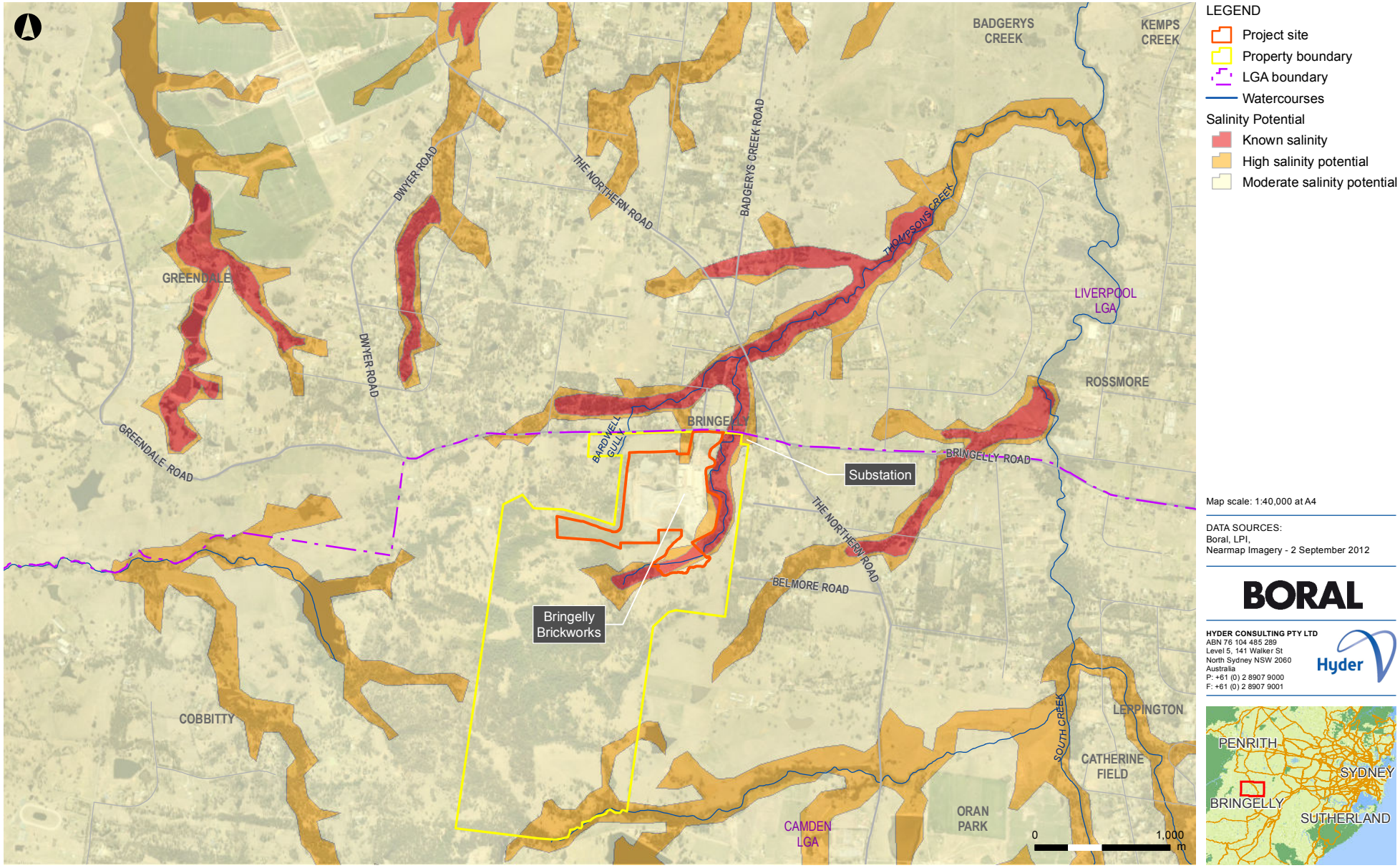

Figure 7-18: Salinity potential for the project site and surrounds

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Created by : GC
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Clay/shale resources

Considerable clay/shale resources have been identified through historic and recent core drilling logs. These shales are the primary raw materials of the brick making process and were found to extend to a depth beyond 30 metres.

Detailed investigations of the central portion of the existing quarry operations occurred in 1984 by Corkery and Co Pty Ltd with 14 diamond drill holes which provided information on the stratigraphy to a maximum depth of 37 metres below the ridges that dominate the project site. In early 1989, five cored holes were drilled by Resource Planning in the eastern and southern parts of the project site. These holes were designed to test the cream-burning potential of units below the 80 metres AHD. In late 1989, drilling was extended to the west of the existing quarry where three cored holes were sunk. In April 2013, seven cored holes were drilled to confirm clay/shale resource patterns and depth across the proposed quarry expansion area. Extensive deposits of “black”, “brown” and “red” clay were identified to the full drilling depth of 40 metres and is interspersed with sandstone rock lenses which vary in thickness between 0.5 metres and three metres.

Historical land use and contaminated land

While the majority of contaminated land is associated with industrial uses, there is the potential for historical land uses such as livestock intensive industries, to result in contamination e.g. through the use of pesticides, storage of fuel for farm machinery, etc. The project site is adjoined by grazing land to the west and south that may have involved activities with the potential to result in contaminated materials.

An investigation of the OEH Contaminated Land Records for the Camden LGA indicates that the project site has not been recorded as a contaminated land or been remediated.

Agricultural context, including land capability

The project site does not consist of any agricultural operations, and has not since the Bringelly Brickworks commenced operations in 1968. The project site consists of existing quarry pits, brickmaking facilities and storage areas. Boral owned land to the south of the Bringelly Brickworks project site, toward Thompsons Creek and the neighbouring privately owned land to the west, is currently used for grazing purposes. Some four kilometres west of the project site is the Sydney University Farms which comprises a 466 hectare beef cattle fattening enterprise with limited use by teaching and research staff.

The project site and surrounding lands are characterised by rich alluvial soils. Consequently, the surrounding area has historically been used for agricultural and grazing purposes, when settlement on the Cumberland Plain began in the 1790s. The earliest record of crown grants near the project site was to Robert Lowe in 1812. The clearing and grazing activities undertaken were largely centred on Lowes Creek to the south of the Bringelly Brickworks site. Agricultural uses were soon replaced by rapid urban development and subdivision which began in the 1980s, with much of the surrounding area now used for rural residential purposes. There will likely be a significant expansion in rural and industrial lands in future years given that the area falls within the boundary of the SWGC precinct.

Rural land capability typically consists of classes IV and VI on undulating hills, with classes III and V on the footslopes and plains. Land capability classes are used to assign land according to its suitability for landuse practices such as agriculture. Class I lands are indicative of arable lands that can support intensive agricultural production while classes V and VI are characterised by major environmental constraints.

The project site is not located within two kilometres of land marked as Strategic Agricultural Land under the Strategic Land Use Policy.

7.2.3 POTENTIAL IMPACTS

The project could have potential impacts on the soils and geology of the project site and on the downstream environment including:

- Soil erosion and sedimentation.
- Decreased water quality as a result of sediment laden runoff.
- Exposure of sodic soils to runoff.
- Removal of vegetation resulting in rising groundwater levels.
- Poor drainage.
- Interception of Acid Sulfate Soils (ASS).
- Potential disturbance of historical land contamination and future contamination through fuel storage and hydrocarbon spills.
- Potential for dust deposition and reduction of water quality for livestock grazing downstream.

Soil erosion and sedimentation

There is potential for soil erosion to arise on the project site at the quarry cells (past, present and future), the raw material and overburden stockpiles and unsealed access roads, due to the removal of topsoil materials through vegetation clearing and excavation of cells and unrestricted drainage. The most common forms of erosion tend to be gully and sheet erosion. This erosion could give rise to migration of coarse to fine sediments in surface runoff. Impacts associated with soil erosion and sedimentation on water quality are outlined in Section 7.6.

Sediment laden runoff

The stockpiling of soil materials excavated from the quarry has the potential to result in sediment laden runoff and dust if not managed appropriately. Impacts associated with soil erosion and sedimentation on water quality are outlined in Section 7.6.

Land salinity

Review of published information and previous reports together with inspection of the site indicate that existing salinity impacts are limited. There is no visible indication of salt scalds, vegetation dieback or other indicators of serious salinity effects on the project site. Potential impacts from the project on land salinity are likely to include the following:

- Waterlogging mostly due to leakage from dams or poor existing drainage.
- Increased salinity close to watercourses and drainage lines, probably reflecting discharge of deep groundwater from the Bringelly Shale.
- Exposure of susceptible soils, characterised by high salinity risk potential to catchment runoff.

Notwithstanding the above, potential for the proposed development to cause or exacerbate salinity impacts is limited. In recent months there have been no exceedances of the project site's EPL with regard to salinity discharges from Thompsons Creek (refer to Section 7.6).

Moderately to highly saline soils may be present on the project site, particularly close to drainage lines, and excavation of these could release additional salt into the environment. Construction in areas of high water tables and elevated soil salinity could result in salinity damage to roads or buildings, although the potential for such impacts is limited, since the water table at the site lies well below the base any roads or buildings on the project site (Golder Associates 2013).

Poor drainage

The project has the potential to alter natural drainage patterns as a result of quarrying, construction of haul roads and stockpile emplacement areas.

The plastic clay soil types on the project site contain high levels of water and are prone to water logging. Consequently, soils are unable to absorb large volumes of water during storm events resulting in higher levels of stormwater runoff and associated erosion and sedimentation. In the flatter areas of the project site water is likely to pond, impacting on vehicle movement and exacerbating salinisation.

Interception of acid sulphate soils

The project site is classified by the Australian Resource Information System as having an extremely low probability of ASS occurrence. Therefore it is considered unlikely that the project would result in ASS related impacts and no ASS management measures are required.

Potential mobilisation of existing contaminants and contamination through fuel storage and hydrocarbon spills

The proposed quarry expansion extends almost exclusively into wooded areas that are not used for agricultural activities. There are no historic records that suggest that contaminating activities such as livestock tick dip sites or agricultural fuel storage facilities were once located within the proposed quarry expansion footprint. No records of historical contamination within the proposed disturbance footprint, from historical agricultural activities, are recorded in the OEH Contaminated Lands Record or property records kept by Camden Council. In addition there was no evidence of historic contamination or hazardous materials within the proposed quarry expansion footprint during the site visits undertaken by the project team or through the interrogation of historical aerial photography over the past 10 years. It is therefore unlikely that contaminated land will be disturbed during the expansion of quarrying activities.

The project site is used for quarrying activities and industrial manufacturing purposes that include extensive vehicle movements, bulk earthwork machinery and the importation of raw materials, all of which have the potential to contaminate soils through fuel or hydraulic fluid leaks (hydrocarbon spillages) during the unloading of raw materials, quarry campaigns and refuelling of vehicles. Small quantities of fuels and oils are also stored on site in a bunded, roofed area. Appropriate management of this hydrocarbon storage area is required to prevent contamination of soils and stormwater runoff.

Agricultural impacts

The quarry expansion proposed as part of this project will not replace or encroach on any existing agricultural land. There is potential for impacts on the surrounding existing agricultural operations (largely grazing) through the reduction of water quality used for livestock watering.

The proposed expansion will not result in any significant impacts on downstream water users. Boral do not currently extract water from the Upper South Creek catchment and will not require a licence to meet proposed water demands to support quarry expansion works. All current and on-site water demands will be met by a combination of potable water, on-site water and water imported from industrial recycling schemes; therefore, the project will operate in accordance with the requirements of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011*.

The project could also increase potential for deposition of dust on grazing land. Mitigation measures to limit this potential impact are discussed in Sections 7.5 and 7.6 respectively.

7.2.4 MITIGATION MEASURES

The continuation and expansion of operations at the project site would be governed by management practices in the Surface Water Management Report (Appendix I) that are summarised in Section 7.6, which would be updated as appropriate to reflect the project. The Rehabilitation Strategy (Appendix D) for the project site also identifies relevant mitigation strategies relevant addressing potential impacts on land resources.

Mitigation measures proposed for the project site to ameliorate potential impacts to the soils and geology of the area are:

- Stockpiles and batter faces would be stabilised and erosion and sediment controls such as silt fencing used to ensure that impacts would be confined to distinct areas.
- Avoid/minimise exposure of saline sub-soils, wherever practicable.
- Retain vegetation and avoid disturbance in riparian zones and poorly drained areas.
- Retain and establish vegetation, where practicable in areas subject to erosion and disturbance.
- Continue to implement Pollution Reduction Program to minimise impacts associated with off-site saline discharges to Thompsons Creek.
- Temporary structural methods (including silt fencing) would be used where required to protect newly treated areas, which are generally highly susceptible to erosion.
- Bunding and batter slopes for new quarry cells would be designed to minimise the potential for erosion in accordance with the Rehabilitation Strategy and Soil and Water Management Plan for the site. This will include the implementation of clean water diversion along the western boundary of the project site and revegetation of quarry benches.
- Haul roads would be maintained for the productive life of the quarry.
- Sediment fencing would be used on site as temporary measures in the mitigation of sediment movement to down slope lands and waterways.
- Rehabilitation of the project site would be carried out in accordance with the Rehabilitation Strategy for the project site (Appendix D).
- Overburden and unusable material would be used to rehabilitate the unused pits wherever practical, such that no new stockpiles would be created.
- Water carts would be used to assist with control of dust.

7.3 NOISE

7.3.1 OVERVIEW

Audible increases in noise are likely at nearby sensitive receivers as a result of the increase in brick production, increase in brick deliveries (truck movements) and the expanded quarrying operations. Therefore, Wilkinson Murray were commissioned to undertake a Noise Assessment that addressed relevant DGRs, which included a quantitative assessment of the potential:

- Construction, operational and off-site transport noise impacts.
- Reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed.
- Monitoring and management measures, in particular real-time, attended noise monitoring and predictive meteorological forecasting.

This Section summarises the findings of the Noise Assessment, prepared by Wilkinson Murray (2013). The assessment established the existing noise sources within the study area and identified potential sensitive receptors. Predicted environmental noise impacts of the project were established and assessed in relation to relevant noise management criteria. A copy of the Noise Assessment is contained in Appendix E.

7.3.2 EXISTING NOISE ENVIRONMENT

Noise sensitive receptors

There are 36 residences surrounding the project site, and of those the following residences were identified as having the closest proximity to the Bringelly Brickworks site. A detailed noise assessment was undertaken for the nearest sensitive receivers, as outlined in Table 7-18 and identified in Figure 7-19.

Table 7-18 Nearby residential receivers

Receiver number	Receiver address
1	55 Loftus Road
2	54 Loftus Road
3	20 Greendale Road
4	9 Greendale Road
5	5 Greendale Road (Community Centre)
14	23 Greendale Road
16	29 Greendale Road
17	25 Greendale Road
19	35 Greendale Road
20	170 Tyson Road
33	107 Belmore Road
35	108 Belmore Road

Figure 7-19 Site location and surrounding noise sensitive residential receivers

Unattended noise monitoring

Environmental noise measurements were performed to quantify the existing noise environment at receptors within the vicinity of the project site. This assists with determining the applicable environmental noise criteria in accordance with the NSW Industrial Noise Policy (INP). Measurements were performed at three locations, and are also shown in Figure 7-20 above:

- 9 Greendale Road (Noise Monitoring Location 1).
- 26 Loftus Road (Noise Monitoring Location 2).
- 1037 Northern Road (Noise Monitoring Location 3).

Table 7-19 summarises the result of noise monitoring, for daytime, evening and night time periods as defined in the INP. The summary values are:

- $L_{Aeq,Period}$ – the overall L_{Aeq} noise level measured over the assessment period. The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
- RBL – Rating Background Level is a measure of typical background noise levels which are used in determining noise criteria.

In addition a shoulder period RBL for the period between 6 and 7am was calculated to reflect the operational period of the last hour of the night period.

Table 7-19 Summary of measured levels

Location	RBL (dBA)				$L_{Aeqr,Period}$ (dBA)			
	Daytime 7am-6pm	Evening 6pm-10pm	Night time 10pm-7am	Shoulder period 6am-7am	Daytime 7am-6pm	Evening 6pm-10pm	Night time 10pm-7am	Shoulder period 6am-7am
1	41	40	37	42	57	49	46	53
2	41	41	38	45	51	50	48	53
3	39	43	38	42	49	48	45	45

The assessment noted that the background RBL noise levels at the three locations were typically consistent around the site.

Attended noise monitoring

To provide further perspective on the noise levels at various locations around the facility for daytime and night time periods, attended noise measurements were conducted to measure noise emissions from the existing brickmaking facility. This data was used in validation of the noise model for the existing day and night time operations.

Table 7-20 Attended noise measurement of site noise

Measurement location	Measurement address	Site operations	Time	Measurement contribution from site (dBA)	Remarks
6	46 Loftus Road	Production and clay preparation plant operating.	15:00-15:15	33-35	Distant traffic 40 dBA
34 and 35	96 and 108 Belmore Rd	Production and clay preparation plant operating.	00:00-00:15	35	36 dBA when environment quietest (site audible)
6	46 Loftus Road	Production and clay preparation plant operating (incl. front end loader).	00:45-1:00	42	43–45dBA when front end loader throttling
4	9 Greendale Road	Production and clay preparation plant operating (incl. front end loader).	01:15-01:30	37	Production building noise 37–39 dBA.
6	46 Loftus Road	Production and clay preparation plant operating (incl. front end loader). Incl. quarry operations.	11:20-11:35	44	Dozer engine and ripping 44–46 dBA. Truck dumping 48 dBA, audible for 30-60 sec.

7.3.3 ENVIRONMENTAL NOISE CRITERIA

Existing noise limit conditions

Existing noise limits for the Bringelly Brickworks are set by the conditions of the Camden Council DA3500/060/00 and the EPA Environment Protection Licence (EPL) Conditions – Licence Number 1808.

In addition, the provisions of the INP also apply. The INP provides the relevant guidance in relation to acceptable noise limits for the proposed operations.

Further discussion on the relevance of these conditions and the INP is contained in Appendix E.

Industrial Noise Criteria

The INP recommends two criteria, intrusiveness and amenity, both of which are relevant for the assessment of noise. In most situations, one of these is more stringent than the other, and becomes the dominate noise criteria. The criteria are based on the L_{Aeq} descriptor. For sources such as the fixed plant associated with the facilities, appropriate noise criteria are specified in the INP. The criterion depends on whether existing noise levels in an area are close to recommended amenity levels for different types of residential receiver areas (i.e. urban, rural, near existing roads).

The amenity criteria are determined by which particular characterisation surrounding residences become classified. The potentially affected residences near the Bringelly facility are in an area which would be classified as 'rural' and the relevant recommended 'acceptable' amenity criteria for $L_{Aeq,period}$ are 50, 45 and 40 decibels for daytime, evening and night time periods respectively. Maximum recommended levels are also part of the criteria and are all five decibels higher than the acceptable levels.

Table 7-21 below outlines the relevant industrial noise criteria for this project based on a rural area classification. Noise criteria for all receivers are based on the existing background measurement at Noise Monitoring Location 3 as these measurements are not influenced by noise from the Brickworks site and are considered the most conservative.

Table 7-21 Industrial noise intrusiveness and amenity criteria

Receiver area	Time period	RBL (dBA)	Intrusiveness criterion $L_{Aeq,15min}$ (dBA)	Amenity criterion $L_{Aeq,period}$ (dBA)
Boundary of nearest residential receivers	Daytime (7am–6pm)	39	44	50
	Evening (6pm–10pm)	43*	44	45
	Night time (10pm–7am)	38	43	40
	Shoulder period (6 am – 7am)	42	47	n/a

*The EPA recommend where the evening RBL is above the daytime RBL, the daytime RBL should be taken to develop the intrusive noise criteria.

For day and evening, the intrusive noise levels are below the amenity criteria. Therefore, the project specific noise levels for the day and evening are the intrusive noise criteria.

With regard to night time, the intrusive criterion is higher than the amenity criterion. From site noise measurements and as this site is the only industrial noise source around the area it was estimated that typically a minimum three decibels difference would exist between intrusive noise levels ($L_{Aeq,15minutes}$) and amenity noise levels ($L_{Aeq,period}$). Therefore if the intrusive noise criterion for night time is met this would mean that the amenity criterion is met. As such, the intrusive noise criterion for night time can be used as the night time project specific noise level.

Road traffic noise criteria

Criteria for the assessment of road traffic noise is set out in the NSW Government's *NSW Road Noise Policy* (RNP). It is noted that the haulage route for the project is along Greendale Road and then The Northern Road. The Northern Road is a main arterial road where additional project traffic would not be discernible. Greendale Road is classified as a local road and as such the project traffic noise assessment has focussed on this road.

The traffic noise level criteria for residential receivers is as follows:

- $L_{Aeq,1hr}$ day – 55 decibels.
- $L_{Aeq,1hr}$ night – 50 decibels.

In addition, the RNP recommends a maximum internal level of $L_{Aeq,\ 1hr}$ 40 decibels for schools when in use. There are no specific criteria for community centres; however, the usage would be similar to a classroom as discussions and lectures could take place. Therefore, it would seem appropriate that the same criteria be used as a school. Internal noise levels are generally 10

decibels below external noise levels with windows open to a normal extent. The RNP would therefore imply a recommended external noise level criteria of $L_{Aeq,\ 1hr}$ 50 decibels (no façade reflection) at the school and community centre.

Where existing traffic noise levels are above the noise assessment criteria the RNP states the following regarding permissible increases in road traffic noise from a land use development:

In assessing feasible and reasonable mitigation measures, an increase of up to two decibels represents a minor impact that is considered barely perceptible to the average person.

and

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to two decibels above that of the corresponding 'no build option'.

Construction noise criteria

The NSW EPA released the "Interim Construction Noise Guideline" (ICNG) in July 2009 which provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the $L_{Aeq,\ 15min}$ noise level should not exceed the background noise by more than 10 decibels. This is for standard hours: Monday to Friday, 7am to 6pm and Saturday, 8am to 1pm. Outside the standard hours, the criterion would be background plus five decibels.

Table 7-22 presents the applicable noise management levels for construction activities at surrounding receivers.

Table 7-22 Site specific construction noise management levels

Location	Construction Noise Management Level, L_{Aeq},15min – dBA			Maximum Construction Noise Level, L_{Aeq},15min – dBA
	Day	Evening	Night	
Residences	49	49**	43	75
All commercial properties		70		
Schools/preschools		55*		
Parks/outdoor play areas		65		

*The external noise goal of 55dBA is based on a 10 dB reduction through an open window.
** Based on Daytime RBL

Sleep disturbance criteria

Intermittent noises due to activities such as reversing alarms during the night time period are not directly addressed by the INP. In order to minimise the risk of sleep disturbance from the operations during night time operation, the EPA recommends that sleep disturbance is assessed independently from general operational noise levels at sensitive receptors.

Appropriate screening criteria for sleep disturbance are determined to be an $L_{A1,1min}$ level 15 decibels above the RBL for the night time period. The L_{A1} level is the noise level which is exceeded for one per cent of the sample period. During the sample period, the noise level is below the L_{A1} level for 99 per cent of the time. Based on noise logging, a night period RBL of 38

decibels has been established therefore resulting in a sleep disturbance criterion of 53 decibels at nearby residences.

7.3.4 METEOROLOGY

Wind can increase noise at a receiver when it blows from the direction of the noise source. An increase in wind strength results in a corresponding increase in wind noise at the receiver which masks noise from the source under investigation.

The affectation of noise due to wind should be considered when wind is a feature of the area under consideration. The INP defines this as where wind blows at speeds up to three metres per second for more than 30 per cent of the time in any season.

Twelve month weather data for the year 2011 was obtained for the OEH meteorological station located at Bringelly. This data was analysed to determine the frequency of occurrence of seasonal winds up to speeds of three metres per second for the daytime, evening and night periods and it was determined that a two metres per second SSW wind is applicable at this site for daytime periods.

Similarly, temperature inversions can increase noise levels at surrounding receivers by the reflection of sound waves from warmer upper layers of air. Temperature inversions occur predominantly at night. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30 per cent of the total night-time period during a season, typically winter.

Given temperature inversions are common in the area (predicted to occur approximately 33.9 per cent of the total night-time period during a season) the noise assessment has been undertaken factoring in night time temperature inversion.

Further detail on the association between noise assessments and meteorology are provided in the Noise Assessment report in Appendix E.

7.3.5 OPERATIONAL NOISE

Methodology

Noise modelling was conducted for the proposed changes to the future operation of the site. The existing brickmaking facility has been previously modelled and validated in previous assessments of the site by Wilkinson Murray. This model has been amended to reflect the current project and then used for assessment purposes.

Site related noise emissions were modelled using CONCAWE noise model implemented in the Cadna A acoustic noise prediction software. Factors that are addressed in the modelling are:

- Equipment sound level emissions and location.
- Screening effects from buildings.
- Receiver locations.
- Ground topography.
- Noise attenuation due to geometric spreading.
- Directivity.
- Ground absorption.
- Atmospheric absorption.

Noise levels for both calm and adverse meteorological conditions that increase the propagation of noise are presented for both untreated and treated operations.

Noise sources

Noise radiated from the crusher, grinder and main production buildings was based on internally measured noise levels and the attenuation through building enclosures (e.g. Spandek Steel Sheeting). The internal noise level measured within the crusher building was between 90 decibels (northern end of the building) and 100 decibels (southern end of the building) as a reverberant noise level. The internal noise level measured at the main production building was 79 decibels as a reverberant noise level. A summary of the sound power levels of the plant at the existing Bringelly brickmaking facility are recorded below.

Table 7-23 Sound power levels of the Bringelly plant

Item of plant	Number of plant	Sound power level – dBA
Brickmaking facility operations		
Production building roof	-	97
Production building walls	-	82 to 89
Box feeder	-	94
Primary crusher	-	94
Crusher building roof (east)	-	94
Crusher building roof (west)	-	79
Crusher building walls	-	73-95
Kiln exhaust fan	-	102
Kiln exhaust stack	-	78
10 tonne forklift	1	99
3.5 tonne forklift	4	99
Truck engine	-	105 engine 97 exhaust
Front end loader	1	106
Extraction at quarry pit		
Grader	1	102
Dozer D8	1	111
Dozer Kamatzu 475	1	106
Excavator	1	102
Dump truck (40t) – full	3	10
Dump truck (40t) – empty	3	97

Processing/manufacturing noise assessment

Various noise modelling scenarios were conducted, representing future year round operations of the brickmaking facility outside of campaigns. The following modelling scenarios have been undertaken:

- Daytime – typical operations.
- Evening – typical operations.
- Night time – typical operations.
- Shoulder period – typical operations.

The time periods under consideration are a “worst case” 15 minute period for proposed hours of operation.

Noise modelling results

Table 7-24 identifies the untreated noise levels associated with the processing and manufacturing noise assessment. Exceedances of project specific criteria are presented in red.

Table 7-24 Predicted noise levels untreated plant $L_{eq, 15min}$

Receiver number	Period	Day		Evening		Night 10pm-7am		Shoulder period 6am-7am	
	Criterion	44		44		43		47	
	Receiver	Calm	SSW Wind	Calm	Temperature inversion	Calm	Temperature inversion	Calm	Temperature inversion
1	55 Loftus Road	45	46	44	47	44	47	44	47
2	54 Loftus Road	44	46	43	46	43	46	43	46
3	20 Greendale Road	43	46	40	44	40	44	40	44
4	9 Greendale Road	48	50	43	45	43	45	43	45
5*	5 Greendale Road (Bringelly Community Centre)	41	44	38	41	38	41	38	41
14	23 Greendale Road	53	54	48	48	48	48	48	48
15	27 Greendale Road	39	40	35	38	35	38	35	38
16	29 Greendale Road	37	39	35	38	35	38	35	38
17	25 Greendale Road	42	44	37	40	37	40	37	40
19	35 Greendale Road	30	30	29	33	29	33	29	33
20	170 Tyson Road	30	29	29	33	29	33	29	33
33	107 Belmore Road	37	34	36	40	36	40	36	40
35	108 Belmore Road	40	37	40	44	40	44	40	44

* A noise objective of 50 dBA has been established for this receiver based on achieving an internal level of 40 dBA (windows open)

Generally, all receivers that experience noise levels that exceed the site specific noise criteria can be separated into three noise exceedance categories, namely:

- 0-2 decibels: minor exceedances, (residences 3 and 35).
- 3-5 decibels: marginal exceedances, (residences 1 and 2).
- >5 decibels: significant exceedances, (residences 4 and 14).

The following observations are presented:

- For typical daytime, evening and night operations, residential receivers to the north near the site entrance and to the east exceed the recommended noise criterion of 44 decibels $L_{Aeq,15minutes}$.
- For typical shoulder period operations with extraction, residential receivers to the north near the entrance marginally exceed the recommended noise criterion of 47 decibels $L_{Aeq,15minutes}$.

Proposed mitigation measures

In cases where the criteria set out in Table 7-21 are exceeded, the INP sets out a range of responses, including:

- Application of 'feasible and reasonable' mitigation measures to reduce noise levels.
- Negotiation with relevant government bodies and/or the affected community to determine reasonable levels based on the extent of any residual impacts and other factors such as social and economic benefits derived from the noise source.
- In extreme cases, acquisition of affected properties. Recent Department of Planning and Infrastructure (DP&I) approaches for major projects suggest acquisition of properties where the operational noise level, under meteorological conditions as previously defined, exceeds the RBL by more than 10 decibels. None of the predicted noise levels in Table 7-24 exceed the criteria by more than 10 decibels and therefore acquisition is not being considered for this project.

Based on the predicted exceedances of the noise criteria at receivers, the consideration of reasonable and feasible mitigations measures is considered appropriate.

The basic framework for mitigation was such that there is minimal or no disruption to the proposed operations of the plant. This means that the following components were constrained:

- Number of truck movements.
- Number of active plant.
- Hours of operation.

The largest contributors to plant noise have been targeted to most efficiently mitigate the potential noise impacts on surrounding residences.

A summary of the 'reasonable and feasible' noise mitigation measures required to achieve compliance with site specific INP noise criteria for brick production and product distribution are:

- Acoustically insulate crusher and box feeder walls and roofs.
- Relocate driveway and install a 200 metre long 4.5 metre high noise bund along Greendale Road.
- Treat/mitigate front end loader (maximum sound power level of 102 decibels).

The site has been modelled with the above mitigation measures and the results indicate that compliance with the established noise criteria under all conditions can be achieved. Table 7-25 below identifies the mitigated noise levels associated with the processing and manufacturing noise assessment.

Table 7-25 Predicted noise levels for the proposed operations after mitigation

Receiver number	Period	Day		Evening		Night 10pm-7am		Shoulder period 6am-7am	
	Criterion	44		44		43		47	
	Receiver	Calm	SSW Wind	Calm	Temperature inversion	Calm	Temperature inversion	Calm	Temperature inversion
1	55 Loftus Road	41	41	39	43	39	43	39	43
2	54 Loftus Road	42	42	39	42	39	42	39	42
3	20 Greendale Road	43	44	37	40	37	40	37	40
4	9 Greendale Road	43	44	30	34	30	34	30	34
5*	5 Greendale Road (Bringelly Community Centre)	47	49	33	36	33	36	33	36
14	23 Greendale Road	42	43	27	31	27	31	27	31
15	27 Greendale Road	38	39	30	34	30	34	30	34
16	29 Greendale Road	36	38	31	35	31	35	31	35
17	25 Greendale Road	40	41	31	34	31	35	31	35
19	35 Greendale Road	28	27	25	30	25	30	25	30
20	170 Tyson Road	27	25	25	29	25	29	25	29
33	107 Belmore Road	33	29	32	35	32	35	32	35
35	108 Belmore Road	37	33	35	38	35	38	35	38

* A noise objective of 50 dBA has been established for this receiver based on achieving an internal level of 40 dBA (windows open)

Quarrying activities noise assessment

The noise modelling for each extraction stage has been modelled with the following equipment and assumptions, representing the worst case scenario (both quarry and brickworks operating at maximum production at the same time):

- Production, forklifts and FEL being the normal operation of the production facility.
- Transportation (4 truck 15-min period).
- Dozer in cell.
- Truck in cell.
- Excavator in cell.
- Truck tipping in stockpile area.
- Trucks operating between cells and stockpile area.
- Dozer in stockpile area operating 50 per cent of the time.
- Quarrying of the hill in cell G starting from the western side so that the hill shields noise of the excavator and bulldozers from eastern residences.

The campaigns will occur during shoulder and day periods. Based on proceeding modelling it has been determined that the most stringent period is during the day period when site specific noise criteria for these two periods is the lowest. Therefore, each campaign scenario has assessed under the following meteorological conditions:

- Daytime calm conditions - Air temperature 200°C, 70 per cent relative humidity (RH), no wind, D class stability.
- Daytime prevailing wind condition - Air temperature 200°C, 70 per cent relative humidity (RH), two metres per second wind from SSW, D class stability.

A reasonable and feasible review of noise bunds to mitigate quarrying noise has been investigated by Wilkinson Murray in conjunction with Boral. This review has confirmed a 4.5 metre high noise bund on the northern end of cell D will mitigate noise levels at receivers on the northern side of Greendale Road. The 4.5 metre high noise bund on the northern end of cell D will be constructed prior to excavation commencing in cell D.

Noise modelling results

Table 7-26 identifies the noise levels associated with the quarrying activities. Exceedances of project specific criteria are presented in red. As quarrying campaigns will only occur during daytime and shoulder periods, the most stringent daytime criteria has been applied across all the quarrying scenarios.

Table 7-26 Predicted noise levels for the Proposed Quarrying Campaign Operations, dBA

Receiver number	Quarrying Scenario	1		2		3 (excavation in cell I)		3 (excavation in cell G)	
	Cells	A, B & C		D, E & F		G, H & I		G, H & I	
	Receiver	Calm	SSW Wind	Calm	SSW Wind	Calm	SSW Wind	Calm	SSW Wind
1	55 Loftus Road	44	47	44	47	44	47	44	47
2	54 Loftus Road	44	46	44	46	44	46	44	47
3	20 Greendale Road	44	46	44	46	44	46	44	46
4	9 Greendale Road	44	46	44	46	44	47	44	45
5 *	5 Greendale Road (Bringelly Community Centre) *	46	49	46	49	46	49	46	49
14	23 Greendale Road	42	44	43	46	43	46	42	44
15	27 Greendale Road	38	40	42	45	42	45	39	42
16	29 Greendale Road	37	40	41	44	41	44	28	42
17	25 Greendale Road	40	42	42	45	42	45	40	43
19	35 Greendale Road	30	31	33	34	33	34	32	35
20	170 Tyson Road	36	35	37	35	37	35	37	35
33	107 Belmore Road	36	35	37	35	37	35	37	35
35	108 Belmore Road	42	39	42	39	42	39	42	40

* A noise objective of 50 dBA has been established for this receiver based on achieving an internal level of 40 dBA (windows open)

The above noise predictions in Table 7-26 show compliance with the established noise objectives under calm conditions.

Under SSW wind conditions, exceedances of up to three decibels are predicted at residences to the east and north of the project site. Generally, all receivers that experience noise levels that exceed the site specific noise criteria can be separated into three noise exceedance categories, namely:

- 0-2 decibels – minor exceedances; Residences 2, 3, 4, 14, 15 and 17).
- 3-5 decibels – marginal exceedances; Residence 1.
- >5 decibcels – significant exceedances; no residences.

Proposed mitigation measures

The raising of the noise bund along the eastern boundary of the raw material stockpile area along with some of the treatment of the dozer working the stockpile area was investigated; however, these noise mitigation/attenuation measures did not result a significant noise reduction that would be considered reasonable and feasible. In order to manage the possibility of noise exceedances, Boral will develop and implement a noise management plan for the site. The noise management plan would be informed by a noise audit during a quarrying campaign. This would include a thorough review of metrological conditions, including SSW winds and validation of noise predictions to develop effective noise mitigation. It should also be noted that the predicted marginal exceedances will only be experienced while quarrying works are taking place on the hill in cell G, will be of short duration (approximately one quarrying campaign), and only occur during daytime hours.

7.3.6 ROAD TRAFFIC NOISE

Methodology

A Traffic Impact Assessment for the Project has been prepared by Hyder Consulting (2013). Results from that assessment were used to estimate the potential for road traffic noise impacts. As Greendale Road is considered a local road, the noise assessment needs to be conducted for the period where the highest hourly traffic noise levels occur during day and night. The highest hourly traffic noise levels on Greendale Road would occur between 6am and 7am (night-time) and 8am and 9am (daytime).

There would be a total of 176 truck movements daily (an increase of 98 heavy vehicle movements per day). Net increase for peak inbound and outbound would, at a maximum, result in 10 additional movements during the day and eight additional movements between 6am to 7am (night). Based on this, the proposed maximum hourly number of trucks that would be dispatched and received at the facility has been modelled using 39 movements during the day, 26 movements at night. Tcontahe noise generated by these truck movements along Greendale Road has been assessed with respect to the $L_{Aeq,1\ hr}$ hourly traffic noise level, using the Calculation of Road Traffic Noise (CoRTN) traffic noise prediction technique.

Noise modelling results

Due to the relocation of the entrance of the project site, the property at 10 Greendale Road will be the only potentially affected residential receiver. Current and future peak hour traffic noise levels have been calculated at 10 Greendale Road, Bringelly Public School and Bringelly Community Centre and are presented in Table 7-27.

Table 7-27 Calculated traffic noise levels along Greendale Road

Location	Day time (8am-9am)		Night time (6am-7am)	
	Existing	Future	Existing	Future
	$L_{Aeq,1hr}$ (dBA)	$L_{Aeq,1hr}$ (dBA)	$L_{Aeq,1hr}$ (dBA)	$L_{Aeq,1hr}$ (dBA)
10 Greendale Road	54.1	54.9	53	53.8
Bringelly Public School	57.5	58.3	Not operational during this time	
Bringelly Community Centre	56	56.9		

Peak hour day traffic noise levels of 54.1 decibels (existing) and 54.9 decibels (future) have been predicted at the facade of the most potentially affected residence, being 10 Greendale Road. It is noted that compliance with the RNP objective is indicated. The existing traffic noise levels for Bringelly Public School, Bringelly Community Centre and 10 Greendale Road at night (6am to 7am) are above the RNP objective. Therefore, the RNP recommends that any increase in traffic noise levels at residential and sensitive receivers due to the proposed development should not exceed two decibels. Review of Table 7-27 shows that increases in road traffic noise levels along the Greendale Road are less than two decibels and therefore comply with the relevant RNP criteria.

Mitigation measures

Road traffic noise levels have been predicted and assessed in accordance the RNP with compliance being shown.

7.3.7 SLEEP DISTURBANCE

Methodology

Night time activities that would result in noise sources which have the potential to result in sleep disturbance include reversing alarms and engine noise from forklifts and front end loaders. Table 7-28 outlines typical maximum sound power levels for these machines.

Table 7-28 Typical maximum sound power levels

Noise source	Sound power level (dBA)
Front end loader engine	106
Forklift	99
Reversing alarm	105 – 115*

*The upper level is for a standard beeper reversing alarm. The lower noise level is for a broadband type reversing alarm

Resultant noise levels at the closest residences were predicted based on the operation of reversing alarms being the loudest noise source on site.

Noise modelling results

Activities that could cause maximum noise levels leading to potential sleep disturbance are likely to be reversing alarms and engine noise from forklifts and front end loaders. As previously outlined, reversing alarms are expected to be the loudest noise source on site during night time hours. Based on the noise assessment undertaken, the predicted maximum noise levels for the night ‘worst case’ standard beeper type reversing alarm, will comply with sleep disturbance noise criteria. It should be noted that front end loaders are currently fitted with a broadband alarm and the forklifts have standard beeper alarms. Predicted noise levels are presented in Table 7-29.

Table 7-29 Predicted maximum noise levels at residences – dBA

Receiver Location		Predicted L_{Amax} noise level (dBA)		Sleep disturbance screening criterion (dBA)	Compliance with screening criterion
		Calm conditions	Temperature inversion		
1	55 Loftus Road	47	51	53	Yes
2	54 Loftus Road	47	51	53	Yes
3	23 Greendale Road	38	41	53	Yes
4	9 Greendale Road	40	43	53	Yes
6	46 Loftus Road	45	50	53	Yes

Mitigation measures

Whilst compliance with criteria is indicated, forklifts fitted with standard beeper alarms will be replaced with broadband alarms on decommissioning of the old plant equipment. This measure is recommended as best practice noise management.

7.3.8 CONSTRUCTION NOISE

Methodology

Two typical “worst case” construction noise scenarios were selected for noise modelling during the construction. These included the following activities, which are further detailed in Appendix E:

- Scenario A - Road realignment works and roadside noise bund construction.
- Scenario B - Northern Bund construction.

Noise levels associated with construction equipment and associated maximum noise levels of the plant likely to be used during various stages of the construction works were measured at other similar construction sites, and typical noise levels are detailed in Appendix E.

These noise levels were utilised in predicting noise levels at nearby receivers (noise modelling). For noise modelling purposes construction equipment was assumed to be located randomly across the relevant sections of the proposed construction site, representing typical locations during the relevant construction period. Although exact equipment locations may vary from day to day, this variation will not have a significant impact on noise levels at relevant receivers.

Site related noise emissions were modelled using the CONCAWE algorithms implemented in the Cadna A acoustic noise prediction software. Factors that are addressed in the modelling are:

- Equipment sound level emissions and location.
- Screening effects from buildings.
- Receiver locations.
- Ground topography.
- Noise attenuation due to geometric spreading.
- Ground absorption.
- Atmospheric absorption.

Computation of noise emission was carried out based on calm meteorological conditions which is consistent with normal practice for construction noise assessment. The following were sources that were modelled for the assessment:

- Line noise source – Truck haulage or road routes are modelled as line noise sources.
- Point noise source – Individual equipment that is located in one place or which has particular characteristics (concrete pumps) is modelled as a point source.

The modelling assumes a 'typical worst case' scenario whereby all the plant is running continuously. As such, the modelling represents likely noise levels that would occur during intensive periods of construction. Therefore, the presented noise levels can be considered in the upper range of noise levels that can be expected at surrounding receivers when the various construction scenarios occur.

Once noise sources have been applied to the model, the resultant noise levels at identified surrounding receivers are predicted. These results are then compared with established site specific noise objectives.

Construction noise results

A review of the results indicates compliance with normal EPA management levels at the residences with the exception of residences immediately to the north of the site under scenario A. An exceedance of up to 17 decibels is predicted. This exceedance is not a-typical by construction standards where residences are in close proximity to construction activities. It is noted that if the northern roadside bund is constructed prior to road works, the period of higher construction noise levels will be minimised. Therefore, where practicable, the northern bund should be constructed prior to the new access road. Additionally, construction of the new access road is proposed to be completed within eight weeks; therefore, the duration of exceedances would be minimal.

A review of the results indicates that compliance is indicated with normal EPA construction noise objectives at the residences for construction scenario B.

Mitigation measures

In the case of construction it has been determined that general compliance with noise management levels will be achieved at the majority of residences surrounding the site. The exception is residences to the north of the entrance when an exceedance of up to 17 decibels is predicted when the new Northern roadside bund is constructed.

In order to minimise and construction noise impacts, it is recommended that the following "best practice" construction noise mitigation measures are implemented:

- Noise sensitive sites – The quietest available plant and equipment that can economically undertake the work required should be selected. Mobile plant such as excavators, front-end loaders and other diesel-engined equipment should be fitted with residential class mufflers and other silencing equipment, as applicable.
- Plant noise audit – Noise emission levels of all critical items of mobile plant and equipment should be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service.
- Operator instruction – Operators should be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission.
- Site noise planning – Where practical, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels.

- Community liaison – An effective community relations programme should be put in place to keep the community that has been identified as being potentially affected appraised of progress of the works, and to forewarn potentially affected groups (e.g. by letterbox drop, meetings with community groups, etc.) of any anticipated changes in noise emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms. Close liaison should be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints, should they occur.
- Environmental management plan – Management of noise should be included in the construction environmental management plan.

7.3.9 SUMMARY OF MITIGATION MEASURES

Table 7-30 below summarises the mitigation measures proposed to ameliorate noise impacts from the proposed operational, quarrying and construction activities.

Table 7-30 Summary of noise mitigation measures

Noise activity/ assessment	Recommended noise mitigation
Processing/ manufacturing	Acoustically insulate crusher and box feeder buildings to ensure compliance with the INP criterion.
	Relocate driveway and install a 200 m long 4.5 m high noise bund along Greendale Road.
	Treat/mitigate front end loader (maximum sound power level of 102 decibels).
Quarrying	A noise management plan will be developed and implemented for the site. The noise management plan would be informed by a noise audit undertaken during a quarrying campaign. This would include a thorough review of meteorological conditions, including SSW winds and validation of noise predictions to develop effective noise mitigation.
	A 4.5 m noise bund is constructed on the northern end of Cell D prior to excavation in this cell.
	Quarrying of the hill in Cell G should start from the western side so that the hill shields noise of the excavator and bulldozers from eastern residences.
Sleep disturbance	Forklifts fitted with standard beeper alarms will be replaced with broadband alarms on decommissioning of the old plant equipment.
Construction	Noise sensitive sites – The quietest available plant and equipment that can economically undertake the work required should be selected. Mobile plant such as excavators, front-end loaders and other diesel-engined equipment should be fitted with residential class mufflers and other silencing equipment, as applicable.
	Plant noise audit – Noise emission levels of all critical items of mobile plant and equipment should be fitted with residential class mufflers and other silencing equipment, as applicable.
	Operator instruction – Operators should be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission.

Noise activity/ assessment	Recommended noise mitigation
	Site noise planning – Where practical, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels.
	Community liaison – An effective community relations programme should be put in place to keep the community that has been identified as being potentially affected appraised of progress of the works, and to forewarn potentially affected groups (e.g. by letterbox drop, meetings with community groups, etc.) of any anticipated changes in noise emissions prior to critical stages of the works, and to explain compliant procedures and response mechanisms. Close liaison should be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities and to ensure prompt response to complaints, should they occur.
	Environmental management plan – Management of noise should be included in the Construction Environmental Management Plan.

7.4 TRAFFIC AND TRANSPORT

7.4.1 OVERVIEW

The project has the potential to impact traffic conditions on Greendale Road and intersection performance at the Greendale Road/The Northern Road intersection as a result of an increase in trucks delivering bricks manufactured at the Bringelly brickmaking facility. Hyder Consulting were commissioned to undertake a Traffic Impact Assessment in order to address the DGRs associated with potential traffic and transport impacts, including:

- Accurate predictions of the road traffic generated by the construction and operation of the project.
- An assessment of potential impacts on the safety and efficiency of the road network.
- A detailed description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road networks in the surrounding area over the life of the project.

This section summarises the Traffic Impact Assessment prepared (Hyder Consulting 2013). The full report is included in Appendix F of this EIS.

7.4.2 EXISTING ENVIRONMENT

Existing road network

The Northern Road is an arterial road linking Narellan in the south with Richmond in the north, passing through Penrith LGA. It is generally an undivided, two-lane road (both directions) with asphalt pavement (Figure 7-20). In the vicinity of Greendale Road, the speed limit on The Northern Road is 80 kilometres per hour.

The Bringelly Brickworks site is accessed via Greendale Road. Greendale Road is a two-way sealed rural road running westward from The Northern Road up to the Sydney University Farms where the alignment then shifts northward towards Penrith (Figure 7-21). It was constructed in

1998 and comprises a full depth asphalt pavement design that is 230 mm thick, with a 20 years design life. Bringelly Public School is located at the northwest corner of The Northern Road and Greendale Road intersection. There is a 40 kilometres per hour school zone during the prescribed hours along Greendale Road. Beyond the school zone, Greendale Road has a speed limit of 60 kilometres per hour, up to 350 metres west of the Brickworks access road where the speed limit increases to 80 kilometres per hour.

Medway Road is a local road off Greendale Road, directly opposite the existing access road to the Bringelly Brickworks site. It is a two-way road that is signposted as a “No Through Road” that provides access to some low density residential properties (Figure 7-22). It has a posted speed limit of 50 kilometres per hour.

Figure 7-20 The Northern Road, view north from southwest corner of intersection with Greendale Road

Figure 7-21 Greendale Road, view west from southwest corner of intersection with The Northern Road

Figure 7-22 Medway Road, view looking north from the intersection with Greendale Road

Existing traffic flows

Traffic counts conducted for the NSW Roads and Maritime Services (RMS) indicate that The Northern Road at Greendale Road carries approximately 14,000 vehicles per day, of which six per cent are heavy vehicles. During morning peak hour (7–8am) flows are 689 vehicles. During evening peak hour (4–5pm) flows are 779 vehicles (SKM 2012).

Traffic surveys indicate that Greendale Road carries approximately 1500 vehicles per day. The average weekday morning peak hour (8–9am) volume is 103 vehicles per hour, with an eastbound peak direction. The average weekday evening peak (4–5pm) is 130 vehicles per hour, with a westbound peak direction. Additional information on traffic flow volumes is provided in the Traffic Impact Assessment in Appendix F.

Existing intersection performance

The performance of the road network is largely dependent on the operating performance of key intersections that serve as critical capacity control points on the road network. The Level of Service (LoS) criteria for evaluating the operational performance of intersections are provided by the *Guide to Traffic Generating Developments, Version 2.2,* (RMS October 2002) and are detailed in Table 7-31. More information about the LoS criteria is provided in Appendix F.

Table 7-31 Level of Service (LoS) criteria for intersection performance

LoS	Average delay per vehicle (sec/veh)	Type of intersection	
		Traffic signals, roundabout	Give way and stop signs
A	<14	Good operation.	Good operation.
B	15 to 28	Good with acceptable delays and spare capacity.	Acceptable delays and spare capacity.
C	29 to 42	Satisfactory.	Satisfactory, accident study required.
D	43 to 56	Operating near capacity.	Near capacity accident study required.
E	57 to 70	At capacity: at signals, incidents will cause excessive delays and roundabouts require other control modes.	At capacity, requires other control mode.
F	>70	Unsatisfactory with excessive queuing.	Unsatisfactory with excessive queuing.

SIDRA Intersection (the microanalytical traffic evaluation tool endorsed by Austroads) predicts intersection performance for the following key parameters:

- Degree of saturation (DoS).
- Average delays to intersection.
- LoS determined from LoS criteria.
- Queue length.

Table 7-32 summarises results of SIDRA Intersection operational performance modelling for the key access intersection for the Bringelly Brickworks site: The Northern Road/Bringelly Road/Greendale Road intersection. Results of the SIDRA Intersection modelling indicate that current operational performance of this intersection is good.

Table 7-32 The Northern Road/ Bringelly Road/ Greendale Road – existing intersection performance (2013)

Time period	Intersection control	Average delay[1] (sec/veh)	LoS[2]
Morning peak hour (8–9am)	Signals	20.9	B
Evening peak hour (4–5pm)	Signals	27.2	B

Notes:

[1] The average delay for signalised intersection is taken over all movements.

[2] The level of service for signalised intersection is based on the average delay per vehicle for all movements during peak conditions.

Existing mid-block capacity

The capacity of the urban roads is generally determined by the capacity of the intersection; however, an assessment of mid-block lane capacity is required to provide an indication of the ability of the approach roads to carry additional traffic for strategic planning purposes.

The *Guide to Traffic Engineering Practice - Part 2: Roadway Capacity* (Austroads 2009) indicates that two-lane rural roads have a capacity of 2800 passenger cars per hour total for both directions of flow under ideal conditions where there are no restrictive roadway, terrain or traffic conditions.

The peak hour volumes along Greendale Road are around 11.3 per cent of the average daily traffic volumes (1500 vehicles per day, inclusive of both directions of flow). These volumes were assessed using the abovementioned AUSTROADS guideline in the Traffic Impact Assessment (Hyder Consulting 2013, Appendix F) and it was determined that with an Average Annual Daily Traffic (AADT) volume of 1500 vehicles per day, the LoS provided by Greendale Road is equivalent to LoS A.

Existing public transport, cyclist and pedestrian facilities

There are currently no public transport services in the immediate vicinity of the site. The nearest service is Bus Route 856, operated by Busabout. It links Bringelly with Liverpool via Prestons and Churchill Gardens and runs along The Northern Road, Bringelly Road, Ingleburn Road, Camden Valley Way and The Hume Highway.

The closest bus stop for the direction towards Bringelly is located on The Northern Road at Bringelly Public High School just north of the intersection of The Northern Road and Greendale Road. The closest bus stop for the direction towards Liverpool is located on Bringelly Road just east of the intersection with The Northern Road.

There are no dedicated pedestrian and cycle facilities in the immediate vicinity of the site. There is a pedestrian footpath on the northern side of Greendale Road running west from The Northern Road for approximately 320 metres. In the vicinity of Greendale Road, The Northern Road has a pedestrian footpath on the western side.

Existing road safety

The crash data for the existing road network between 2006 and 2010 was reviewed as part of the Traffic Impact Assessment (Hyder Consulting 2013). No significant safety issues were identified in the immediate vicinity of the site. Only one crash occurred in the immediate vicinity of the entrance to the site. Based on available records, over the five year period, a total of four crashes were recorded to have occurred in the vicinity of The Northern Road/ Bringelly Road/ Greendale Road intersection, with no fatalities recorded (a double fatality is known to have occurred but is not recorded). There were no accident clusters at the intersection for the five year period.

Existing operational traffic: Bringelly Brickworks

The main entry to the project site is currently provided at the intersection of Greendale Road with Medway Road. The access road is a two-way sealed road that leads to the main entrance of the Bringelly Brickworks.

There are 38 staff employed on-site, and up to 26 employees are present on the site at any one time. A more detailed breakdown of the current operational workforce is provided in Section 5.2.9 and Appendix F. Current brick production is undertaken between 6am and 5pm; therefore, staff movements in the morning generally occur outside the morning peak hour traffic and movements in the afternoon can coincide with peak hour traffic on the local road network. It is assumed that all staff drive a vehicle to work, given the lack of public transport options in the

vicinity of the site. There are currently 50 light vehicle parking spaces and 10 truck parking/laydown spaces on the site.

The volume of trucks arriving at and departing from site is attributed primarily to the delivery of raw materials/supplies and finished products. A small number of truck movements are attributed to heavy vehicles for maintenance. Currently, a total of 450 truck movements occur weekly (225 inbound /225 outbound), with an average of 74 movements per day.

The present distribution of traffic flows observed at the intersection of The Northern Road, Bringelly Road and Greendale Road is presented in Table 7-33.

Table 7-33 Traffic distribution parameters, Greendale Road (2013)

Directional flow	Inbound to Greendale Road		Outbound from Greendale Road	
	LV	HV	LV	HV
The Northern Road, North	39.1%	45.0%	26.0%	62.0%
Bringelly Road, East	43.5%	0.0%	41.0%	15.0%
The Northern Road, South	17.4%	55.0%	33.0%	23.0%

The Northern Road upgrade

An upgrade of The Northern Road by Roads and Maritime Services (RMS) is currently in detailed design stage. Although timing of the upgrade will be determined by future land releases and the availability of funds, the project is expected to progress. The proposed intersection configurations for the Northern Road/ Bringelly Road/ Greendale Road intersection for the design years 2016, 2026 and 2036 were modelled for the future scenario traffic assessment of the Bringelly Brickworks expansion project. More information about this upgrade is presented in Appendix F.

7.4.3 POTENTIAL IMPACTS

Traffic generation during construction

The construction works associated with the new driveway and extensions to the brickmaking facility will be completed concurrently over a period of eight weeks. An estimated peak construction staff (comprising project management and various trades) of 10 employees is anticipated to create approximately 20 daily trips, at least half to be undertaken during morning and evening peak hours. In addition, it is estimated that four heavy vehicles a day would be used over this period (an estimated 8 trips per day).

This represents an increase of 4.5 per cent in daily heavy vehicle trips, and a 0.005 per cent increase in total daily trips. It is not anticipated that this minor increase in traffic flows during construction would have a significant impact on intersection performance, mid-block capacity or safety in the surrounding road network.

Traffic generation during operation

The proposed increase in production will require the brickmaking facility to operate on a 24-hour basis. An additional 34 employees will be required, bringing the total employee base to 72. Up to 44 employees will be present on the site at any one time. The Traffic Impact Assessment (Hyder Consulting 2013) provides a more detailed breakdown of the employment numbers and shifts worked (Appendix F).

With the proposed increase in brick production, it is estimated that a total of 1034 truck movements (inclusive of inbound and outbound movements) are expected to occur per week. These movements would be undertaken by trucks and trailers, B-doubles, semi-trailers, light trucks and standalone trucks. It is anticipated that haulage would occur between the following times:

- 6am and 6pm Monday to Friday.
- 6am and 1pm Saturdays.

Assuming truck movements to be spread over six days, the increased production at the brickworks will result in an average of approximately 98 additional truck movements per day. For the purposes of this assessment, a conservative factor of 20 per cent is assumed on movements likely to occur during the AM or PM peak hour, resulting in a net increase of 20 truck movements (10 inbound/10 outbound).

For the proposed expansion works, the net increase in traffic generation is summarised in Table 7-34.

Table 7-34 Total net increase in traffic generation

Vehicle movements	Total daily movements	Net increase due to proposed expansion	Estimated net increase for peak inbound	Estimated net increase for peak outbound
Light vehicle movements	88 movements	33 vpd[1]	3 (am) 12 (pm)	12 (am) 6 (pm)
Heavy vehicle movements	176 movements	98 vpd[1]	10	10

[1] vehicles per day

In terms of directional split of traffic generated by the proposed development, the 2013 distribution has been based on present distribution (Table 7-33) while the future distribution has been based on projected traffic flows as presented in the modelling for The Northern Road upgrade (SKM 2012).

Impact on roadway capacity and intersection performance

It is estimated that the proposed expansion will attract an additional 131 vehicle trips per day consisting of 33 light vehicles and 98 heavy vehicles. This would increase the average daily traffic along Greendale Road to approximately 1631 vehicles per day with 16.1 per cent heavy vehicle composition. The increase in traffic does not have a significant effect on the LoS for Greendale Road with an acceptable LoS of B (a decrease from the current LoS of A).

The results of SIDRA modelling undertaken as part of the Traffic Impact Assessment (Hyder Consulting 2013) indicated that the additional movements generated by the project are minor and will not have a significant effect on the operation of the intersection of The Northern Road/Greendale Road/Bringelly Road. The intersection is expected to operate at a similar level of service as under the existing traffic volumes.

Access and parking

The project includes provision of a new replacement access road (driveway), which will be located 150 metres east of the existing access road, along Greendale Road. The new access road will accommodate a dedicated 60 metre left turn lane at the proposed vehicle access on the westbound lane on Greendale Road. This may require the removal of some vegetation on the southern side of Greendale Road, east of the proposed access location in order to meet the sight distance requirements as required by the *Guide to Road Design, Part 3 – Geometric Design* (Austroads 2009).

Onsite parking provisions currently provide for 50 light vehicles. In accordance with RMS Guidelines and Camden Council's Development Control Plan 2011, the adequacy of these provisions was assessed in the Traffic Impact Assessment (Hyder Consulting 2013). This parking suitability assessment was based on employee parking requirements considering the location, work hours and limitations on accessibility to public transport and active transport facilities. Using the conservative assumption of one car space per employee, peak demand for parking will be at around 5pm when 32 staff will still be finishing their shift and another 12 staff will have arrived to start their shift. On this basis, car parking requirements are estimated to be a minimum of 44 spaces. It was concluded that the current site layout provides 50 spaces, which will be sufficient to cater for the predicted staff parking requirements.

In addition, onsite parking provisions currently provide for 10 semi-trailers and eight light trucks. With a total of 1,034 truck movements a week or roughly 176 movements over a 12 hour (6am – 6pm) delivery period, it is estimated that there will be a need to accommodate at least seven trucks every hour. The provision of a total 18 spaces for truck parking allows a layover time of around two hours per truck. This is sufficient for accommodating the proposed truck parking requirements.

Road condition and ongoing maintenance

As discussed in Section 3.3, Camden Council has confirmed that funding has been approved for the upgrading of the approximately 2.2 kilometres section of Greendale Road between the existing Bringelly Brickworks site entrance and Dwyer Road to the west. These works are scheduled to be completed as part of the 2012-13 Works Program.

With the expanded operations at the Bringelly Brickworks site, Boral vehicles entering and exiting the site will use the 450 metres section of Greendale Road between The Northern Road intersection and the new Bringelly Brickworks driveway. Although this section of road is in good condition, with only minor shoulder break along portions of the southern road edge, Boral has undertaken an assessment of the proposed road maintenance contribution for Greendale Road. This assessment will form the basis of discussions with both Camden and Liverpool Councils around potential annual road maintenance contributions to be paid by Boral for the ongoing maintenance of this section of road, over the life of the project. As the boundary between the Camden and Liverpool LGA falls on the centreline of Greendale Road, both Councils have an agreement in place that Liverpool Council undertake all road maintenance on Greendale Road, while Camden Council provide half of the funding towards the maintenance or any upgrading. These discussions with both Councils will continue through the EIS process and Boral is aiming to reach an agreement with the Councils by determination of the development application by DP&I.

Boral's road maintenance contribution assessment concluded that as Greendale Road was constructed in 1998, the remaining life of the 20 year pavement design is five years. At the end of 2018, it is anticipated that the scheduled asphalt re-surfacing will reinstate the pavement design life to 15 years. The additional truck loading attributed to the proposed increase in production at the Bringelly Brickworks site will hasten the pavement life to reach its design life by approximately one half and indicates that asphalt re-surfacing may be required in intervals of seven years instead of 15.

The estimated maintenance cost contribution for the project is presented in Table 7-35.

Table 7-35 Costs attributable to proposed development

Year	Major maintenance works[1]	Annual routine maintenance[2]	Haulage (tpa)	Total maintenance cost	Allocation to Boral	Boral $/t-km
2013	$19,483.20	$4,788	263,500	$24,271.20	$12,135.60	0.0128
2018	$22,374.00	$4,788	263,500	$27,162.00	$13,581.00	0.0143
2018	$23,868.00	$4,788	263,500	$28,656.00	$14,328.00	0.0151
2018	$88,380.00	$4,788	263,500	$93,168.00	$46,584.00	0.0491
2023	$19,483.20	$4,788	263,500	$24,271.20	$12,135.60	0.0128
2028	$26,848.80	$4,788	263,500	$31,636.80	$15,818.40	0.0167
2033	$41,580.00	$4,788	263,500	$46,368.00	$23,184.00	0.0244
2033	$23,868.00	$4,788	263,500	$28,656.00	$14,328.00	0.0151
2033	$88,380.00	$4,788	263,500	$93,168.00	$46,584.00	0.0491
2038	$22,374.00	$4,788	263,500	$27,162.00	$13,581.00	0.0143
2043	$41.580.00	$4,788	263,500	$46,368.00	$23,184.00	0.0244

[1] data provided by Liverpool City Council

[2] based on annual routine maintenance costs of $1.33/m2

Cumulative impacts

Consultation was undertaken with Camden Council to seek information on other developments proposed along Greendale Road, which could result in a cumulative increase in traffic on Greendale Road in the future. A 4,533 plot Muslim cemetery is proposed to be located on the northern side of Greendale Road further west of the Bringelly Brickworks site. The access road to the cemetery would be located some 400 metres west of the Bringelly site entrance. The Traffic Impact Assessment (Hyder Consulting 2013) reported that when all plots are fully sold out, the project is expected to attract a maximum of 30 vehicles per hour during the peak hour when at full capacity. The expected peak hour traffic generation can occur anytime between their operating hours of 9am and 4pm during a weekday and occasionally on weekends. The cumulative traffic impact of the Bringelly Brickworks expansion project and the cemetery on Greendale Road would not be significant.

7.4.4 MITIGATION MEASURES

Prior to the commencement of construction of the new access road (driveway) including the dedicated 60 metre left turn lane on the westbound lane on Greendale Road:

- A Construction Traffic Management Plan will be developed and implemented in accordance with RMS Guidelines and will be submitted to Camden Council for review. The Construction Traffic Management Plan outlines arrangements for the safe management of construction traffic entering and exiting the site and working along the westbound lane on Greendale Road during the construction of the dedicated 60 metre left turn lane.
- Boral will fund a proportion of the road maintenance costs incurred by Council, as outlined in Section 7.4.3.
- Vegetation on the southern side of Greendale Road, east of the proposed new access road, will be carefully cleared and/or pruned in order to meet the sight distance requirements as required by the Guide to Road Design, Part 3 – Geometric Design

(Austroads 2009). The extent of vegetation clearing and/or pruning will be determined in consultation with Camden Council prior to the commencement of construction of the new site access and left turn lane.

The following mitigation measures would be implemented during operation of the project:

- Personnel operating trucks and vehicles to and from the project site would be required to undertake a site-specific health and safety induction specifying operating hours, speed limits along Greendale Road, safe access and egress, and the avoidance of the morning and afternoon peak periods where practicable.
- A heavy vehicle protocol would be developed for the project site and distributed to relevant staff and contractors during induction procedures. The protocol would deal with such issues as timing of vehicle movements, idling of vehicles, speed limits on Greendale Road and parking.
- Deliveries would be scheduled on larger capacity 'truck and trailer' vehicles rather than 'truck only' vehicles where possible to minimise truck movements.
- Where non-routine vehicular movements are required, such as for the transport of oversized loads, where practical and subject to appropriate standards, Boral would undertake these tasks outside of normal working hours and/or the peak morning and afternoon periods.
- Where feasible, Boral trucks servicing the site will be fitted with speed monitoring system via GPS tracking software.

7.5 AIR QUALITY

7.5.1 OVERVIEW

Quarrying and brickmaking facilities generate dust, particulate matter and other emissions from the brick production process, which have the potential to have a negative impact on local air quality. An air quality assessment was undertaken for the project by specialist air quality consultants, Wilkinson Murray (2013), which provides a quantitative assessment of potential impacts addressing the following relevant DGRs:

- Construction and operational impacts, with a particular focus on processing and dust emissions, as well as diesel emissions.
- Reasonable and feasible mitigation measures to minimise processing, dust, diesel emissions; including evidence that there are no such measures available other than those proposed.
- Monitoring and management measures, in particular real-time air quality monitoring.

The study modelled predicted emissions from both the quarrying and brick production process, estimated likely levels of air pollutants at nearby sensitive receivers and identified management and mitigation measures that could be implemented to achieve relevant air quality criteria. This section presents a summary of the full air quality impact assessment, which is included in Appendix G of this EIS.

7.5.2 EXISTING ENVIRONMENT

Long-term climate data

Air quality in Sydney's south-west region is primarily influenced by traffic related air pollution and industrial emissions. Air quality is also influenced by the prevailing weather and climatic conditions, including extreme events such as bushfires and storms. The south-west region is more heavily affected by air pollution mainly because the prevailing sea breeze is north-easterly.

The closest Bureau of Meteorology Station is Badgerys Creek (AWS – Station Number 067108), approximately four kilometres from the project site. Total rainfall recorded at Badgerys Creek in 2011 was 672 millimetres. February was the highest rainfall month; 107 millimetres were received during February in 2011). July was the driest month, with 25.5 millimetres received in July 2011. The climate data indicate that on average, January is the hottest month of the year with a mean maximum temperature of 29.7 degrees Celsius and July is the coldest month of the year with a mean minimum temperature of 4.2 degrees Celsius.

Mean 9am humidity levels range from 62 per cent in October to 84 per cent in June. Mean 3pm humidity levels range from 44 per cent in August and September to 56 per cent in June. Mean 9am wind speeds range from 8.4 kilometres per hour in March to 11.8 kilometres per hour in October. Mean 3 pm wind speeds range from 13.7 kilometres per hour in June to 19.9 kilometres per hour in October.

Sensitive receivers

The land uses surrounding the project site are a mixture of rural-residential and agricultural. The Bringelly Public School and village is located approximately 500 metres to the northeast of the brickmaking facility. There are a number of rural residential properties distributed around the area surrounding the project site. The Air Quality Impact Assessment identified 36 nearby residential receivers. The 12 closest sensitive receivers were included in a more detailed assessment within the Air Quality Impact Assessment. These are indicated in Table 7-36.

Table 7-36 Surrounding residential receivers

Receiver number	Receiver address
1	55 Loftus Road
2	54 Loftus Road
3	20 Greendale Road
4	9 Greendale Road
5	5 Greendale Road (Bringelly Community Centre)
14	23 Greendale Road
16	29 Greendale Road
17	25 Greendale Road
19	35 Greendale Road
20	170 Tyson Road
22	46 Belmore Road
35	108 Belmore Road

Figure 7-23 Nearby residential receivers in relation to site location and dust deposition gauges

Ambient air quality

The existing air quality environment in the vicinity of the project site was characterised using background ambient monitoring data obtained from the EPA Bringelly monitoring station for the year 2011. The EPA meteorological station at Bringelly is about four kilometres from the Boral Brick facility.

The air pollutants monitored at the meteorological station include:

- Particulate Matter (PM_{10}).
- Oxides of Nitrogen oxide (NO, NO_2 and NO_x).
- Sulphur dioxide (SO_2).

The background concentrations for each of these air pollutants are presented in Table 7-37. Table 7-37 also includes estimated values for ambient Total Suspended Particulates (TSP) and dust deposition, for which there are no readily available data. It is noted that there is currently no monitoring data available for Carbon Monoxide (CO), Hydrogen Chloride (HCl), and Hydrogen Fluoride (HF). Given the semi-rural location of the project site, background concentrations of these pollutants are assumed to be negligible.

Table 7-37 Background pollutant concentrations at the EPA Bringelly Meteorological Station

Air pollutant	Averaging period	Background concentration (µg/m^3)
PM_{10}	Annual	16.0
	24-hour (maximum)	83.8
NO_2	Annual	9.7
	Monthly (maximum)	41
SO_2	Annual	3.5
	Monthly (maximum)	4.5
TSP	Annual	40.0[1]
Dust deposition	Annual	1.8[1,2]

Source: Wilkinson Murray (2013)

[1] This is an estimated value
[2] g/m^2/month

The monitoring data show the annual average PM_{10} concentrations are below the 30µg/m^3 criterion. The Air Quality Impact Assessment also noted that there were occasions in the year where the maximum measured 24-hour average exceeded the National Environment Protection Measures (NEPMs) goal of 50 µg/m^3, most likely due to bush fire events or other localised sources.

The maximum monthly 1-hour average and annual average concentration of NO_2 recorded was significantly below the impact assessment criterion of 246 µg/m^3.

The maximum monthly 1-hour average and annual average concentration of SO_2 recorded was also significantly below the impact assessment criterion of 228 µg/m^3.

The Air Quality Impact Assessment estimated annual average background TSP concentrations of 40 µg/m^3 based on measured PM_{10} concentrations, assuming that 40 per cent of the TSP is PM_{10}. Estimated annual average background TSP concentrations are significantly below the impact assessment criterion of 90 µg/m^3. More information about this calculation is provided in the Air Quality Impact Assessment (Appendix G).

Site specific dust deposition monitoring occurred between March 2010 and July 2012 in the vicinity of the project site, at the four locations shown in Figure 7-23. The values range from 0.52 to 4 g/m^2/month, which the Air Quality Impact Assessment noted are fairly typical for this type of environment.

Annual dust deposition levels (independent of the Boral Bringelly Brickworks activities) were estimated using a similar method to the one used to estimate TSP concentrations. This approach assumes that a TSP concentration of 90 µg/m^3 has an equivalent dust deposition value of 4 g/m^2/month and that the background annual average dust deposition for the area surrounding the project site is 1.8 g/m^2/month.

Assessment criteria

Air quality criteria for possible pollutants are outlined in this section, including dust deposition, particulate matter concentration, and other air pollutants.

The EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC 2005) specifies air quality assessment criteria for annual average dust deposition:

- Maximum increase – 2 g/m^2/month.
- Maximum total – 4 g/m^2/month.

These criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (NEPC 1998).

Air quality assessment criteria for particulate matter concentrations are detailed in Table 7-38. It is noted that these air quality goals relate to the total dust burden in the air and not just the dust from the project. Therefore, some consideration of background levels needs to be made when using these goals to assess impacts.

Table 7-38 Air quality assessment criteria for particulate matter concentrations

Pollution standard	Goal	Averaging period	Agency
TSP	90 µg/m^3	Annual	NHMRC*
PM_{10}	50 µg/m^3	24-hour maximum	NSW OEH
	30 µg/m^3	Annual mean	NSW OEH long-term reporting goal
	50 µg/m^3	(24-hour average, 5 exceedances permitted every year)	NEPMs

*National Health and Medical Research Council

Source: Wilkinson Murray (2013)

EPA specifies ground-level concentration impact assessment criteria for other air pollutants (DEC 2005), as listed in Table 7-39.

Table 7-39 Air quality assessment criteria for other air pollutants

Pollutant standard	Goal	Averaging period	Agency
SO_2	712 µg/m^3	10-min	NHMRC (1996) [1]
	570 µg/m^3	1-hr	NEPC (1998) [2]
	228 µg/m^3	24-hr	NEPC (1998) [2]
	60 µg/m^3	Annual	NEPC (1998) [2]
SO_3	18 µg/m^3	1-hr	VIC EPA (2001) [3]

Pollutant standard	Goal	Averaging period	Agency
NO_2	246 µg/m^3	1-hr	NEPC (1998) [2]
	62 µg/m^3	Annual	NEPC (1998) [2]
CO	100 µg/m^3	15-min	WHO (2000) [4]
	30 µg/m^3	1-hr	WHO (2000) [4]
	10 µg/m^3	8-hr	NEPC (1998) [2]
HF	0.25 µg/m^3	90 days	ANZECC (1990) [5]
	0.4 µg/m^3	30 days	ANZECC (1990) [5]
	0.8 µg/m^3	7 days	ANZECC (1990) [5]
	1.5 µg/m^3	24-hr	ANZECC (1990) [5]
HCl	140 µg/m^3	1-hr	VIC EPA (2001) [3]
Acetone	22 mg/m^3	1-hr	VIC EPA (2001) [3]
Benzene	0.029 mg/m^3	1-hr	VIC EPA (2001) [3]
Carbon disulphide	0.07 mg /m^3	1-hr	VIC EPA (2001) [3]
Chlorine	0.05 mg/ m^3	1-hr	VIC EPA (2001) [3]
Chloroethane	48 mg/m^3	1-hr	VIC EPA (2001) [3]
Ethylbenzene	8 mg/m^3	1-hr	VIC EPA (2001) [3]
Xylene	0.19 mg/m^3	1-hr	VIC EPA (2001) [3]
Phenol	0.02 mg/m^3	1-hr	VIC EPA (2001) [3]
Styrene	0.12 mg/m^3	1-hr	VIC EPA (2001) [3]
Tetrachloroethane	1.0 mg/m^3	1-hr	VIC EPA (2001) [3]
Toluene	0.36 mg/m^3	1-hr	VIC EPA (2001) [3]
Arsenic	0.00009 mg/m^3	1-hr	VIC EPA (2001) [3]
Beryllium	0.000004 mg/m^3	1-hr	VIC EPA (2001) [3]
Manganese	0.018 mg/m^3	1-hr	VIC EPA (2001) [3]
Mercury	0.0018 mg/m^3	1-hr	VIC EPA (2001) [3]

[1] National Health and Medical Research Council (NHMRC) 1996, Ambient Air Quality Goals.
[2] National Environment Protection Council (NEPC) 1998, National Environment Protection Measure for Ambient Air Quality.
[3] Victorian Environment Protection Agency (VIC EPA) 2001, State Environment Protection Policy (Ambient Air).
[4] World Health Organisation (WHO) 2000, Guidelines for Air Quality.
[5] Australian New Zealand Environment Conservation Council (ANZECC) 1990, National Goals for Fluoride in Ambient Air and Forage.

Source: Wilkinson Murray (2013)

7.5.3 POTENTIAL IMPACTS

Dust

The Air Quality Impact Assessment looked at dust generation by quarrying activities, transportation of raw material to stockpiles and subsequent processing. This was modelled for three scenarios, based on the three stages of quarrying operations that are proposed:

- Stage 1 - Operation in Cells A, B and C.
- Stage 2 - Operation in Cells D, E and F.
- Stage 3 - Operation in Cells G, H and I.

Information about the dust-generating operations which take place at the site (that is, how much material is moved, how far it is moved and so on) has been used with emission factors developed both locally and by the US EPA to estimate the amount of dust produced from each operation. The calculations that were completed, as well as the spatial distribution of predicted impacts over the modelling domain for dust emissions are presented within the Air Quality Impact Assessment (Appendix G).

The predicted results show that minimal incremental impacts from the proposed operations would arise at nearby sensitive receptors. Therefore, it is unlikely that the existing PM_{10}, TSP or dust deposition levels at any sensitive receptor would be significantly changed. There are no exceedances of the total (cumulative) 20-hour average PM_{10} criterion of 50 $\mu g/m^3$ for Stages 1, 2 or 3.

It should also be noted that these dust generation levels are highly conservative as the effect of the precipitation rate (rainfall) in reducing dust emissions was not applied in the modelling of dust generation. Studies have shown that significant vegetation barriers can reduce dust emissions by up to 30 per cent (Warren 1973). Boral propose to retain a five metre strip of existing native Cumberland Plain Woodland along the northern boundary of quarry cell D, with the primary purpose of retaining a substantial, densely vegetated strip of vegetation to minimise dust deposition to the north of the quarry activities as the dominant wind at the site is from the SSW. In addition, two substantial 4.5 metre high noise bunds are proposed: one 200 metres in length and the other 362 metres long. These noise bunds will be revegetated with appropriate locally occurring native vegetation including trees and shrubs which, once established, will provide an even more robust vegetative buffer, further reducing dust emissions from the site and deposition impacts on neighbouring residential receivers to the north. The dust generation modelling didn't take this into account the reduction factors from these vegetation buffers. More information about these noise bunds is provided in Section 5.2 and Section 7.3.

Other air pollutants

The Air Quality Impact Assessment used computer-based dispersion model AUSPLUME to predict ground level concentrations of the flue gases hydrogen fluoride, hydrogen chloride, oxides of sulphur, nitrogen dioxide, carbon monoxide, VOCs and metals emitted from the stack associated with the kiln and dryers. The results of this modelling which shows ground level concentrations and the criteria are included in Tables 7-5 and 7-6 of the Air Quality Impact Assessment. The spatial distribution of predicted impacts over the modelling domain for all stack pollutants assessed is presented in isopleths within in the Air Quality Impact Assessment. These dispersion modelling results indicate that all sensitive receptors would be below the relevant criterion for all pollutants assessed.

7.5.4 MITIGATION MEASURES

Dust will be generated from the proposed operations, as well as from stockpiles and exposed areas on the project site. A dust emissions management and control procedure will be developed as part of the CEMP and OEMP. Table 7-40 outlines some dust mitigation measures that will be stipulated in the dust emissions management and control procedure.

Table 7-40 Dust mitigation measures

Source	Control procedure
Exposed areas and quarry pit	▪ Restrict ground disturbance to the minimum area practically possible in accordance with the staging plan. ▪ Rehabilitate exhausted quarry pits as soon as practicable (refer to Rehabilitation strategy, Section 5.3 and Appendix G).
Stockpiles	▪ Stockpiles are to be restricted to the designated raw material stockpile area to the south of the brick making facility. ▪ Unusable material is to be used as backfill in exhausted quarry pits (refer to Rehabilitation strategy, Section 5.3 and Appendix G). ▪ Temporary topsoil stockpiles are to be located in previously disturbed areas (devoid of vegetation) within the proposed quarry footprint. Topsoil stockpiles to remain in place for more than a month should be covered by establishing vegetative cover to minimise dust lift-off (refer to Rehabilitation strategy, Section 5.3 and Appendix G).
Hauling activities	▪ Watering of active haul roads and manoeuvring areas to minimise dust. ▪ Limit vehicle speeds.
All dust generating activities	▪ Retain a 5 m strip of mature woodland along the northern boundary of quarry Cell D. ▪ Establish dense vegetation cover (mixture of locally occurring, native trees and shrubs on the two 4.5 m high noise bunds to be established along the northern boundary of quarry Cell D and to the east of the proposed new site access. ▪ The above measures will act as significant vegetation buffers between the active quarry and sensitive receives to the north of Greendale Road, reducing fugitive dust emissions.

The Air Quality Impact Assessment identified that the generation of nitrogen oxides (NOx) emissions is a key air quality issue in western Sydney; however, it was observed that this project has limited opportunities to reduce NOx emissions because the kiln is not being refurbished. Should the kiln be refurbished in the future, the best available control technology (such as low NOx burning technology or flameless regenerative thermal oxidation technology) will be considered.

7.6 SURFACE WATER

7.6.1 OVERVIEW

Uncontrolled discharge of sediment laden stormwater has the potential to result in impacts on water quality of Thompsons Creek. Currently, on-site stormwater management is guided by a Stormwater Management Plan (SWMP) that was prepared for the site in 2002 (ERM). This SWMP was reviewed by Hyder Consulting and a Surface Water Management Report was prepared for the proposed expansion project (Hyder Consulting 2013, Appendix I). This Surface Water Management Report, as well as the summary presented in the section below, has addressed the following DGRs:

- Detailed assessment of potential impacts on the quality and quantity of existing surface water resources.
- Impacts on affected licensed water users and basic landholder rights.
- Impacts on riparian, ecological, geomorphological and hydrological values of watercourses, including environmental flows.
- A detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures.
- As assessment of proposed water discharge quantities and qualities against receiving water quality and flow objectives.
- Identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*.
- Demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable water supply in accordance with the operating rules of any Water Sharing Plan (WSP).
- A description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo.
- A detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface water impacts.

7.6.2 EXISTING ENVIRONMENT

Hydrology

The project site is located within the Hawkesbury-Nepean catchment, which is the largest catchment within the Sydney area, covering an area of approximately 21,400 square kilometres. It falls directly within the upper reaches of the South Creek sub-catchment, which encompasses most of the Cumberland Plain of Western Sydney.

The South Creek sub-catchment covers an area of approximately 620 square kilometres, comprising small rural residential and urban areas. The upper South Creek sub-catchment lies within Camden City Council's Local Government Area and includes (from west to east) Thompsons Creek, Lowes Creek, Rileys Creek, Kemps Creek and Bonds Creek (WMA Water, 2012).

The project site rises within the south western portion (146m AHD) and falls toward Bardwell Gully and Thompsons Creek in the north (76m AHD).

South Creek

The project site is located within the upper portion of South Creek catchment. The confluence of South Creek and Thompsons Creek is located 3.5 kilometres to the north east of the project site. The location of the project site relative to South Creek and Thompsons Creek is shown in Figure 7-24.

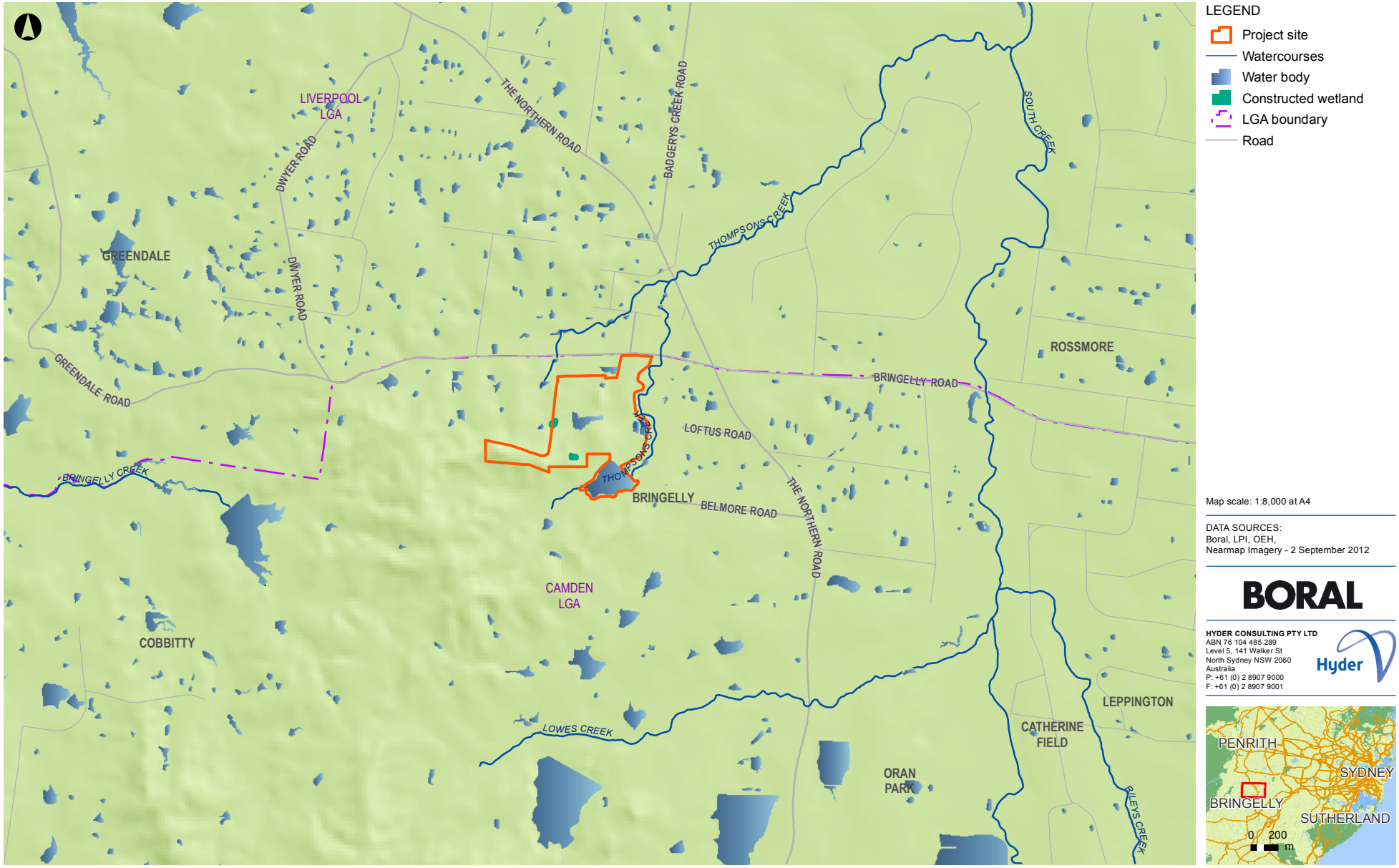


Figure 7-24: Location of the project site relative to South Creek and Thompsons Creek

South Creek is regarded as one of the most degraded sub-catchments in the Sydney region. The hydrological regime of the catchment has been greatly altered through vegetation clearance and an increase in impervious areas through the urbanisation of the catchment. This in turn has led to changes in catchment geomorphology and a reduction in water quality. Water quality is impacted by both point and diffuse sources of pollution, including sewage treatment plants, industrial discharges in the lower reaches of the catchment, and runoff from land uses such as market gardens, grazing lands and urban and stormwater runoff.

The *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources* 2011, established under the *Water Management Act 2000*, covers the project site and the South Creek catchment. The plan splits the South Creek Catchment into two management zones, being the Upper South Creek management zone, within which the project site is located, and the Lower South Creek management zone. The Upper South Creek Management Zone supports 88 surface water licences with a peak daily demand of 43.85 mega litres per day. Water is used to support irrigation and stock watering.

Thompsons Creek

Thompsons Creek is a tributary of South Creek and forms the eastern boundary of the project site. It is classified as a second order ephemeral (intermittently flowing) stream using the Strahler stream classification system (Strahler 1952). Thompsons Creek crosses the eastern and southern boundaries of the study area directly south of the existing brickworks quarry. Thompsons Creek flows in a northerly direction adjacent to the eastern boundary of the project site and discharges directly into South Creek.

The dam at the south eastern corner of the project site (known as Dam 6), located within the headwaters of Thompsons Creek has a capacity of 50 mega litres and is utilised as part of Boral's water management system. Boral holds an EPL (Ref 1808) to discharge into Thompsons Creek from the dam.

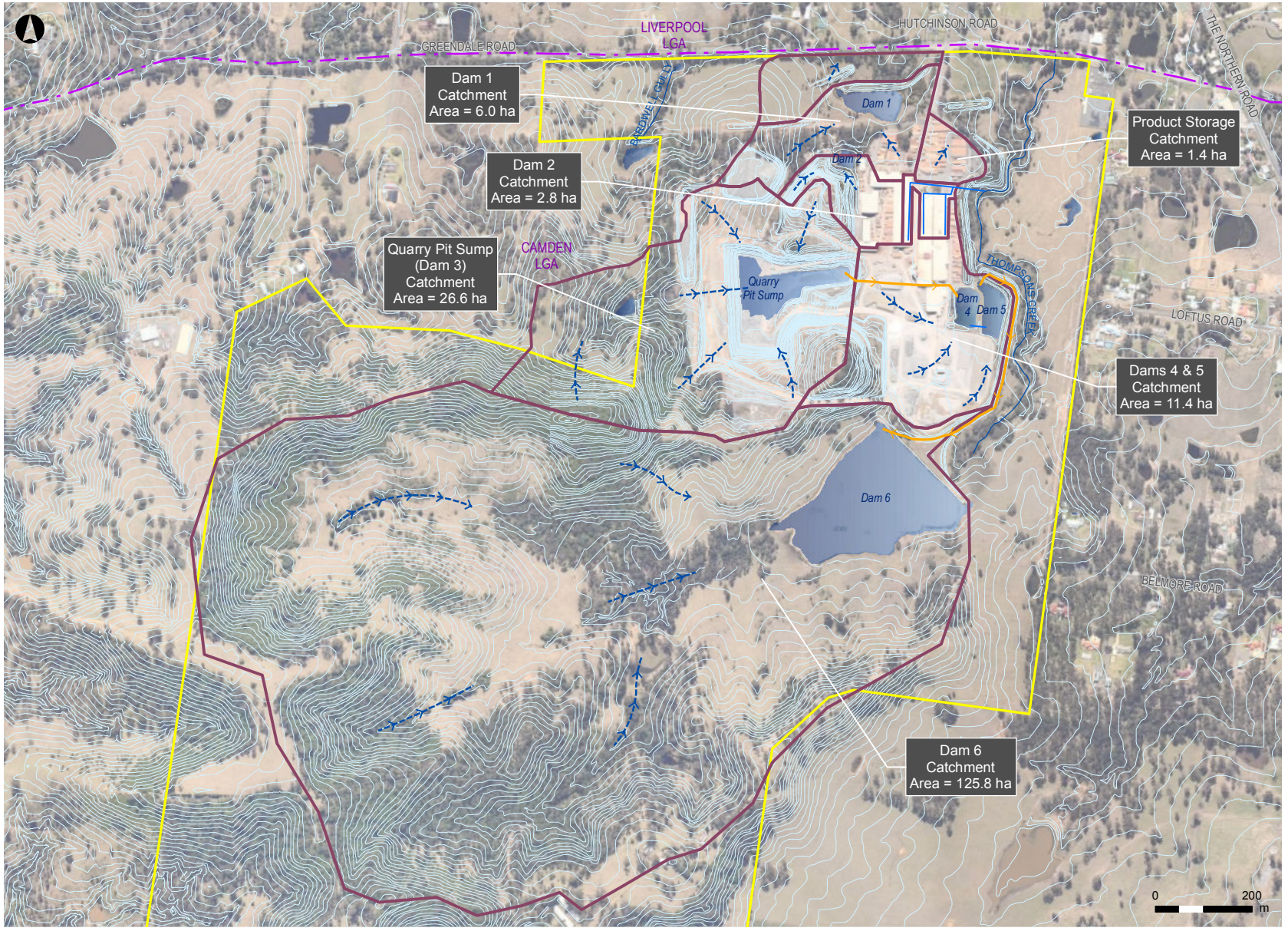
Thompsons Creek drains rural, rural residential and urban areas and has poor environmental health. A site inspection of this watercourse on the 6 May 2013 found that it is impacted by erosion, weed outbreaks, channel modification, litter and poor water quality.

Bardwell Gully

Bardwell Gully is a small drainage channel that flows into Thompsons Creek in a northerly direction from central northern boundary of the project site. The gully drains northwards, under Greendale Road, before diverting eastwards and converging with Thompsons Creek, approximately one kilometre to the north east of the project site. The gully drains Greendale Road, rural and residential areas and has a highly degraded environmental condition.

Site water management

The project site's drainage systems have been designed to minimise uncontrolled off-site discharges. The existing site drainage system is shown in Figure 7-25.



LEGEND

- Property Boundary
- Existing catchments
- Direction of overland flow
- Piped flow
- Pump lines
- Watercourse
- LGA boundary

Map scale: 1:12,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012

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Hyder

Figure 7-25: Existing site drainage system

Runoff from the roofs of some of the brickworks buildings is collected in a separate drainage system and discharged directly to Thompsons Creek. Runoff from the car park and brickmaking facility drains to a wet pit at the northern end of the car park. The pit discharges into an open drain at the eastern end of the currently inactive effluent irrigation area, which then discharges into Thompsons Creek.

Runoff from the temporary raw material and unusable material stockpiles, western brick product storage area and material storage facility is directed to Dams 1 and 2 at the northern end of the site for removal of coarse and fine solids respectively through settlement and flocculation. Dam 1 is a licensed discharge point, discharging settled water to Bardwell Gully that in turn discharges to Thompsons Creek. Runoff from the raw material stockpile area located south of the brickworks is directed to Dams 4 and 5.

Runoff from a catchment area of 26.6 hectares to the west of the project site, of which 4.8 hectares is located within the existing quarry footprint currently drains towards and is captured within the existing quarry. Pit (quarry) water collected in the quarry and runoff from raw material stockpiles and operational areas around the brickmaking facility is transferred to Dam 4 and Dam 5 for removal of course and fine solids. Flocculent is added to water via a dosing pit during the process of pumping water from the quarry pit to Dam 4. Water from Dam 5 is pumped to Dam 6, for further dilution prior to discharge to Thompsons Creek. Water discharges intermittently from Dam 6 into Thompsons Creek, usually following heavy rainfall events. This dam is licensed for discharge of stormwater and pit water under the project site's existing EPL.

Sewerage at the site is collected and treated in an on-site bio-cycle system. Treated effluent is stored within a holding tank and utilised for irrigation of a fenced, open grassed area of approximately 0.25 hectares located at the northern end of the site, north of the brick product storage area. Boral is currently authorised under its EPL to discharge 3500 litres per day of effluent to the irrigation area.

Flooding

Flood liability in the Upper South Creek catchment is constrained to low lying areas and floodplain. Additionally, flood levels do not increase markedly for rarer events and flood extent does not vary significantly between smaller more frequent events and larger rarer events, largely attributable to the well-defined floodplain (WMA, 2011).

Resource Planning Pty Ltd (1991) found that a significant proportion of the project site, including the plant site, is located at a height of approximately 85 metres AHD and is well above the effects of regional flooding.

A review of a flood study prepared for the Upper South Creek catchment shows that a small area of the project site is potentially impacted by Probable Maximum Flood Levels and the five per cent Annual Exceedance Probability (AEP) event. Figure 7-26 shows that the south eastern corner of the project site, including the southernmost extent of the brickmaking facility and the raw materials storage area are potentially impacted by flooding. However, it should be noted that a key constraint posed by this study is that the approach utilised is conservative and does not consider all existing flood mitigation controls.

Boral has constructed a bund wall for visual screening and noise attenuation along the eastern boundary of the project site, extending from the brickmaking facility to the raw material storage area and finishing adjacent to the Dam 6 headwall located in the south eastern margin of the site boundary. This bund shown in Figure 7-26 has a maximum height of six metres and also serves as a mitigant for flood waters from the Thompsons Creek catchment entering the project site. The site has been operational since the mid-1960s and over this period there has been no evidence of flooding at the project site.

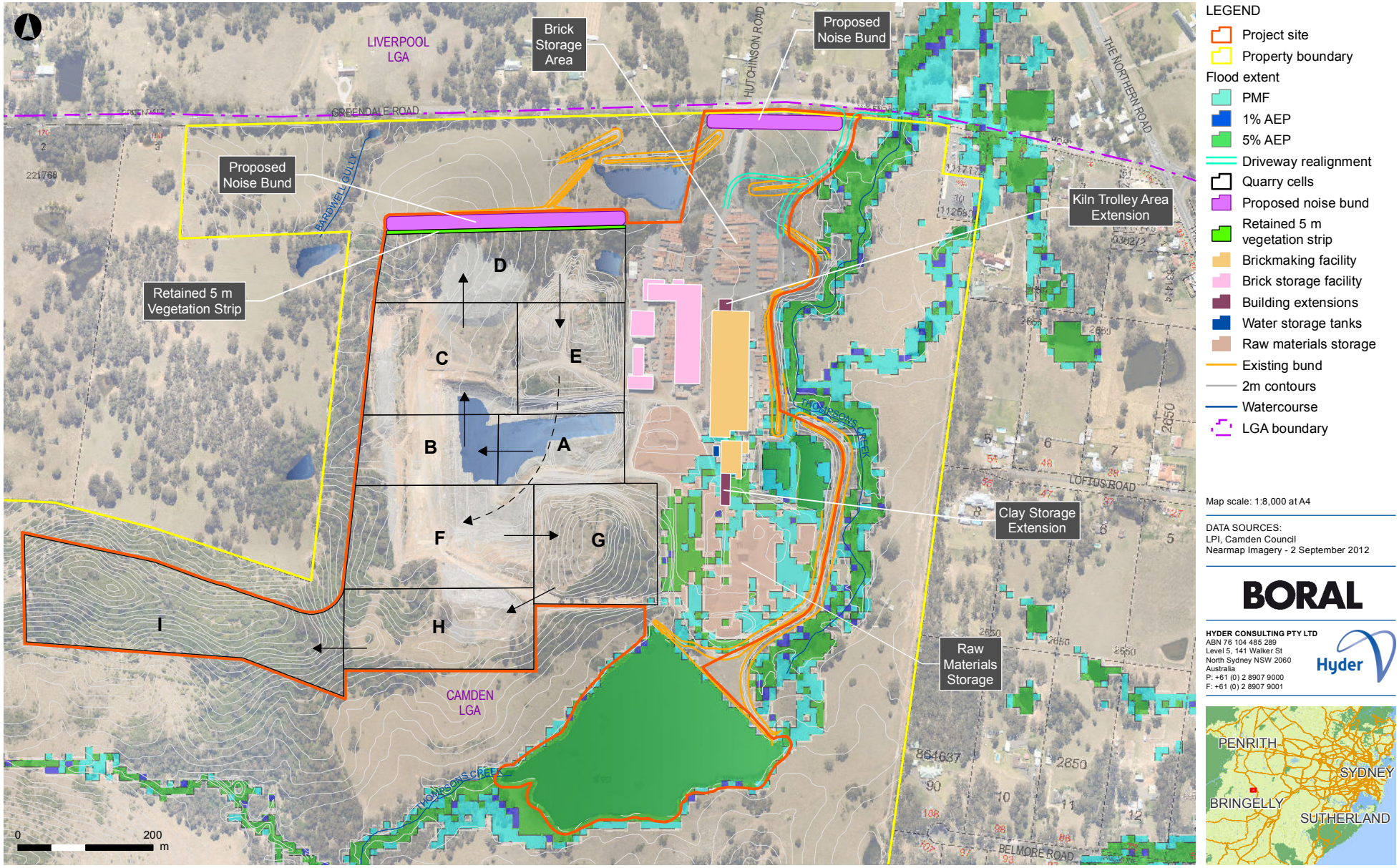


Figure 7-26: Flood mapping for Bringelly, including project site

Date: 29/08/2013 Path: \\hc-aus-ns-fs-01\jobs\AA005667\L-GIS\A_Current\B_Maps\EIS\AA005667_EIS_F007-26_Flooding_r3v1.mxd
Created by : GC
QA by : UOD

Water Quality

South Creek

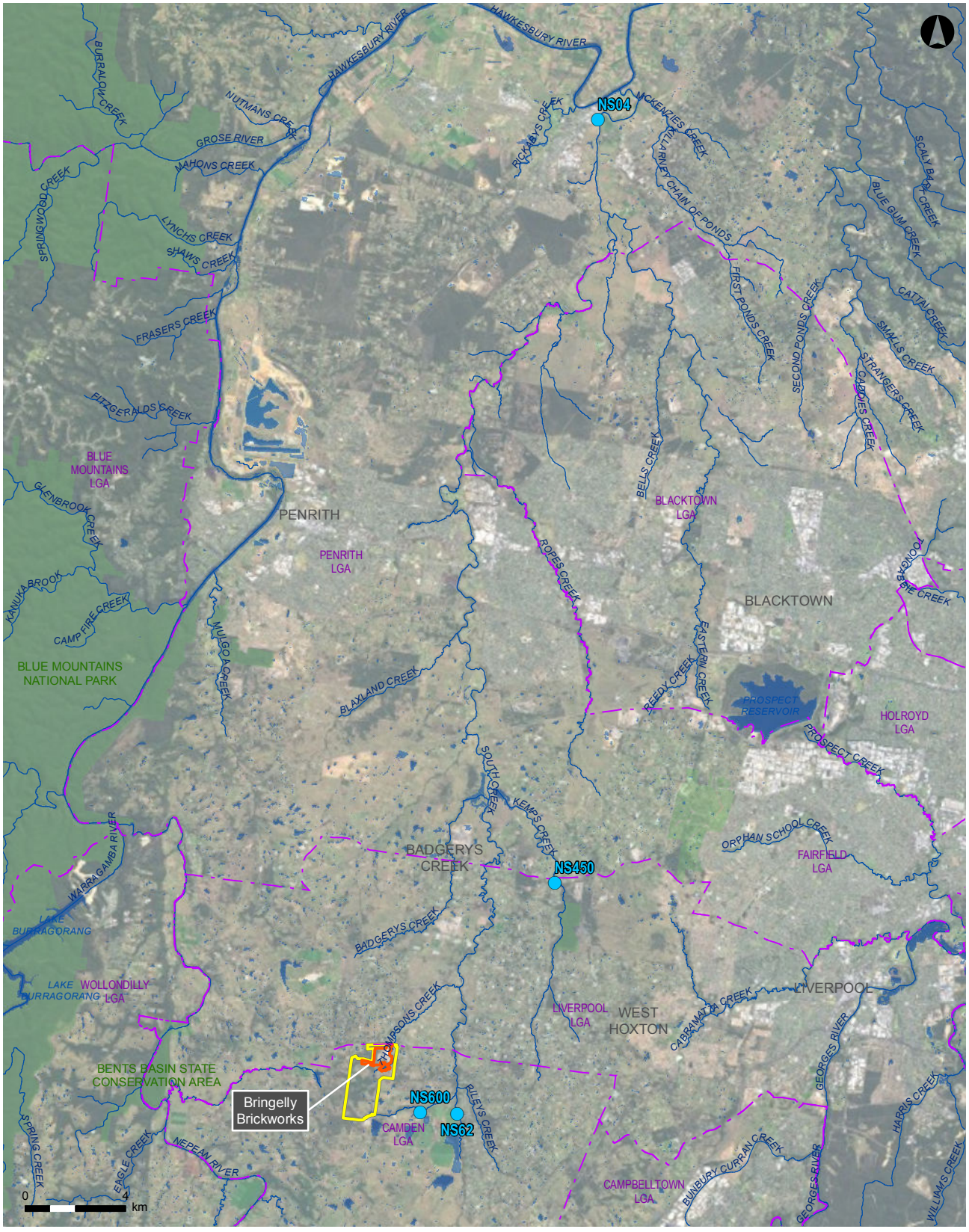
As discussed above, all discharges from the project site ultimately drain to South Creek. A baseline water quality study for South Creek catchment was undertaken by Sydney Water to establish the baseline environmental conditions of watercourses that could be affected by the growth of both South West and North West Growth Areas. This highlights the following attributes for water quality in the Upper South Creek catchment (Hassan *et al,* 2009):

- Nutrient concentrations for all sites, including tributaries of South Creek were found to be higher than the recommended concentrations for protection of aquatic ecosystems.
- Chlorophyll-a values higher than guideline values for most upper South Creek monitoring locations.
- Faecal coliforms and *Enterococci* exceed the ANZECC primary contact recreational water quality guidelines at almost all sites. Possible sources of pollution include stormwater discharges, agricultural activities and pre-existing bacterial population in the slopes and sediments of the catchment.
- Dissolved oxygen saturation levels were generally low and below the guideline value for the majority of sites.
- Turbidity levels were very high at most of the sites of South Creek indicating poor land and riparian management.

The above findings indicate that South Creek is a highly degraded system whereby water quality is impacted by a diverse range of land uses including rural, grazing, market gardening, intensive agriculture as well as both urban and industrial uses (Hassan *et al,* 2009).

The South Creek catchment has also been identified as a highly saline catchment, which is demonstrated from a review of historical water quality data for Sydney Water monitoring stations located in the South Creek catchment. Elevated conductivity results were observed at Upper South Creek (NS62), Lowes Creek (NS600) and Kemps Creek (NS450) during 2003, with maximum concentrations of 677, 683 and 477 uS/cm recorded respectively at each of these monitoring sites (Figure 7-27). A study by Nicholson (2012) also found that rivers and streams in the Upper South Creek catchment carry high salinity and high salt loads from the surrounding landscape. These results highlight the influence of the local geology on conductivity in the upper South Creek catchment area.

Maximum conductivity concentrations were significantly higher for the downstream monitoring locations at South Creek with a maximum concentration of 1331 uS/cm recorded in May 2012. Average historical conductivity concentration with levels of 900 uS/cm. This may also be attributable to the influence of discharges from sewage treatment plants in the lower South Creek Catchment (Hassan *et al.,* 2009).



LEGEND

- Project site
- Property boundary
- National Parks
- LGA boundary
- Water monitoring station
- Watercourses

Map scale: 1:225,000 at A4

DATA SOURCES
Boral, LPI

Imagery: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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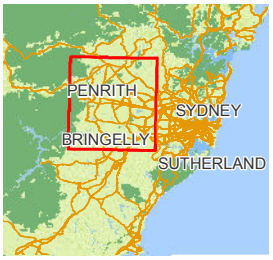


Figure 7-27: Water quality monitoring stations in South Creek

Date: 29/08/2013 Path: \\hc-aus-ns-fs-01\jobs\AA005667\L-GIS\A_Current\B_Maps\EIS\AA005667_EIS_F007-27_WaterMonitoring_r3v1.mxd
Created by : DD
QA by : LD

Project site

Discharges from the project site are subject to an EPL issued under the POEO Act. The EPL sets water concentration limit values for the project site for Dam 1 and Dam 6, the latter being located in the headwaters of Thompsons Creek. Water quality limit values specified in the EPL are shown in Table 7-41.

Table 7-41 Water quality limit values included under EPL 1808 for the project site

Pollutant	Limit value
Conductivity	700 uS/cm
Oil and grease	10 mg/L
pH	6.5-8.5
Total Suspended Solids	50 mg/L
Turbidity	150 NTU

Typically the limit value for conductivity as stipulated by ANZECC for upland streams, such as Thompsons Creek is 350 uS/cm. The EPL conductivity limit value is 700 uS/cm, which is likely to be attributable to the high salinity potential of the local geology and hydrogeology underlying the project site. This is discussed further in Section 7.2.

A review of annual returns submitted for EPL1808 submitted under the POEO Act indicates that the project site is generally compliant with all water quality trigger values outlined in Table 7-41. Notwithstanding this finding there have been some exceedances of conductivity limit values for discharges from Dam 6 to Thompsons Creek. A Pollution Reduction Program (PRP) is currently being implemented by Boral, consisting of regular sampling of conductivity levels in water management storage structures (Dam 5) and Thompsons Creek upstream and downstream of the discharge point from Dam 6. The key purpose of this PRP is to obtain further background data to provide improved information on potential causes of elevated conductivity.

Table 7-42 provides water quality results for conductivity for Dam 6, including upstream and downstream of the storage in Thompsons Creek for the period of 25 November 2011 to 15 March 2013. On 25 November 2012 and 10 February 2012 there were exceedances of the EPL for conductivity.

Table 7-42 Conductivity monitoring results for Dam 5, Dam 6 and Thompsons Creek

Monitoring period	Conductivity (uS/cm)			
	Dam 5	Thompsons Creek – Upstream of Dam 6	Dam 6	Thompsons Creek - Downstream of Dam 6
25/11/11	N/A	1010	992	1420*
10/2/12	N/A	114	946	904*
6/3/12	N/A	252	581	768*
13/3/12	N/A	417	440	667
30/3/12	N/A	401	381	585
18/4/12	N/A	422	280	570
15/12/12**	720	530	530	520
30/1/13	N/A	580	580	580

Monitoring period	Conductivity (uS/cm)			
	Dam 5	Thompsons Creek – Upstream of Dam 6	Dam 6	Thompsons Creek - Downstream of Dam 6
15/2/13	720	530	530	520
1/03/13	540	105	470	480
15/3/13	570	440	430	450
3/4/13	940	530	510	530
15/4/13	1340	580	580	580

*Exceedance of EPL 1808
**Commencement of PRP

Dam 5 receives runoff waters from exposed strata and waters pumped from the quarry pit. High levels of conductivity are likely to be directly influenced by the presence of clays and shales that exhibit a very high salinity potential. Conductivity levels have been observed to increase during dry periods as result of evaporation processes. Notwithstanding this finding, available water quality data collected under Boral's PRP since 15 December 2012 demonstrates that the water management train reduces conductivity between Dam 5 and Dam 6. In addition there has not been an exceedance of the EPL for conductivity since the 6th March 2012.

7.6.3 POTENTIAL IMPACTS

The progressive expansion of quarrying operations at the project site will effectively result in an increase in on-site water storage capacity. Over time, this will result in a reduction in off-site discharges from Dam 6 to Thompsons Creek. Notwithstanding this finding, the loss of some water management structures, such as Dam 2 will have the potential to result in localised stormwater runoff impacts.

Notwithstanding this finding, given that the development project is for an expansion of the quarry footprint from ~9.9 hectares to 30.65 hectares, there is the potential for impacts on water quality of surrounding/downstream drainage systems if potential stormwater runoff impacts are not managed appropriately.

Stormwater runoff and water access

In order to manage stormwater runoff and minimise discharges from the project site under existing operations, runoff currently draining to Dam 2 will be re-diverted to an enlarged Dam1. The Quarry pit sump (Dam 3) will also be expanded as a result of quarry operations to ensure there is no increase in discharge frequency to Thompsons Creek.

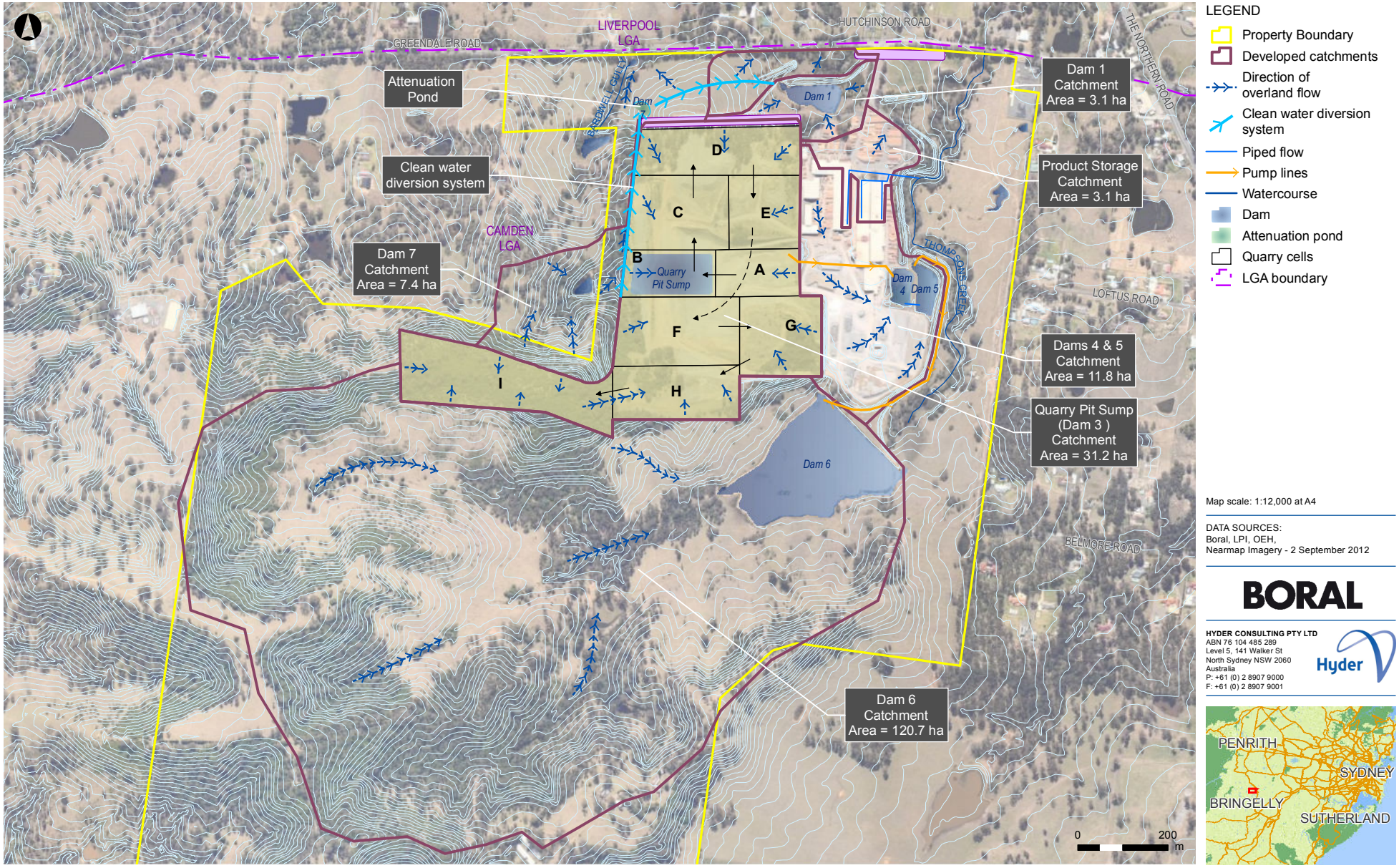
Over the life of the project, the following changes to stormwater management would occur:

- Dam 2 will be removed following the commencement of quarrying in Cell D. Runoff from the material storage facility/area will be re-directed to Dam 4.
- The central water storage located in Cell A will be shifted to Cell B following the cessation of quarrying in Cell A and B. Water will be pumped during quarrying campaigns into Dam 4. Flocculent is added to water pumped from the quarry via a dosing pit on route to Dam 4. The majority of the sediment in the pumped quarry water settles out in Dam 4. When Dam 4 becomes full it overflows into Dam 5 where further sediment fall out takes place. When Dam 5 becomes full the water is pumped to Dam 6. The overflow between Dam 4 and Dam 5, the area from where water is pumped in Dam 5 and the discharge point at

Dam 6 are also all fitted with floating sediment curtains, as an additional mitigation measure to reduce the levels of sediment entering Dam 6.

- A clean water diversion bund and swale will be constructed along the western boundary of the quarry, adjacent to Cells B, C and D to divert runoff to the north western corner of Cell D where it will overflow into Dam 1, during high rainfall events and dissipate into the Bardwell Gully sub-catchment.
- Total quarry operational footprint increases from 9.9 hectares to 30.65 hectares. The volume of water management structures on the project site will increase from 406.350 mega litres to 443.170 megalitres under the final proposed developed condition.
- Dams 1, 4, 5, and 6 to have catchment areas of 3.1, 8.8, 3 and 120.7 hectares, respectively. The central quarry pit, located in Cell B will have a catchment area of 31.2 hectares.
- Boral will actively investigate and pursue opportunities for reuse of water for other beneficial purposes such as use of on-site water for dust suppression and irrigation.
- Increase of treated effluent discharge from 3,800 litres per day (area of irrigation 0.25 hectares) to 7,200 litres per day (area of irrigation 0.5 hectares).

An overview of surface water management structures associated with the final developed condition of the project site is presented in Figure 7-28.



LEGEND

- Property Boundary
- Developed catchments
- Direction of overland flow
- Clean water diversion system
- Piped flow
- Pump lines
- Watercourse
- Dam
- Attenuation pond
- Quarry cells
- LGA boundary

Map scale: 1:12,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012

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Hyder

Figure 7-28: Proposed surface water management

Water balance modelling

To support the EIS, a water balance model based on a single 'worst case scenario' was developed for both the "existing" and "developed" condition for the project site. The objective of the water balance modelling was to assess the ability of the project site to provide on-site water detention and to understand potential changes in surface water drainage. The modelling involved two components:

- Estimating the minimum stormwater storage requirements of each water management structure to contain runoff from a 90th percentile 5 day rainfall event.
- Water balance modelling to develop strategies for minimising off-site discharges over a 10 year period.

Modelling approach

The modelling approach is defined in the Surface Water Management Report (Hyder, 2013), included in Appendix I to this EIS. Modelling was undertaken in accordance with *Managing Urban Stormwater: Soils and Construction – Mines and Quarries* (DECC, 2008). This guideline recommends carrying out water balance modelling with a daily time-step over a ten year period when assessing the performance of internal quarry storages. The major inflows and outflows of the project site considered in the water balance are shown in Table 7-43.

Table 7-43 Summary of inflows and outflows

Inflows	Outflows
Initial system storage	Evaporation from pit surfaces
Direct rainfall onto pit surface	Seepage losses (assumed to be negligible)
Rainfall/runoff within catchment	

Modelling results

The results of modelling in relation to available storage capacity to accommodate the 90th percentile five day rainfall event are presented in Table 7-44.

Table 7-44 Available site storage capacity to respond to a 90th percentile, 5 day rainfall even

Catchment	90th Percentile, 5 day Volume (m^3)
Dam1	4,000
Dam 2	____*
Quarry pit sump (Dam 3)	381,500
Dam 4	3,350
Dam 5	3,020
Dam 6	50,000
Dam 7	1,300
Total	**443,170 (47,784)**

* Dam 2 will no longer exist after commencement of material extraction from cell 'D' and therefore all water from the existing dam 2 catchment will flow into dam 1.
** Proposed storage volume upstream of dam1, located on central northern boundary of project site to hold the diverted runoff from western off-site catchment.

Allowing for sediment loading, all dams and pits have the capacity to contain runoff of approximately 48 mega litres from a 90th percentile, five day rainfall event for the project site.

Detailed results of the ten year water balance modelling for the project site are provided in Appendix I. The results show that the proposed development will result in an increase of disturbed area and changes to the existing catchments. This will in turn cause higher volumes of runoff into the quarry storage (quarry pit). However, through expansion of the quarry, the utilisation of redundant voids will present opportunities for capture and retention of increased runoff volumes. Therefore, the combined capacity of water storages on the project site, including current and proposed will be sufficient to contain runoff and maintain authorised discharges to Thompsons Creek at current levels.

Under post-operating conditions, pumping of water from the quarry pit to Dam 4 will not be required. All runoff from the project site catchments will be effectively contained within the quarry water storage structures with no requirement for pumping to Dams 4 and 5,

The increase in the site's brick production rate will correlate to an increase in the number of the staff based at the project site. Staff numbers will increase from 38 (current) to 72 people when maximum production capacity is realised. Therefore, using an industry standard of 100 litres per day, it is there will be an increase in requirements for effluent discharge from current levels of 3,800 litres per day to 7,200 litres per day. The current approved effluent irrigation area will also need to increase its current footprint from 0.25 hectares to 0.5 hectares to account for the increase in sewage volumes.

Water access

The *Water Management Act 2000* identifies basic landholder rights and when access licences are required. The harvestable water right is defined in terms of an equivalent dam capacity, the Maximum Harvestable Right Dam Capacity (MHRDC). Schedule 1 of the *Water Management Regulation 2011* exempts certain classes of dam including those 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. Therefore, as the on-site dams are used solely for the capture, containment and reticulation of drainage, consistent with best management practice to prevent impacts to Thompsons Creek, the dams are exempt from the need to obtain a licence under the WM Act.

Water quality

The development of future quarry pits would alter surface water flow and sub-catchments across the project site and would also increase the area of surface disturbance, resulting in greater potential for water quality impacts, including:

- Increased potential for erosion and sedimentation resulting in associated increased potential for sediment laden runoff to enter surrounding waterways, which in turn potentially increases turbidity and degradation of water quality.
- Increased potential for contamination of soil and water resulting from accidental spillage of fuel from vehicles or machinery entering nearby waterways.

A Soil and Water Management Plan will be developed in accordance with the principles established in *Managing Urban Stormwater Soils and Construction: Volume 2E Mines and Quarries* and implemented for the project site to mitigate potential water quality impacts.

The development of the future quarry pits would alter surface water flow and sub-catchments across the project site. The majority of runoff water from the project site will be flow to the quarry pit in Cell B where it would be used for dust suppression, stored within the cell or transferred to other water management structures during active quarrying.

As discussed in Section 7.6.6, there have been some exceedances of the project site's EPL with regard to conductivity for discharges from Dam 6 into Thompsons Creek. Discharges from the project site are not considered likely to significantly impact environmental condition within Thompsons Creek or South Creek due to the highly degraded nature of the catchment systems and the high salinity values observed upstream and downstream of the discharge point from Dam 6.

Value of watercourses

The project will not have any significant impacts on the existing condition of nearby watercourses, including Thompsons Creek, Bardwell Gully and South Creek. These systems are characterised by degraded environmental conditions as previously outlined in this section.

There will be no increase in the frequency of discharges over and above current levels and therefore no additional impacts on riparian environments, including geomorphology and environmental flows. As discussed in Section 7.6.1, an environment protection licence is currently in place to regulate discharges to Thompsons Creek. The EPL will be amended to accommodate the project.

The project will not impact significantly or be impacted by flooding as outlined in this section. Dam 6, located in the headwaters of Thompsons Creek has changed the natural hydrological regime of this creek; however, this structure has been in place since the 1960s and no changes to Dam 6 are proposed as part of the Bringelly brickworks and quarry expansion.

Potential impacts on riparian and ecological values of Thompsons Creek and/or its tributaries are discussed in detail in the flora and fauna technical report (Appendix K) and in Section 7.8.

Flooding

A review of a flood study prepared for the Upper South Creek catchment shows that a small area of the project site are potentially impacted by Probable Maximum Flood Levels and the five per cent Annual Exceedance Probability (AEP) event. Boral have constructed a bund wall for visual screening and noise attenuation along the eastern boundary of the project site, extending from the brickmaking facility to the raw material storage area and finishing adjacent to the Dam 6 headwall located in the south eastern margin of the site boundary. This bund shown in Figure 7-26 has a maximum height of six metres and also serves as a mitigant for flood waters from the Thompsons Creek catchment entering the project site. The site has been operational since the mid-1960s and over this period there has been no evidence of flooding at the project site.

The brickmaking facility, material storage facility and quarry cells are largely located outside flood prone areas identified on Council flood maps (refer to Figure 7-26).

Given that the location of current or future proposed quarrying is not within the flood plain of the Upper South Creek catchment, the project is unlikely to impact on the natural functioning of the floodplain. The quarry pits themselves will also not be at risk from flooding.

Water users

The project will not result in any significant impacts on downstream water users. Boral do not currently extract water from the Upper South Creek catchment and will not require a licence to meet proposed water demands to support quarry expansion works. All current and on-site water demands will be met by a combination of potable water, on-site water and water imported from industrial recycling schemes.

Therefore the project will operate in accordance with the requirements of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011*.

7.6.4 MITIGATION MEASURES

Soil and water management on the project site is well established through implementation of an existing Stormwater Management Plan for the site and an existing Environment Protection Licence and Pollution Reduction Program, regulating discharges to Thompsons Creek and Bardwell Gully. Key soil and water mitigation strategies currently implemented on the project site include bunding, sediment booms, emergency spill kits and water quality monitoring in compliance with the EPL.

A Surface Water Management Report has been prepared to support the environmental assessment for the project. Many of the mitigation strategies documented in the current stormwater management plan will continue to be implemented on the project site over the life of the project. Additional stormwater mitigation strategies to be implemented for mitigation of potential impacts include:

- Reconfiguration of the catchment to proportion runoff going to storage pits according to their storage capacity. This will result in the separation of clean and dirty water flows as well as minimising frequency of discharges to Thompsons Creek. This will include the construction of a stormwater diversion along the western boundary of the quarry, along cells B, C and D resulting in the diversion of runoff from an approximately six hectare area to the west of the quarry and into a new stormwater attenuation pond. This pond will be constructed as a dry dam and will attenuate storm flows before releasing water into Bardwell Gully which will in turn discharge to Thompsons Creek.
- Investigation of options for the reuse of water stored on-site for beneficial use in order to increase the on-site water extraction regime, improve on-site storage capacity and reduce discharges to Thompsons Creek. Key potential uses will include using water from the Quarry Pit, Dams 4 and 5 for dust suppression activities associated with routine operations and extraction campaigns as well as for irrigation of noise bunds to reduce fire hazard as a result of dry grass build up.
- Continue to implement monitoring under PRP to determine background salinity levels in the Thompsons Creek catchment.

Additional mitigation measures to be implemented on the project site for the proposed operations include:

- Continued use of drains, silt fences and bunding to direct site runoff into appropriate sediment basins and to control erosion.
- Stabilisation of temporary stockpiles in accordance with the Rehabilitation Strategy to minimise the risk of erosion.
- Use of flocculants in sediment basins to increase sediment removal rates, where required.
- Routine maintenance of silt curtains located in Dams 4 and 5, where required.
- Routine maintenance and inspection of drains, sediment basins and bunds.
- The continued use of a combination of town water and potential use of recycled industrial water for the brickmaking process.

7.7 GROUNDWATER

7.7.1 OVERVIEW

A groundwater impact assessment was prepared by Golder Associates (2013) to establish a reasonable understanding of the groundwater system upon which to evaluate potential impacts from Boral operations on groundwater resources within and around the project site. Environmental values were assessed to help identify any highly productive groundwater (as defined by the *NSW Aquifer Interference Policy*), groundwater dependent ecosystems (GDEs), and/or existing registered groundwater users. Potential impacts were identified, as well as necessary management and mitigation measures. Licensing requirements or other approvals under the *Water Act 2012* and/or *Water Management Act 2000* were also identified.

7.7.2 METHODOLOGY

Key legislation and policies applicable to ground water issues relevant to the project were reviewed to inform the assessment. An understanding of the controlling factors for the behaviour of groundwater was established from a review of the site characteristics and existing site data relevant to climate, geology, hydrogeology, environmental values, groundwater vulnerability, and existing registered groundwater users.

Groundwater sampling was carried out during the field investigations using four monitoring bores (GW01, GW02, GW03 and GW04). Samples were analysed by a NATA accredited laboratory. Groundwater quality data was compared to the regulatory guidelines in order to assess their environmental values and vulnerability of groundwater resources.

Following the baseline data characterisation, different site datasets were used in the development of a hydrogeological conceptual model to describe the controlling factors in groundwater flow and occurrence in the project area. The conceptual model reflects an interpretation of the hydrogeology of the project area including hydrostratigraphic units, aquifer connectivity, recharge and discharge, groundwater levels and hydraulic parameters and groundwater quality. Total groundwater inflows to the final quarry pit were estimated using an analytical method. The anticipated groundwater flow to the quarry pit was estimated using the AnAqSim [Analytic Aquifer Simulator] software. AnAqSim utilises the analytic element method (AEM), which superposes analytic solutions to yield a composite solution consisting of equations for head and discharge as functions of location and time.

The potential groundwater impacts and risks as a result of the project were assessed using a risk-based framework. The risk-based approach allows potential groundwater related risks associated with proposed mining activities to be considered and classified with respect to multiple evaluation criteria, such that the primary risk-driving activities are identified, prioritised and mitigated accordingly. The significance of the groundwater impacts was assessed based on the magnitude of the impact and the sensitivity of resource/receptor. The impact significance assessment results of the groundwater impact assessment were then used in the risk assessment. The necessary management/mitigation measures and groundwater monitoring strategy to manage impacts were recommended based on results of the impact assessment.

7.7.3 EXISTING ENVIRONMENT

The project site is located within the ‘Hawkesbury Nepean Water Management Area’ and within the ‘Sydney Basin Central Groundwater Source’. The Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 applies to the project. The project site sits within the Hawkesbury-Nepean Catchment, which is the largest catchment area in the Sydney area (approximately 21,400 square kilometres).

The site is located within a sequence of interbedded claystone, siltstone, laminate and sandstone known as the Middle Triassic Wianamatta Group, which crops out over a wide area to the west of Sydney. The group forms the upper most part of the Permo-Triassic sequence which comprises the Sydney Basin sediments and is divided into three formations (Bringelly Shale, Minchinbury Sandstone, Ashfield Shale). The upper unit is the Bringelly Shale, a formation dominated by claystone and siltstone with thin laminate horizons and minor sandstone. This is underlain by Minchinbury Sandstone, a 3–6 metre thick quartz lithic sandstone; followed by the Ashfield Shale which comprises sandstone-siltstone laminate and sideritic claystone. The Wianamatta Group is underlain by Hawkesbury Sandstone. The project site is underlain by the lower 75 metres to 150 metres of the Bringelly Shale which comprises claystone, siltstone, laminate and sandstone. The base of the sequence in this area is defined by the Cobbity Claystone, a thin (maximum six centimetres) persistent layer of weathered tuff. Alluvium (sands and gravels, fined-grained sand, silt and clay) derived from surrounding rocks are present along streams such as Thompsons Creek and Bardwell Gully.

The hydrogeology of the project site is mainly controlled by the geology. Hydrostratigraphy units within the Wianamatta Group comprise the Bringelly Shale, Minchinbury Sandstone and Ashfield Shale Units. The Bringelly Shale unit can be characterised as low permeability, majority of groundwater flow via fractures and bedding planes, a layered aquifer system with limited inter-connection between zones, the groundwater potentiometric surface generally follows topography. Groundwater levels varied from 60 to 76 metres AHD. A weathered unit overlies the Bringelly Shale and perched shallow groundwater can occur within this layer at places. As the Bringelly Shale formation within the project area is very low yielding and of low quality and does not have high environmental values. The Bringelly Shale groundwater is not considered to be ‘high productive’ water source based on the *NSW Aquifer Interference Policy* criteria.

The regional groundwater system is recharged by rainfall recharge and discharge via evaporation, evapotranspiration and discharge to creeks to the creeks to the east of the project site and to the Hawkesbury-Nepean system to the north.

There are no existing registered groundwater bores within the project site based on search results of the NSW Office of Water groundwater bore database and NSW Natural Resource Atlas.

There are no high priority GDEs springs or national parks located within the project site. South Creek is categorized as a GDE category ‘Reliant on surface expression of groundwater (rivers, springs, wetlands) and the zone along the creek is rated as area of ‘high’ vulnerability rating based on the vulnerability mapping from NSW Atlas. South Creek is located approximately 2.5 kilometres to the east of the project site. Results of the search for groundwater dependent ecosystems from the National Atlas of GDEs indicated the following GDEs (Category ‘Reliant on subsurface groundwater – vegetation’) within the project site: Cumberland Shale Hills Woodland, Cumberland Shale Plains Woodland and Cumberland River Flat Forest.

7.7.4 POTENTIAL IMPACTS

The groundwater impact assessment in this report focuses on the impact and risks arising from the continuation and expansion of the quarry pit. The current Bringelly quarry operations already have existing environmental approvals. The key impacts of the project on the groundwater regime during quarry operations are summarised in this section.

Potential impact on groundwater levels and flow

The impact of the project on groundwater levels is expected to be localised, and limited mainly to the vicinity of the quarry pit. There will be no impact to groundwater flow system when the excavation depth of the quarry pit extension is above the groundwater levels. The predictive modelling results indicated a negligible change in groundwater regional flow direction as a result of the proposed activities. It is not envisaged that the groundwater seepage into the open cut

quarry areas could potentially induce groundwater flow from neighbouring strata (from the underlying sandstone aquifers).

An analytical groundwater model was developed to assess potential changes to groundwater heads due to the project and total groundwater inflows to the final quarry pit. Model assumptions are conservative including groundwater level as the highest water level observation within the project site (76 metres AHD) and the pit depth as the maximum depth of the proposed quarry extension (30 metres below ground level).

The two predictive model runs show two extremes of the potential impact of pit deepening. The low hydraulic conductivity case (Scenario A) has minimal inflow and essentially no impact on groundwater levels. The high hydraulic conductivity case (Scenario B) permits the influence of the pit to extend beyond two kilometres with an estimated inflow of one litre per second after 10 years of maximum drawdown. Interpretation of the impact model results, combined with site information and the conceptual model suggests that the likely impact will lie between these results. With local surface water feature essentially isolated, above the groundwater table, any impacts from pit deepening are likely to be sufficient small to be unnoticeable.

The modelled total groundwater inflow to the final quarry pit is estimated to be 0.1-1 litres per second with a likely inflow of 0.1 litres per second (Scenario A). If there is water ponding in the pit during the time quarrying ceases then groundwater may actually being recharged during this time and groundwater withdrawn during quarrying is recharged during the time the pit is allowed to fill. It is envisaged that the actual groundwater loss per year during the quarry expansion is less than the estimated annual inflows based on a conservative modelling approach.

Potential impact on surface water systems

There is no measureable groundwater impact expected on Thompsons Creek, Bardwell Gully and South Creek as a result of the quarry pit extension. Thompsons Creek is fed from rural, residential and urban drainage and demonstrates poor water quality. Bardwell Gully, a drainage channel on the site's northern boundary, flows north under Greendale Road and into Thompsons Creek. Section 7.6 provides more detail related to potential surface water impacts.

Available information suggests the water table lies well below the base of the Thompsons Creek and Bardwell Gully and does not intersect these surface drainage lines. The depth to groundwater level is generally observed at GW01 to GW03 in the project site as being 10 to 26 metres below ground surface. It is inferred that the groundwater does not provide baseflow to these creeks. It is envisaged that the pit dewatering will not have impact on Thompsons Creek and Bardwell Gully.

The groundwater vulnerability mapping indicated that South Creek is a GDE category 'Reliant on surface expression of groundwater' (NSW Natural Resource Atlas, accessed June 2013) and it is inferred that the baseflow condition occurs at South Creek. Increased salinity close to watercourses and drainage lines has been observed, probably reflecting discharge of deep groundwater from the Bringelly Shale. The modelled drawdown does not extend to the South Creek in Scenario A and is less than 0.2 metres at South Creek in Scenario B; therefore, the impact on this receptor is considered to be low.

The Bringelly Shale groundwater has high salinity; however, Boral will monitor the water quality at Thompsons Creek Dam (Dam 6) to ensure that the discharge complying with requirements in the existing Environment Protection Licence.

Potential impact on groundwater quality

There is the potential for spills and contamination by metals and hydrocarbons from the machinery, waste disposal, waste oil used in maintenance of equipments and fuel storage areas; however, adequate bunding and immediate clean-up of spills which is standard practice and/or a legislated requirement at the project site should prevent contamination of shallow strata and subsequent leakage to the groundwater system.

Potential impacts on registered bores

There is no registered groundwater bore within the project site. Based on the extent of the predicted drawdown in the Bringelly Shale formation associated with the project, no private groundwater users have been identified as being affected or potentially affected by the project.

Impact on groundwater dependent ecosystems

There are no identified 'high priority' GDEs within or surrounding the project area. Within the project site, there are no river base flows, no karst or cave ecosystems, no known springs that are fed by groundwater around which groundwater dependent ecosystems have developed. No GDEs category 'Subterranean' were identified within the project site based on information from the Australian National Atlas of GDEs.

Results of the search for groundwater dependent ecosystems from the National Atlas of GDEs indicated the following GDEs Category 'Reliant on subsurface groundwater – vegetation': Cumberland Shale Hills Woodland, Cumberland Shale Plains Woodland and Cumberland River Flat Forest.

These woodlands are likely to be supported by localised perched water near the surface or rainfall. The likelihood of this receptor being impacted because of the loss of quantity of deeper groundwater in Bringelly Shale (10 to 26 metres below ground surface) due to quarry operations is low as the drawdown caused by the project is limited and that the slight lowering in groundwater table is not likely to stress the woodland. Where terrestrial ecosystems (vegetation) are rainfall dependant and not connected to the groundwater system, the quarrying and associated dewatering would have no impact on this receptor.

It is envisaged that the baseflow in South Creek will not be affected by the potential groundwater drawdown at the quarry pit extension; therefore, any GDE that may occurs in the South Creek will not be impacted by the project.

Post-operation recovery of groundwater levels

During the post-operation stage, the groundwater will slowly enter the open pit and eventually an equilibrium water level will be reached over time. It is anticipated that the surface water runoff will fill the open pit the cessation of operations and the pit water may represent a source of fresh water recharging the local groundwater if the pit water level is higher than the groundwater level. It is likely that no long term impact on post operation groundwater levels would be observed at any significant distance from the pit.

7.7.5 MITIGATION MEASURES

The following mitigation measures would be implemented to avoid and minimise potential impacts to groundwater:

- Boral will engage a regular (biannual) water quality sampling and groundwater level monitoring program in order to establish seasonal trend records of water quality and identify outliers in any key parameters.
    - Depth to groundwater will be measured and reported during each monitoring event. Field physico-chemical measurements of groundwater including EC, pH, temperature and dissolved oxygen should be collected during purging and sampling using a calibrated water quality meter.
    - Groundwater samples should be collected and analysed at a NATA accredited laboratory for EC, pH, TDS, major cations (Na, K, Ca, Mg) and major anions (Cl, SO4, alkalinity).
    - Trigger levels, regarding declines in groundwater levels and the degradation of groundwater quality, will be established to manage the potential impacts as part of the project environmental management plan.
    - Where monitoring results indicate levels in excess of the trigger values, an investigation appropriate for the situation will be conducted to assess the need to implement management/mitigation/remedial measures.
- The monitoring and exploration wells are designed, constructed and decommissioned to limit the risk of interaction between aquifers/saturated zones according to the Australian guidelines/standards.
- Fuel and chemical storages will be constructed and adequately bunded to the relevant Australian Standard. Accurate records of oil volumes, purchased, used, disposed, and recycled will be maintained.
- Spill containment procedures will be implemented to prevent migration and exposure of chemicals.
- Boral will ensure correct protocols regarding cleaning up of spills or leaks. Spill clean-up kits will be in accordance with Australian Standards (AS1940 and AS3780) and will be kept on site.
- Any significant leaks or spills of hazardous materials will be cleaned up according to appropriate emergency clean-up operations. Immediate clean-up of spills, which is standard practice and/or a legislated requirement at mine sites, will prevent contamination of shallow strata and subsequent leakage to the groundwater system.
- The proposed rehabilitation management and monitoring plans will be reviewed and altered as necessary.

7.8 BIODIVERSITY

7.8.1 OVERVIEW

The project site is located in the SWGC, with much of the proposed quarry expansion being contained in certified areas under the biodiversity certification in the Growth Centres SEPP. Vegetation at the project site and surrounds is highly modified and fragmented as a result of historical clearing due to agriculture and quarry activities. A comprehensive Ecological Assessment (Hyder Consulting 2013, Appendix K) was completed to address the relevant DGRs for the project. These include:

- Measures taken to avoid, reduce or mitigate impacts on biodiversity.
- Accurate estimates of proposed vegetation clearing.
- A detailed assessment of potential impacts of the development on:
  - Terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems.
  - Regionally significant remnant vegetation or vegetation corridors.
  - Impacts on Existing Native Vegetation (ENV) identified under the Biodiversity Certification Order for the Sydney Region Growth Centres.
- A comprehensive offset strategy to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long-term.

This section presents a summary of the findings of the Ecological Assessment. The full report is contained in Appendix K.

7.8.2 STUDY METHODOLOGY

The Ecological Assessment included undertaking database searches, a literature review and evaluation of vegetation mapping which informed the methodology for the field surveys. The field surveys were conducted on 23rd and 31st January 2013, and included random meanders, targeted searches, plot based surveys, vegetation condition assessments, terrestrial fauna habitat assessment including hollow-bearing tree surveys and an assessment of aquatic habitat values.

The area surveyed in relation to the Bringelly Brickworks project is depicted within Figure 7-29 and is defined as the ecological study area. Detail of all aspects of the survey is included within Appendix K.

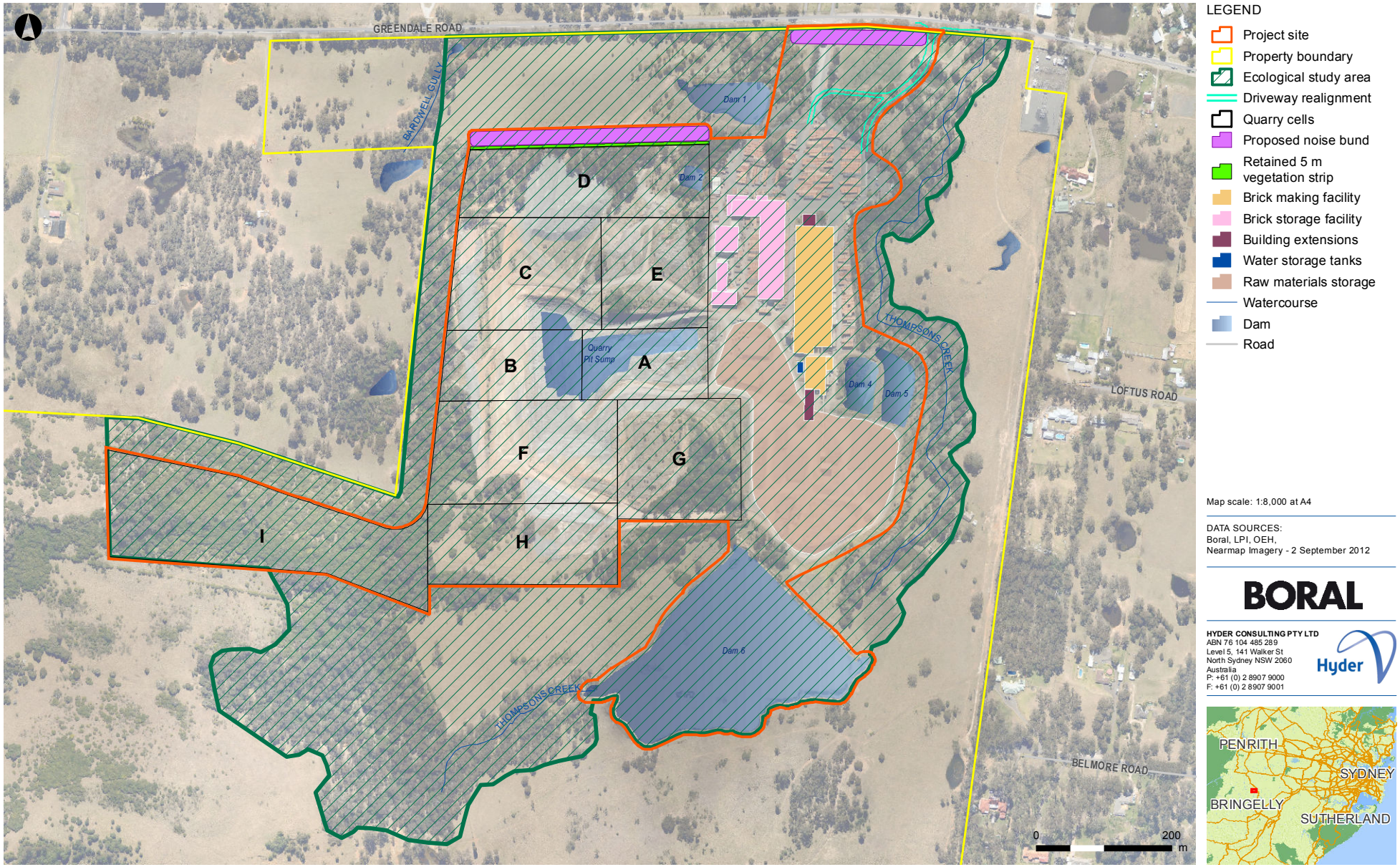

Figure 7-29: Aerial showing ecological study area in relation to project site

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7.8.3 EXISTING ENVIRONMENT

FLORA

Ecological communities

Seven vegetation communities were identified within the ecological study area. Areas of each vegetation community within the ecological study area are provided in Table 7-45.

Table 7-45 Vegetation communities identified in the study area

Vegetation community		Area in study area (ha)
Native vegetation	Moderate Condition Cumberland Plain Woodland	15.12
	Poor Condition Cumberland Plain Woodland	6.58
	Derived Grassland Cumberland Plain Woodland	0.97
	Poor Condition Riparian Woodland	8.22
Exotic vegetation	Exotic Grassland	14.80
	Mixed Exotic/Planted Native	2.58
	Olive Dominant Woodland	9.02
	TOTAL	**57.30**

These vegetation communities are discussed below and further in Appendix K. A map showing the distribution of the vegetation communities within the ecological study area and project site is provided in Figure 7-31.

Moderate Condition Cumberland Plain Woodland

Areas of Moderate Condition Cumberland Plain Woodland (CPW) had a canopy of regrowth *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum) to approximately 10 to 14 metres in height with an average diameter at breast height (dbh) of 20 to 30 centimetres. The understorey in these areas consisted of patchy cover of *Olea europaea* subsp. *cuspidata* (African Olive) with other native shrubs such as *Acacia implexa* (Hickory Wattle), *Bursaria spinosa* (Blackthorn) and *Melaleuca styphelioides* (Prickly Paperbark) occasionally present. The ground layer varied from sparse native grasses and herbs with high leaf litter to dense native and exotic grasses, including *Themeda australis* (Kangaroo Grass), *Aristida ramosa* (Wiregrass), *Austrostipa scabra* (Speargrass), *Microlaena stipoides* (Weeping Grass) and *Eragrostis curvula* (African Lovegrass). Good cryptogam cover was observed in some patches of these areas. Understorey vegetation in the northeast section of Cell D was particularly weedy, containing exotic species such as *Eragrostis curvula, Bryophyllum delagoense* (Mother-of-millions) and *Chloris gayana* (Rhodes Grass). This area was not dominated by *Olea europaea* subsp. *cuspidata* in the understorey and therefore was not considered to constitute Poor Condition CPW.

Poor Condition Cumberland Plain Woodland

Poor Condition CPW consisted of areas of remnant and regrowth *E. moluccana* and *E. tereticornis* over a dense midlayer of *Olea europaea* subsp. *cuspidata*. In most parts of this community, the *O. europaea* subsp. *cuspidata* is greater than 50 per cent cover and ground layer vegetation is absent, supports Olea seedlings and leaf litter or has been reduced to very sparse cover of native and exotic grasses. These areas only very loosely meet the criteria for CPW and are considered unlikely to be viable in the long term.

Derived Grassland

South of the existing quarry, the stands of tree-dominated vegetation were interspersed with patches of grassland. The grasslands were dominated by native species such as *Themeda australis, Microlaena stipoides, Aristida ramosa and Chloris truncata* (Windmill Grass), with the cosmopolitan native pasture grass *Cynodon dactylon* (Couch) and exotic species such as *Eragrostis curvula, Chloris gayana* (Rhodes Grass) and *Briza subaristata* also present and dominant in patches. Areas of derived grassland are included in the definition of CPW.

Poor Condition Riparian Woodland

Poor Condition Riparian Woodland occurred along Thompsons Creek to the east of the existing quarry. These areas supported scattered large trees of *Eucalyptus tereticornis* with an understorey of scattered *Olea europaea* subsp. *cuspidata* and *Bursaria spinosa* in the south and a denser midlayer of *Melaleuca styphelioides* and *Ligustrum sinense* (Small-leaved Privet) in the north. All areas of Poor Condition Riparian Woodland were in certified areas. This vegetation is in poor condition and loosely meets the criteria for the EEC River-flat Eucalypt Forest.

Olive Dominant Woodland

Areas of Olive dominant woodland support a canopy of *Olea europaea* subsp. *cuspidata* with only occasional eucalypt occurrence. The ground layer is generally absent or supports Olea seedlings and leaf litter, although there are small patches of native and exotic grasses where there are canopy gaps. These areas are not considered to meet the criteria for CPW.

Noxious Weeds

The *Noxious Weeds Act 1993* imposes obligations on occupiers of land to control noxious weeds declared for their area. The control requirements for the classes of noxious weeds recorded in the ecological study area are presented in Table 7-46.

Table 7-46 Weed control classes and requirements

Control Class	Weed type	Control requirements
Class 4	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

Two of the 22 exotic species recorded in the ecological study area are listed as noxious weeds in the Camden Local Government Area (Table 7-47). One of the noxious weeds, *Opuntia stricta* (Prickly Pear) and an additional weed, *Senecio madagascariensis* (Fireweed) are also listed as Weeds of National Significance under the National Weeds Strategy (Australian Weeds Committee 2012).

Table 7-47 Noxious weeds recorded in the ecological study area

Scientific name	Common name	Noxious weed control class	Weed of national significance
Ligustrum sinense	Small-leaved Privet	4	-
Opuntia stricta	Prickly Pear	4	Yes
Senecio madagascariensis	Fireweed	-	Yes

Existing Native Vegetation (ENV)

Under the relevant biodiversity measures (RBMs) of the Growth Centres Biodiversity Certification, clearing of any Existing Native Vegetation (ENV) in the non-certified areas must be offset elsewhere in the Growth Centres. ENV is defined as areas of indigenous trees (including any sapling) that had 10 per cent or greater over-storey canopy cover present, were equal to or greater than 0.5 hectares in area, and were identified as “vegetation” on maps 4 and 5 of the draft Growth Centres Conservation Plan (ELA 2007) at the time the biodiversity certification order took effect. ENV within the ecological study area is shown in Figure 7-30.

The area of mapped ENV within non-certified areas in the ecological study area is approximately 10.7 hectares, of which 1.17 hectares falls within the project footprint. Of the 1.17 hectares of ENV, 1.16 hectares is located to the south of the existing quarry in Cell H and 0.01 hectares overlaps the western tip of Thompsons Creek dam

The mapped ENV in the non-certified areas within the ecological study area was validated using ground-truthed vegetation community data. The areas of validated ENV in the ecological study area and project area are shown on Figure 7-30 and the vegetation communities mapped within areas of ENV in non-certified areas are provided in Table 7-48.

Table 7-48 Vegetation communities mapped within areas of ENV in non-certified areas

Vegetation Community	Areas mapped within ENV in non-certified areas in the ecological study area	Areas mapped within ENV in non-certified areas within the project footprint
Moderate Condition CPW	8.57 ha	0 ha
Poor Condition CPW	1.00 ha	0.26 ha
Derived Grassland CPW	0.1 ha	0.09 ha
Exotic Grassland	0.55 ha	0.39 ha
Olive Dominant Woodland	0.03 ha	0.03 ha
Cleared land	0.45 ha	0.39 ha
Total	10.7 ha	1.16 ha

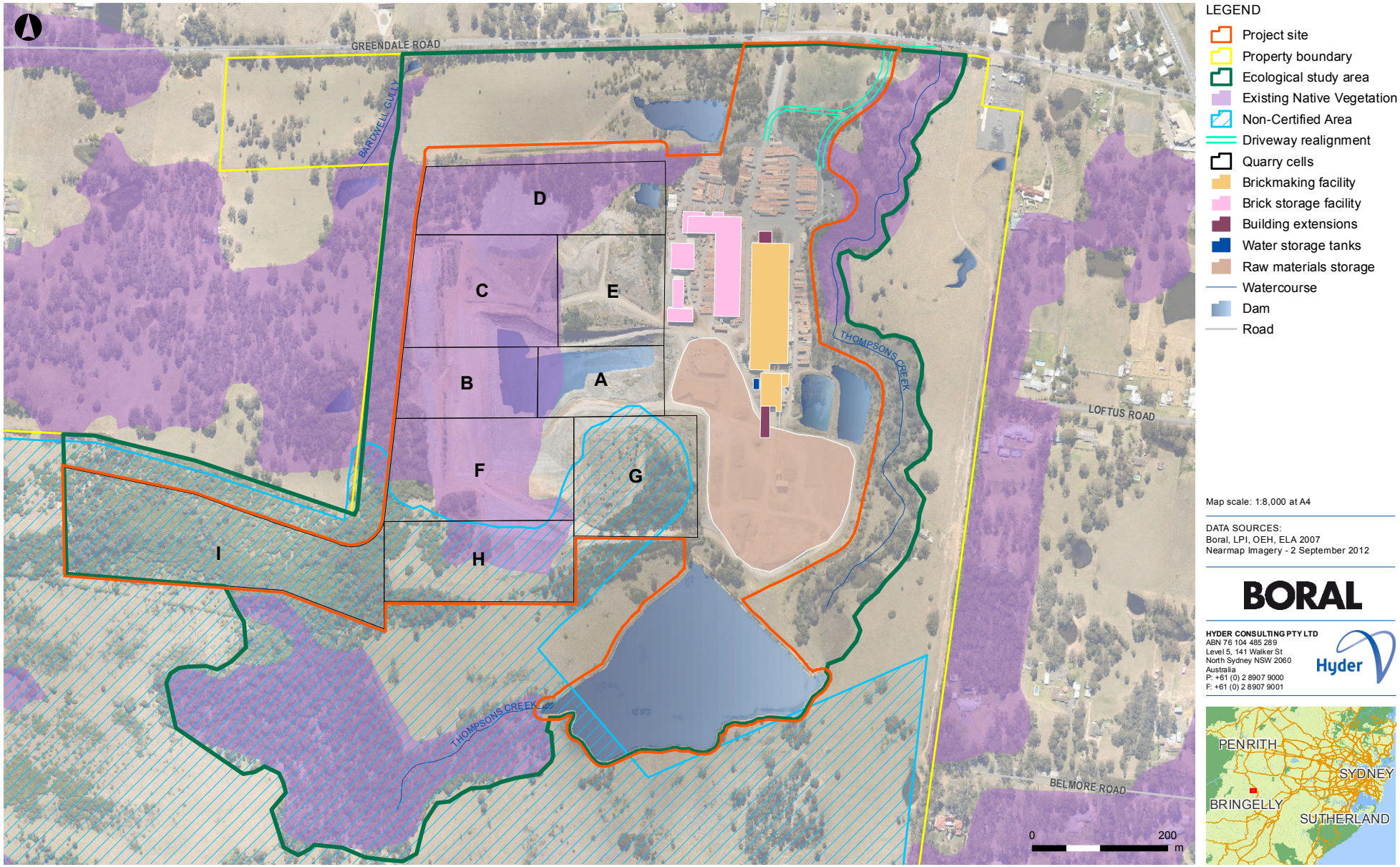

Figure 7-30: Existing Native Vegetation mapped within the study area

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Threatened ecological communities

The EPBC Act Protected Matters Search (Appendix 2 of the Ecological Assessment) identified three Threatened Ecological Communities (TECs) as likely to occur within 10 kilometres of the ecological study area:

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.
- Shale/Sandstone Transition Forest.
- Western Sydney Dry Rainforest and Moist Shale Woodland on Shale.

Shale/Sandstone Transition Forest and Western Sydney Dry Rainforest and Moist Shale Woodland on Shale are unlikely to occur in the ecological study area. CPW does not meet the criteria that define this community under the EPBC Act within the project site; however, it is considered to occur in the south-west of the ecological study area, outside the project site.

Two threatened ecological communities listed under the TSC Act are considered to occur in the ecological study area:

- Cumberland Plain Woodland in the Sydney Basin Bioregion.
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

CPW includes the vegetation communities identified in the ecological study area as listed in Table 7-48.

Threatened species

A habitat analysis was undertaken for threatened flora occurring within 10 kilometres of the ecological study area to determine the likelihood of occurrence within the ecological study area based on suitability of habitat observed during the field survey.

Most of the threatened plant species identified in the database searches were considered to have a low likelihood of occurring in the ecological study area, based on potential habitat and the proximity and number of records of these species in the locality. Native flora habitat in the ecological study area is poor, with stands of *Olea europaea* subsp. *cuspidata* shading out habitat across most of the ecological study area.

Groundwater dependent-ecosystems

GDEs can be defined as those ecosystems whose ecological processes and biodiversity are wholly or partially reliant on groundwater. Examples of GDEs include wetlands, vegetation, mound springs, river base flows, cave ecosystems, playa lakes and saline discharges, springs, mangroves, river pools, billabongs and hanging swamps and near-shore marine ecosystems (NSW Office of Water 2012).A search for GDEs from the National Atlas of GDEs indicates Cumberland Plain Woodland and River-flat Eucalypt Forest are reliant on subsurface groundwater. These woodlands are likely to be supported by water near the surface or rainfall.

The National GDE Atlas lists South Creek as a GDE category ‘Reliant on surface expression of groundwater‘. However, there are no identified high priority GDEs, subterranean GDEs, river base flows, karst or cave ecosystems, or known springs that are fed by groundwater in the study area and surrounds.

More detailed information on the groundwater attributes of the study area is provided in the Golder Associates (2013).

FAUNA

Fauna habitats

Three broad terrestrial fauna habitat types were identified in the ecological study area; woodland, riparian and aquatic habitats and cleared/disturbed grassland (refer to Figure 7-32), as discussed below.

Woodland

Woodland occurred across most of the ecological study area, with the largest continuous patches occurring in the southern extent of the site on non-certified land. Woodland varied in condition from a moderate structure and diversity of flora species to poor quality woodland and woodland dominated by *O. europaea* subsp. *cuspidata*.

Hollow-bearing trees were observed in woodland and were in highest concentration in Cell G at the south-eastern boundary of the quarry operations (refer to Figure 7-32). Hollow-bearing tree locations were recorded if they occurred within the areas proposed for vegetation removal. Thirteen hollow-bearing trees as well as several potential hollow-bearing trees (with no visible hollows) were recorded. Hollow-bearing trees also occurred in the southern portion of woodland well outside the project site.

Riparian and aquatic habitat values for terrestrial fauna

Habitat values for terrestrial fauna in aquatic environments are described in this section.

Dams

Four dams were recorded within the ecological study area that provide habitat for terrestrial fauna. Dams contained emergent vegetation and soft muddy substrates which would provide foraging and breeding habitat for frogs and wading birds. The dams also provide foraging opportunities for microchiropteran bats.

Thompsons Creek and associated dam

Thompsons Creek dam contained emergent vegetation which would provide nesting habitat and shelter for waterbirds. The dam is also a foraging resource for waterbirds. The dam and Thompsons Creek also provides a fresh water resource for most local fauna including exotic species.

The southern section of Thompsons Creek became dry and void of aquatic vegetation as the creek progressed upstream from Thompsons Creek dam (Dam 6). Stagnant pools of water in this section of the creek would provide habitat for frogs. The northern section of Thompsons Creek (downstream of the dam) contained emergent vegetation which would provide habitat for frogs and waterbirds. Gully erosion was common along the creek banks, particularly in the south and some vegetation overhangs the banks which could provide shelter for fauna.

Cleared and Disturbed Grassland

Grassland at the site was mostly heavily grazed and disturbed by feral herbivores and farm animals (e.g. cattle). Rabbits (*Oryctolagus cuniculus*) and/or their scats and warrens were observed in every grassy habitat within the ecological study area. Native grasses occurred in some areas of the site and would provide a food source for native birds and macropods and shelter for reptiles. Other fauna resources within grasslands included fallen timber, loose rock and ant mounds which would provide habitat and/or food for reptiles, birds and mammals.

Aquatic Fauna Habitats

Habitat assessments were undertaken at four locations along Thompsons Creek, Thompsons Creek dam and four other dams within the site boundary (outside of quarry operations).

Thompsons Creek comprised intermittently wet channels and pools. The channel was narrow at times and undefined in some locations, particularly in the east. There was severe disturbance by cows trampling through the creekline on the east and severe bank erosion in the south west. Thompsons Creek is mapped as Key Fish Habitat by DPI and would be considered Class 3 fish habitat using the Fairfull and Witheridge (2003) fish habitat classification system. Class 3 fish habitat is characterised as follows: “Named or unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or recognised aquatic habitats.”

Historical aerial imagery of the Study Area shows that dams have been established in the past few years which collect local runoff and water quality appears to be very low. There is no connectivity between them and any other waterbodies apart from the dam at Site 6C which is connected by a small creek to a dam in the adjacent property to the west. Formal aquatic assessments were not undertaken at other dams within the project site in use for quarry operations. Some emergent aquatic vegetation such as *Typha sp.* was observed in some of these dams. Aquatic vegetation would provide habitat for frogs, waterbirds and fish.

Species recorded

A list of the fauna species and/or evidence of fauna species recorded during surveys is provided in Appendix 4 of the Ecological Assessment. Forty-eight fauna species were observed during the two day survey. Birds were the most diverse assemblage, comprising 35 of the 48 species recorded.

Threatened species

A habitat analysis was undertaken for threatened fauna occurring within 10 kilometres of the ecological study area to determine the likelihood of occurrence within the ecological study area based on suitability of habitat observed during the field survey.

Several threatened fauna species identified in the database searches were considered to have a moderate to high likelihood of occurring in the ecological study area, based on potential habitat and the proximity and number of records of these species in the locality. This included waterbirds that could occur in Thompsons Creek dam, woodland birds that could utilise woodland habitats and native grassland and microbats that could forage at waterbodies and within woodland and utilise hollow-bearing trees for roosting.

Habitat connectivity

The ecological study area is located in a highly modified environment, in which large areas of native vegetation have been cleared for the quarry and urban and agricultural development in the surrounding lands. Connectivity across the broader landscape is patchy, however there is some connectivity to larger areas of vegetation further southwest, providing a corridor to the Nepean River and its tributaries which are of value to highly mobile native fauna occurring in the ecological study area such as microchiropteran bats, birds and mammals (e.g. macropods). The riparian corridor of Thompsons Creek has some connectivity further downstream along Thompsons Creek and the riparian corridor of South Creek. The riparian corridor is very narrow throughout most of Thompsons Creek and is fragmented by local and main roads and residential development. Connectivity of fish habitat between South Creek and Thompsons Creek is highly influenced by the impacts on flow regimes from surrounding development. Refer to Appendix K for further details.

7.8.4 POTENTIAL IMPACTS

Potential biodiversity impacts

The extent or scale of ecological values likely to be affected as a result of the project is summarised in Table 7-49.

Table 7-49 Summary of ecological impacts

Likely Impact	Details	Extent/scale non-certified land	Extent/scale certified land
Loss of Endangered Ecological Communities	Cumberland Plain Woodland	2.87 hectares	3.26 hectares
Loss of native vegetation	Moderate Condition CPW	0.11 hectares	2.15 hectares
	Poor Condition CPW	1.88 hectares	1.05 hectares
	Derived Grassland CPW	0.88 hectares	0.06 hectares
	Poor Condition Riparian Woodland	0 hectares	0.04 hectares
Loss of exotic-dominated vegetation	Mixed Exotic/Planted Native	0 hectares	0.23 hectares
	Olive Dominant Woodland	5.88 hectares	0.25 hectares
	Exotic Grassland	2.06 hectares	0.7 hectares
Loss of fauna habitat	Woodland	7.87 hectares	3.5 hectares
		At least 13 hollow-bearing trees	
	Cleared and disturbed grassland	2.87 hectares	0.76 hectares
	Riparian and aquatic habitats (includes waterbodies)	0.07 hectares	0.13 hectares
Habitat fragmentation	May reduce the capacity of some less mobile fauna to move within and between patches of remaining habitat.	10.81 hectares of habitat to be removed in total	4.48 hectares of habitat to be removed in total
Fauna mortality	May result from collisions with vehicles or plant, or accidental entrapment in plant or pits.	Potential to occur across the entire site, though impacts are likely to be minor	Potential to occur across the entire site, though impacts are likely to be minor

Likely Impact	Details	Extent/scale non-certified land	Extent/scale certified land
Degradation of aquatic habitats	Caused by changes in runoff, potential pollution events and erosion may influence downstream habitats.	May vary depending on mitigation measures and site controls. Impacts are likely to extend beyond the local environment and influence downstream habitats.	May vary depending on mitigation measures and site controls. Impacts are likely to extend beyond the local environment and influence downstream habitats.
Edge effects and weed invasion	Vehicles and plant may transport weed propagules into and across the project site. Creation of new edges will increase fragmentation and vulnerability of native vegetation to weed incursions	New edges where project footprint adjoins Moderate condition vegetation south of the project site are most susceptible.	
Alteration to air quality and noise environments	May impact upon the roosting, breeding and foraging activities of locally occurring fauna	Temporary and localised scale impacts during construction. Potential longer-term impacts during operation.	Temporary and localised scale impacts during construction. Potential longer-term impacts during operation.

Flora

Non-certified land clearing

The proportion of vegetation clearing for non-certified areas is greater than in certified areas, but the majority of this (7.94 hectares) is exotic dominated vegetation. A total of 2.87 hectares of native vegetation is to be removed from the non-certified areas, all of which meets the criteria for the TEC Cumberland Plain Woodland under the TSC Act.

ENV clearing

Of the vegetation to be impacted within the non-certified areas, 1.16 hectares is mapped as Existing Native Vegetation (ENV). A portion of this ENV area (0.39 ha) was cleared prior to classification as ENV in order to carry out stormwater mitigation. The remaining 0.78 hectares of ENV currently supports vegetation cover, including 0.36 hectares mapped as native vegetation communities and 0.42 hectares mapped as exotic dominated vegetation. Vegetation proposed for removal, including mapped ENV within non-certified land, is shown in Figure 7-31.

EEC clearing

The project would result in the loss of native and exotic vegetation, including Cumberland Plain Woodland, a Critically Endangered Ecological Community (EEC) under the TSC Act and has the potential to facilitate the spread of weeds. An assessment of significance, known as a Seven-part test, was undertaken for the loss of Cumberland Plain Woodland and it was determined impacts would not be significant given that most of the areas to be cleared are highly modified, comprise a minor extent of the community and have minimal connectivity.

Clearing of threatened species habitat

Most of the threatened plant species identified in the database searches were considered to have a low likelihood of occurring in the ecological study area, based on potential habitat, the proximity and number of records of these species in the locality. This was confirmed during the two day survey with none of these species being identified. It is therefore unlikely that threatened plant species will be impacted by the proposed quarry and brickworks expansion project.

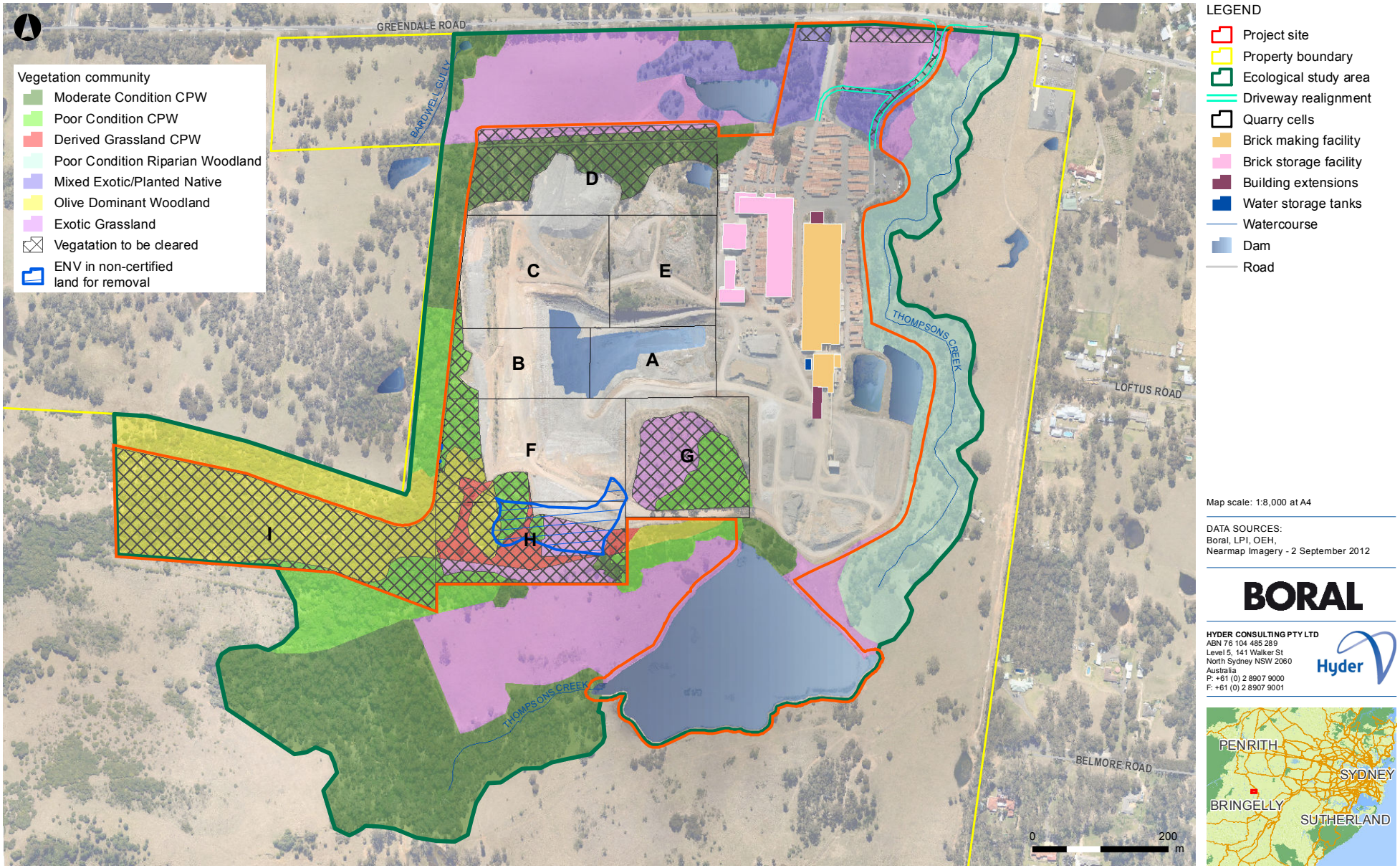


Figure 7-31: Vegetation communities in the ecological study area

Fauna

Fauna habitat would be removed, including woodland and grassland habitats, riparian and aquatic habitat values for terrestrial fauna and hollow-bearing trees. Habitat connectivity would be reduced from further fragmentation of habitat as a result of the project. The project could also impact roosting, breeding and foraging activities of locally occurring fauna, as a result of increased exposure to light, noise, dust, vehicles and people. Vegetation clearing activities could also result in direct mortalities. Direct mortalities may also result from collisions with vehicles or plant, or accidental entrapment in plant, quarry pits or other earthworks.

The project has the potential to result in impacts to several threatened fauna including:

- Varied Sittella – *Daphoenositta chrysoptera* (Vulnerable TSC Act).
- Eastern False Pipistrelle – *Falsistrellus tasmaniensis* (Vulnerable TSC Act).
- Little Lorikeet – *Glossopsitta pusilla* (Vulnerable TSC Act).
- Little Eagle – *Hieraaetus morphnoides* (Vulnerable TSC Act).
- Cumberland Plain Land Snail - *Meridolum corneovirens* (Vulnerable TSC Act).
- Eastern Freetail-bat - *Mormopterus norfolkensis* (Endangered TSC Act).
- Southern Myotis – *Myotis macropus* (Vulnerable TSC Act).
- Scarlet Robin – *Petroica boodang* (Vulnerable TSC Act).
- Flame Robin – *Petroica phoenicea* (Vulnerable TSC Act).
- Greater Broad-nosed Bat – *Scoteanax rueppellii* (Vulnerable TSC Act).

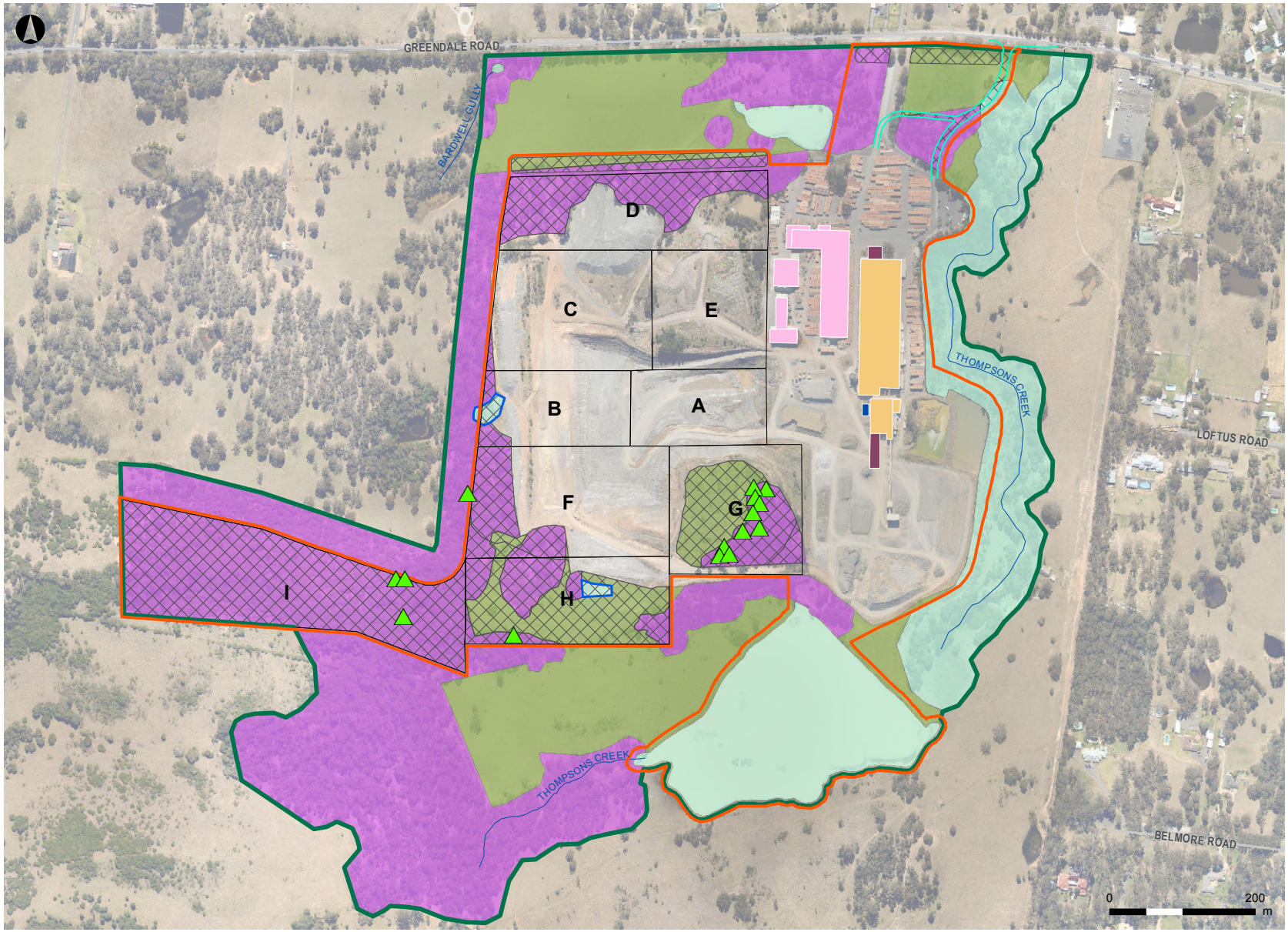
Seven-part tests were undertaken for these species and it was concluded that impacts would not be significant generally due to the low amount and low quality of potential habitat to be impacted as a result of project. Further detail is provided in the Ecological Assessment (Appendix K).

Aquatic habitats

The project would include the removal of aquatic habitat from the permanent removal and alterations to dams within the project site. Dams are of low ecological value for fish containing some aquatic vegetation such as *Typha* sp. Indirect impacts to fish habitat in Thompsons Creek could occur as a result of sediment-laden runoff and/or chemicals reaching the waterway.

Groundwater dependent ecosystems

Golder Associates (2013) concluded that potential impacts to groundwater as a result of the project are expected to be localised and limited mainly to the vicinity of the mine operations. Changes to groundwater as a result of the project include a minor loss of deep groundwater resulting in limited drawdown and a slight lowering of the groundwater table. These changes are not likely to stress any GDEs in the study area and surrounds. Changes could potentially extend to South Creek, though any associated impacts would be minor. Impacts to groundwater and GDEs are discussed in further detail in Golder Associates (2013) (Appendix J of the EIS).



LEGEND

- Project site
- Ecological study area
- Hollow bearing tree
- Dam

Fauna habitats

- Cleared and disturbed grassland
- Remnant vegetation
- Riparian and aquatic habitats
- Fauna habitats to be cleared
- Driveway realignment
- Quarry cells
- Brickmaking facility
- Brick storage facility
- Building extensions
- Water storage tanks
- Watercourse
- Road

Map scale: 1:8,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012

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Hyder

Figure 7-32: Fauna habitats within the ecological study area

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Created by : KC
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7.8.5 MITIGATION MEASURES

A Flora and Fauna Management Plan for the project site will be prepared to manage impacts to flora and fauna as a result of the project across the construction and operational stages. The Flora and Fauna Management Plan would be appended to the CEMP and OEMP and would address the following:

- Sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitat.
- Fauna injury/mortality.
- Weed establishment and invasion.
- Topsoil removal and site rehabilitation.
- Impacts to threatened hollow dependent fauna (microbats and Little Lorikeet).
- Loss of fauna habitat.
- Loss and degradation of native vegetation, including Cumberland Plain Woodland CEEC.
- Reduction in water quality as a result of sediment laden runoff, chemical spills/plant leaks reaching Thompsons Creek.
- Degradation of riparian zones.
- Disruption of fauna foraging, nesting or roosting behaviours.

More information about specific safeguards and management measures that will be included in the Flora and Fauna Management Plan are provided in Appendix K.

7.8.6 OFFSET STRATEGY

The impacts on biodiversity, including ENV, within the certified areas are offset through the Sydney Growth Centres SEPP and do not require additional offsets.

The project will require the removal of a 1.16 hectare area mapped as ENV within the non-certified areas. Although not all of this area currently supports vegetation meeting the criteria for ENV, it is proposed to offset the entire 1.16 hectare mapped area.

In order to offset the loss of 1.16 hectares of ENV within the non-certified areas, it is proposed to conserve a 1.93 hectare strip of ENV in an offset area within the certified area in the north-west of the ecological study area as shown in Figure 7-33. The proposed offset area contains 1.16 hectares of Moderate Condition CPW and 0.81 hectares of Poor Condition CPW.

The Moderate Condition CPW in the proposed offset area was identified as some of the better condition native vegetation in the ecological study area. All vegetation in the proposed offset area was mapped as ENV in the Growth Centres Conservation Plan (ELA 2007), and meets the criteria for ENV as defined in the Biodiversity Certification Order.

The proposed offset area will conserve CPW in a certified area where there are currently no constraints to clearing this vegetation, and will maintain the minimum area of ENV to be retained and protected in the Growth Centre in accordance with the requirements of Biodiversity Certification. An assessment of the consistency of the project with the relevant biodiversity measures of the Biodiversity Certification Order is provided in Appendix 9 of the Ecological Assessment.

The retention of this area would maintain the minimum area of ENV to be retained and protected in the Growth Centre, as specified in relevant biodiversity measure (RBM) 6 of the Biodiversity Certification Order. An assessment of the consistency of the project with RBMs 6 to

13 of the Biodiversity Certification Order is provided in Appendix 9 of the Ecological Assessment.

The proposed offsets have been determined with reference to the *Principles for the Use of Biodiversity Offsets in NSW* (OEH 2011a), which are detailed and is provided in Appendix K.

Management of the proposed offset area would aim to maintain and enhance native vegetation values, and would be undertaken according to a Biodiversity Offset Management Plan for the area. The Biodiversity Offset Management Plan would be prepared in consultation with OEH and prior to vegetation clearing for the project, and would include details of management methods, fencing, timeframes, costs and monitoring

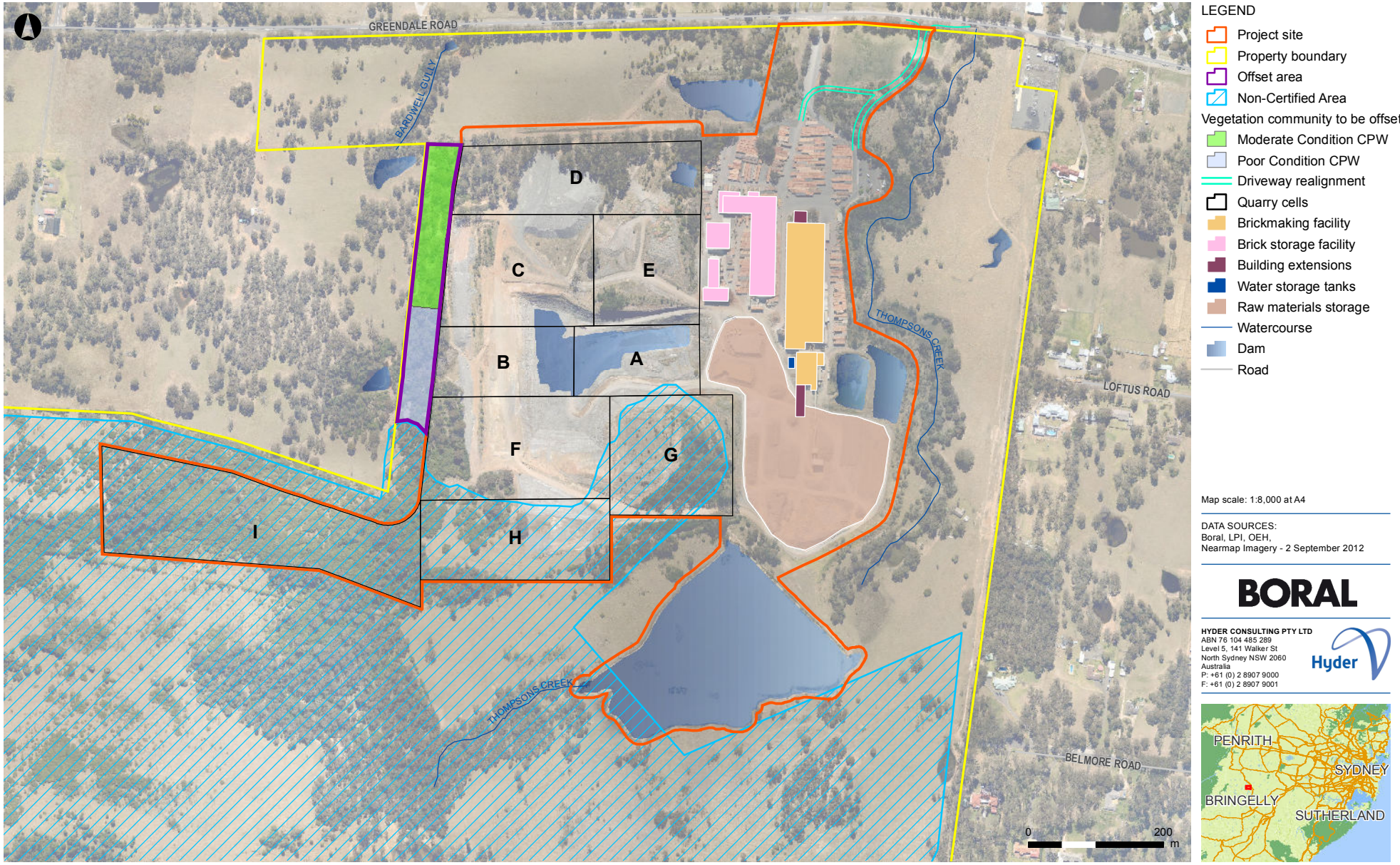


Figure 7-33: Proposed offset area

7.9 ABORIGINAL HERITAGE

7.9.1 OVERVIEW

Historical records show that the Bringelly area was inhabited by a number of Aboriginal groups. In 1990 an archaeological survey was conducted by Resource Planning Pty Ltd. It identified four Aboriginal sites within the vicinity of the project site. The project has the potential to impact on Aboriginal heritage values because it includes expansion of the quarry, brickworks building and construction of new infrastructure into areas outside of the existing approved disturbance footprint. Artefact Heritage (2013) was appointed to undertake an Aboriginal Archaeological Heritage Assessment for the project. The Assessment addressed the DGRs for the project, which require an Aboriginal cultural heritage assessment (including both cultural and archaeological significance which must:

- Demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting mitigation options and measures.
- Outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures).

This section presents a summary of the Aboriginal Archaeological Assessment. The full report is presented in Appendix L.

7.9.2 METHODOLOGY

The Aboriginal Archaeological Assessment was completed in accordance with the *Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation* (DP&I 2005) and is guided by the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (OEH 2010).

The study area for this assessment included both the proposed area of impact from quarrying and other development activities (the project site), and also the areas bordering on the western and northern boundaries of the quarry where extraction will not take place (requirement of the Mining Lease). This area is identified in Figure 7-29.

The methodology of the field investigation and assessment included desktop investigations, detailed site archaeological survey and consultation with the Aboriginal community. As part of the desktop investigation, Native Title and Aboriginal Heritage Information Management System (AHIMS) database searches were conducted on the 15 January 2013 for sites within the study area using a buffer of 50 metres. Previous Aboriginal Archaeological Assessment reports within and adjacent to the study area were considered.

A detailed archaeological survey of the study area was conducted by Artefact Heritage, accompanied by representatives of the Tharawal Local Aboriginal Land Council (TLALC) and Cubbitch Barta Native Title Claimants Aboriginal Corporation (CBNTCAC). This survey was undertaken over two days. The study area was divided into ten survey units according to their landform (refer to Figure 7-34 and Appendix L for a breakdown of the different survey units).

All survey units were covered on foot. All exposed areas within survey units were examined for stone artefacts or other traces of Aboriginal occupation. Old growth trees were examined for signs of cultural scarring or marking. A handheld GPS was used to track the path of surveyors, and to record the coordinates of the site. Photographs were taken to represent the landform unit, vegetation communities, objects of interest and levels of disturbance.

Where items or sites of Aboriginal heritage have been identified as having moderate research potential, further archaeological investigations in the form of test excavations are required.

Prior to and after the completion of these test excavations, comprehensive Aboriginal consultation is required to be undertaken in accordance with the *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005). The test excavation was completed in July 2013 and follow up consultation is currently being undertaken. The results of the consultation will inform the Cultural Heritage Assessment Report (CHAR) that will be provided to the Department of Planning and Infrastructure prior to determination.

The results of the CHAR and test excavation will inform the future management of Aboriginal heritage for the project in the CEMP and OEMP.

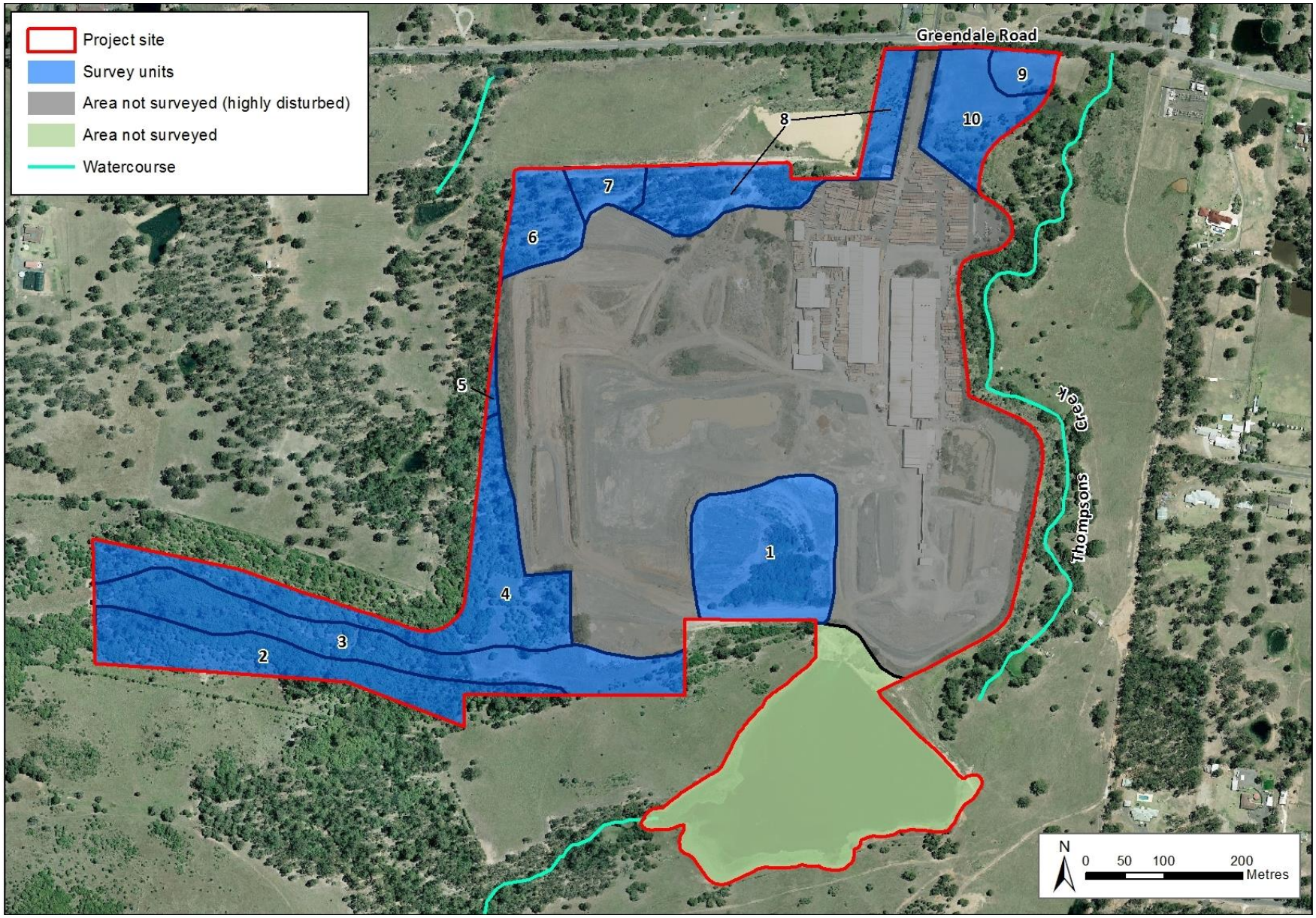


Figure 7-34 Survey area map (Artefact Heritage 2013)

7.9.3 HISTORY

Aboriginal people traditionally lived in small family or clan groups that were associated with particular territories or places. The language group spoken in the Bringelly area is thought to have been Dharawal (Tindale 1974). There is also some evidence that Aboriginal people around Bringelly spoke a distinctly separate language group and their tribal area was known as Cubbitch-Barta after its white pipe clay (Russell 1914). Historical records also show that Gandangara people came into the Bringelly area. Historical observations suggest that Aboriginal people lived in the Bringelly area in relatively large numbers (Barton 1996).

British colonisation had a profound effect on the Aboriginal population of the Sydney region. In the early days of the colony, Aboriginal people were disenfranchised from their land as the British claimed areas for settlement and agriculture. The colonists, often at the expense of the local Aboriginal groups, also claimed resources such as pasture, timber, fishing grounds and water sources.

Although the numbers of Aboriginal people in the area decreased as settlers and farmers moved into the locality, communities remained living at Camden Park and along the Georges River near Liverpool.

7.9.4 EXISTING ENVIRONMENT

The study area is part of a prominent spur landform associated with a high point of 158 metres elevation at the Birling Triangulation Station (also described as the Birling Trig) approximately 750 metres southwest of the study area. Thompsons Creek (a second order ephemeral stream) runs along the southern and eastern margins of the study area. A tributary of Bardwell Gully flows through the western side of the study area, and Lowes Creek (a second order creek) is located over one kilometre south of the study area. The study area is primarily underlain by Bringelly Shale which forms part of the Wianamatta Group, consisting of shale, carbonaceous claystone, claystone, laminate, fine to medium grained lithic sandstone, rare coal, and tuff. The study area would have once been covered by open Cumberland Plain Woodland, typical in areas underlain by the Wianamatta Group geological unit. Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*Eucalyptus tereticornis*) are among the species that would have grown there (Benson and Howell 1990).

Prior to the establishment of Boral's Bringelly Brickworks in 1968, the land had been cleared and used for agricultural purposes. The land on which the brickmaking facility now stands has been extensively quarried. The movement of heavy vehicles on and around the plant has also caused a considerable amount of land disturbance. Areas of woodland remain in the southern sections of the study area.

The predictive model of White and McDonald (2010) indicates that open sites or isolated finds are the most likely Aboriginal site type that would be identified within the study area, and that artefacts densities are likely to be low, with higher densities of sites likely to be found on crest and slope landforms within 300 metres of a permanent watercourse and/or on vantage points, spread across the landscape.

Sites and places

A search of the AHIMS database identified a total of eight Aboriginal sites within the search area. All of these are open artefact sites and none are recorded within the study area.

A survey of the Bringelly Brickworks in 1990 undertaken by Resource Planning identified four open isolated artefact sites (Figure 7-35). Two of these sites contained silcrete flakes, another contained a siltstone flake and the final site contained a silcrete core. All of these sites were located on the edge of woodland in an area that Resource Planning considered to be of low

archaeological potential. The four sites were not registered on the OEH AHIMS site register and have since been destroyed as a result of quarrying activities.

Four new Aboriginal sites were located during the site survey: one artefact scatter and three isolated artefacts (Table 7-50). Three of these are located within the project site, with one site (BB OS3) located immediately outside the southern boundary of the project site (within 30 metres of the southern boundary of quarry Cell I). These sites have now been registered on the AHIMS database.

Table 7-50 Summary of survey findings

Site name	AHIMS number	Site type	Survey unit (location within the study area)	Landform	Artefact characteristics
BB OS1	45-5-4285	Artefact scatter	1	Crest	One red silcrete proximal flake fragment and one red silcrete angular fragment.
BB OS2	45-5-4286	Isolated artefact and PAD	3	Crest/slope	Red silcrete medial flake fragment, PAD due to low level of disturbance and location on slope between two crest forms potentially conducive to Aboriginal occupation.
BB OS3	45-5-4287	Isolated artefact	Nil – outside the study area	Slope	Pink silcrete proximal flake fragment.
BB OS4	45-5-4288	Isolated artefact	4	Slope	Milky white quartz proximal flake fragment.

Source: Artefact Heritage (2013)

There were no Native Title claims granted or registered for consideration within the Aboriginal heritage study area.

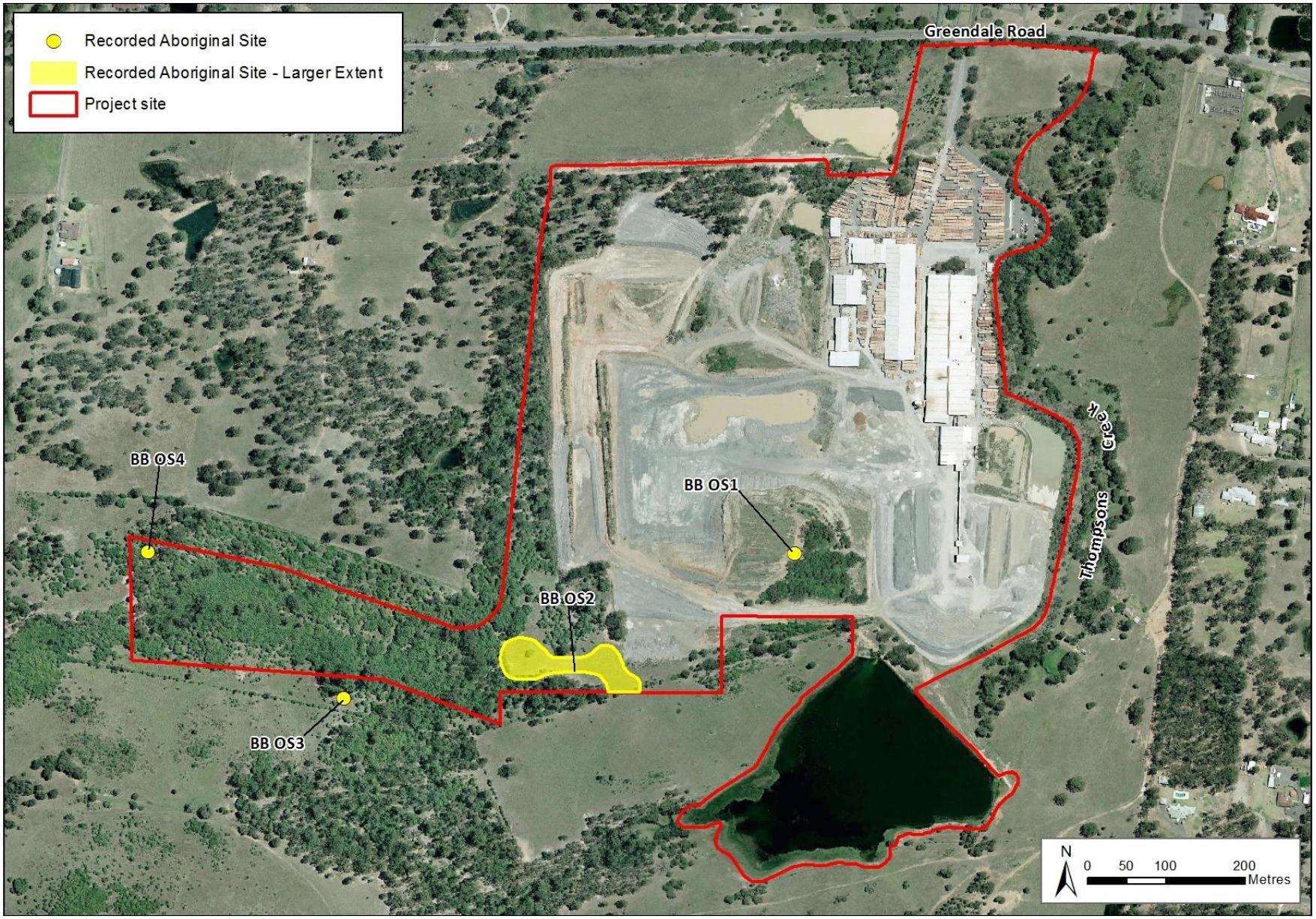


Figure 7-35 Aerial showing identified Aboriginal sites in relation to the project site (Artefact Heritage 2013)

Archaeological potential

Archaeological potential is closely related to levels of ground disturbance in the area. Other factors also taken into account when assessing archaeological potential include whether artefacts were located on the surface, and whether the area is within a sensitive land form unit according to the predictive statements for the area.

There is a high level of disturbance across the study area. The land in the centre of the study area has been extracted as part of quarry activities and the old growth woodland that once covered the study area has been cleared. Most of the areas that were surveyed are now covered in recent regrowth and African Olive weed.

Archaeological significance

Archaeological significance refers to the archaeological or scientific importance of a landscape or area. This is characterised using archaeological criteria such as archaeological research potential, representativeness and rarity of the archaeological resource and potential for educational values.

The assessment of significance concluded the following:

- BB OS1, BB OS3 and BB OS4 are assessed as having low archaeological significance. They are located in areas that have steep slopes and/or a high level of disturbance and are unlikely to be in its original context, more likely washed downslope from their original positions.
- BB OS2 is assessed as having moderate research potential as it has the potential to provide information about Aboriginal land use in the local area. The artefact and associated area of PAD were located in an area of relatively low disturbance in a crest landform context. The archaeological significance of the PAD cannot accurately be assessed until further archaeological investigations have been conducted.

Table 7-51 provides a summary of the assessment of overall archaeological significance for each of the sites identified during the survey.

Table 7-51 Summary of archaeological significance values

Site name	Research potential	Scientific/ archaeological value	Representative value	Rarity value	Overall significance
BB OS1	Low	Low	Low	Low	Low
BB OS2 and PAD	Moderate	Unknown	Unknown	Unknown	Unknown
BB OS3	Low	Low	Low	Low	Low
BB OS4	Low	Low	Low	Low	Low

Source: Artefact Heritage (2013)

Cultural significance

Cultural significance is characterised using both primary and secondary sources, including consultation with Aboriginal cultural knowledge holders who have specific knowledge about objects, places or cultural features. Consultation with registered Aboriginal parties is currently being undertaken as part of the preparation of the CHAR, which will ascertain the cultural significance of the items identified.

7.9.5 POTENTIAL IMPACTS

Three identified Aboriginal sites would be directly impacted by the project: BB OS1, BB OS2 and BB OS4 (Table 7-52).

Table 7-52 Impact assessment summary

Site name	Type of harm	Degree of harm	Consequence of harm
BB OS1	Direct	Total	Total loss of value
BB OS2	Direct	Total	Total loss of value
BB OS3	None	None	None
BB OS4	Direct	Total	Total loss of value

Source: Artefact Heritage (2013)

BB OS3 is located outside of the project site and would not be impacted by the proposed quarry expansion works. It is noted that due to the close proximity of this Aboriginal site to the project site boundary (within 30 metres), there is the potential that quarrying activities may have an indirect impact on the site, including increased erosion and movement of heavy machinery if appropriate mitigation measures aren't implemented.

This impact assessment has assumed that the area in Figure 7-34 indicated as not surveyed would not be impacted by the current project.

7.9.6 MITIGATION MEASURES

The overall guiding principle for Aboriginal heritage management is that where possible, Aboriginal sites would be conserved. If conservation is not possible, measures would be taken to mitigate against impacts to Aboriginal sites.

Due to the expansion of the quarry, conservation of newly recorded sites BB OS1 and BB OS4 is not considered practicable. No further archaeological investigations of these sites are necessary, as they are of low archaeological significance.

BB OS2 and the associated area of PAD have been assessed as having moderate archaeological potential. As the site falls within the proposed quarry footprint and would be destroyed during quarrying activities, further archaeological investigations will be conducted in order to determine the full extent of the site and to accurately assess its significance. These investigations will include an archaeological test excavation of the area of potential.

As Aboriginal objects would be impacted by the project, comprehensive Aboriginal consultation in accordance with the *Interim Community Consultation Requirements for Applicants* (DEC 2004) is currently being undertaken. This consultation was initiated prior to commencement of archaeological test excavations.

Following site survey, a Cultural Heritage Assessment Report (CHAR) was prepared, outlining the results of the site survey and providing an assessment of the impacts and proposed mitigation measures for archaeological sites and cultural places within the project area. The draft CHAR has been provided to Aboriginal stakeholders for review and comment and finally provided to the D&PI prior to determination of the EIS.

During construction and operation, measures should be taken to avoid inadvertent impact to newly recorded site BB OS3, just south of the project site. These measures should be outlined in the Construction Environmental Management Plan and Operational Environmental Management Plan.

Additional measures that should be included within the CEMP and OEMP include a procedure for unexpected finds and an Aboriginal heritage induction.

Unexpected finds

The CEMP and OEMP should include a procedure for unexpected finds. If unexpected finds are encountered during works, all work should cease in the vicinity of the finds and a qualified archaeologist should be contacted to undertake a site inspection and determine whether or not the find is an Aboriginal object. If the find is assessed to be an Aboriginal object, the archaeologist must record it and submit a site card to the OEH AHIMS site register. The archaeologist must also assess the potential for further archaeological material in the surrounding area and provide recommendations regarding the need for further investigation, approvals and stakeholder consultation.

Works may only recommence in the vicinity of the find once all requirements for further investigation, approvals, recording and consultation have been fulfilled.

If suspected human skeletal remains are uncovered during works, all works must cease in the area. The NSW Police should be notified to provide details of the remains and their location. No works in the vicinity of the skeletal remains can recommence until investigations by NSW Police have concluded.

Heritage induction

All employees, subcontractors and agents undertaking construction or quarrying activities at the site should attend a heritage induction to ensure they understand and are aware of the nature of possible Aboriginal heritage finds, including burials. The induction would include a brief introduction to the legal obligations relating to Aboriginal heritage, and provide pictures of the most likely Aboriginal objects to occur within the study area. This would include pictures of different types of stone artefacts, reflecting the main raw materials and colour variations that occur within the region. The induction should also include information on the unexpected finds procedure, including the necessity to stop work immediately and notify a site supervisor, foreman and the Brickworks Plant Manager. The induction could be included as part of the general site induction for all workers.

7.10 NON-ABORIGINAL HERITAGE

7.10.1 OVERVIEW

The village of Bringelly was established in the mid-1800s. There are a number of listed heritage items in the area, including the Bringelly Public School Group and the Maryland estate. The project has the potential to impact on Non-Aboriginal heritage values because it includes expansion of the quarry, brickworks building and construction of new infrastructure into areas outside of the existing approved disturbance footprint. Artefact Heritage was commissioned to undertake a Non-Aboriginal Heritage Assessment (2013). This assessment addresses the DHRs relevant to a Historic heritage assessment (including archaeology):

- Include a state of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items.
- Outline any proposed mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures).

This section presents a summary of the assessment that was undertaken. The full report is included in Appendix M.

7.10.2 EXISTING ENVIRONMENT

History

Exploration to the west of Sydney Cove began shortly after first settlement in favour of improved conditions for cultivation. Initially, this was focussed around the well-watered Hawkesbury and Georges Rivers. Settlement in the Bringelly area was catalysed by several large land grants that were made after 1815, after Lachlan Macquarie was appointed Governor (Atkinson 1988:11).

The development of the village of Bringelly was slow. A post office was opened in 1857 and a public school was opened in 1878 and further community services were established around the post office in the twentieth century, including a Commonwealth Bank in 1914 and a grocery business in 1925. The population of Bringelly increased more rapidly in the late 1950s, as evidenced by school enrolments, which increased by 20 between 1957 and 1960 (Bringelly Public School 1978:8-9). In the 1960s, the post office was moved into a new complex of shops built on the corner of The Northern Road and Greendale Road (Austral Archaeology 2011:98).

Study Area

Free Settler Robert Lowe arrived in New South Wales with his family in 1812 and was granted 1000 acres in the District of Cooke, south of the study area. An additional parcel of 500 acres was acquired by Lowe at a later date. The project site is located on this additional parcel. These parcels of land were combined to form a farm named Newstead, which was occupied by Lowe's son Joseph, from c. 1850 until his death in 1892 (*Australian Town and Country Journal 23 July 1892)*. Joseph Lowe ran cattle on the property (*Sydney Morning Herald 19 Oct 1855:6)*. A homestead named Newstead is still present around 700 metres to the south of the current study area, and it is likely that the original homestead was situated in the same location.

Between 1911 and 1949, the land within the study area was purchased and sold a number of times before it was proclaimed a bird and animal sanctuary under the ownership of William Hartland Cullen, who produced wool on the property. This suggests that this portion of the Newstead property was not used for farming at that time. In 1958, the property was sold once again to Cecil George Holdaway and his wife (Old Title Recof Vol. 2196 Fol. 114). The brickworks began operation on the site in 1968.

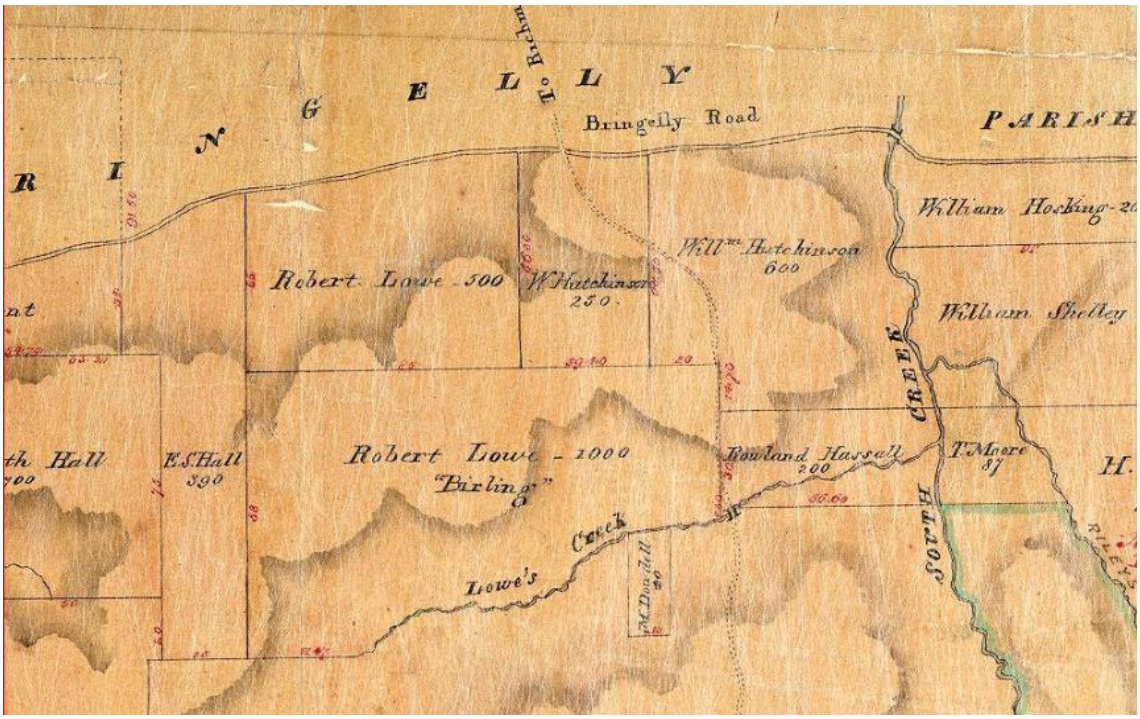


Figure 7-36 Parish map showing original land grants to Robert Lowe (Artefact Heritage 2013)

Heritage listed items

Previously identified heritage items in the vicinity of the project site were located through a search of heritage registers. There are no listed heritage items occurring within the project site. Results are provided in Table 7-53 and listed items identified within the vicinity of the project site are described in this Section.

Table 7-53 Heritage database search results

Heritage database	Statutory/Non-statutory	Items identified within the vicinity of the study area
World Heritage List – maintained by the World Heritage Committee to protect cultural and natural heritage which the Committee deems to have outstanding universal value.	Statutory	Nil.
National Heritage List – established to list places of outstanding heritage significance to Australia. It includes natural, historic and Indigenous places that are of outstanding national heritage value to the Australian nation.	Statutory	Nil.
State Heritage Register – lists places and objects of particular importance to the people of NSW and is administered by the Heritage Branch of the OEH.	Statutory	Nil.
Section 170 Registers – Established in accordance with Section 170 of the *NSW Heritage Act 1997* by government bodies and are registers of all heritage items that are owned, occupied or managed by those bodies.	Non-statutory	The Bringelly Public School Group.
Camden LEP 2010 – lists items/sites of heritage significance within the Camden LGA.	Statutory	Maryland estate (Item number 11).
Liverpool LEP 2008 – lists items of heritage significance within the Liverpool LGA.	Statutory	The Bringelly Public School Group (Item number 7).

Source: Artefact Heritage (2013)

The Bringelly Public School Group

Bringelly Public School was established in 1878. It comprised 10 acres of land, a brick farmhouse (previously functioning as the local post office) and a detached slab kitchen and was initially attended by 20 children. Attendance grew to 50 students in the early 1890s, and in 1894, a new teacher's residence was built, and in 1897 the classroom was replaced by a new building. Both of these buildings are still present on-site.

The teacher's residence is a single storey building, oriented to the east, with a verandah on the eastern side. It had been in use as the administration centre for the school but was recently

vacated due to safety concerns over large cracks in the walls (OEH n.d.). The Schoolroom is also a single storey building, oriented to the east. It is currently used as a classroom, while the in-filled verandah on the northern side is used by the Bringelly Baby Clinic and the Hoxton Park Health Centre (OEH n.d.). Both buildings front The Northern Road.

The Bringelly Public School Group is significant at a local level as a site which demonstrates the history of settlement and education in the area. The classroom building is representative of educational buildings from the late nineteenth and early twentieth centuries, while the teacher's residence is representative of the design of teacher's residences commonly built in association with rural schools at the time.

Maryland Estate

Maryland Estate has been in continuous occupation by two families for over 130 years. The main homestead complex is situated on a knoll and has views to the north over Lowes Creek and toward the Northern Road to the east and includes a stone cottage, former winery, stone store, and gatekeeper's cottage. The main homestead complex is surrounded by mature trees and shrubs.

Further down the slope and to the north is a second group of outbuildings with a stone barn, stables, various sheds, and a worker's cottage. Some modern buildings exist between these and the main homestead complex. Outbuildings and remnant plantings are scattered along the main ridgeline and slopes, and major plantings occur around the homestead, loop road and eastern slopes.

The statement of significance for the item in the State Heritage Inventory indicates that Maryland is an example of early homestead and farm buildings, significant for its completeness as a group and excellent state of preservation. In particular, the outbuildings illustrate the diversity of functions associated with early agricultural activity in this area. The complete statement of significance is included in Appendix M.

Unlisted items of potential heritage value

Bringelly Road/Greendale Road Rural Cultural Landscape

Bringelly Road/Greendale Road, with its associated rural cultural landscape is listed as a potential heritage item in the Camden DCP 2011. This landscape possesses local historical and aesthetic significance as a rural landscape that has remained relatively intact since early settlement and that maintains a clear visual link to the local area's agricultural history. The DCP controls state that "development should optimise the preservation and interpretation of the identified significant cultural and Visual Landscapes" (B3.1.5).

7.10.3 POTENTIAL IMPACTS

Assessment of archaeological potential

No Non-Indigenous archaeological material or areas of archaeological potential were identified during the site survey carried out as part of this heritage assessment. The assessment noted that there are no signs of cultivation or the establishment of structures within the study area. An aerial photograph from 1947 identified no structures within the study area. The only visible feature in this photograph is a dam located within the proposed area of works. Former features so far from the main farmstead are likely to have been limited to fence lines and small ephemeral structures such as shelters for livestock. Such features would be unlikely to leave intact archaeological evidence, and such evidence would be difficult to identify and date through visual inspection if it did survive.

If any surviving archaeological material is present within the study area, it would be expected to be of low research potential as it is likely to be limited in nature and unlikely to provide useful

new information that could answer relevant research questions regarding the history of the site or local area.

Bringelly Public School Group

The Bringelly Public School Group is located around 350 metres from the north-east corner of the Brickworks property (Figure 7-37). There are no views towards the brickworks from the school and the project would have no physical or visual impacts on the heritage significance of the Bringelly Public School Group.

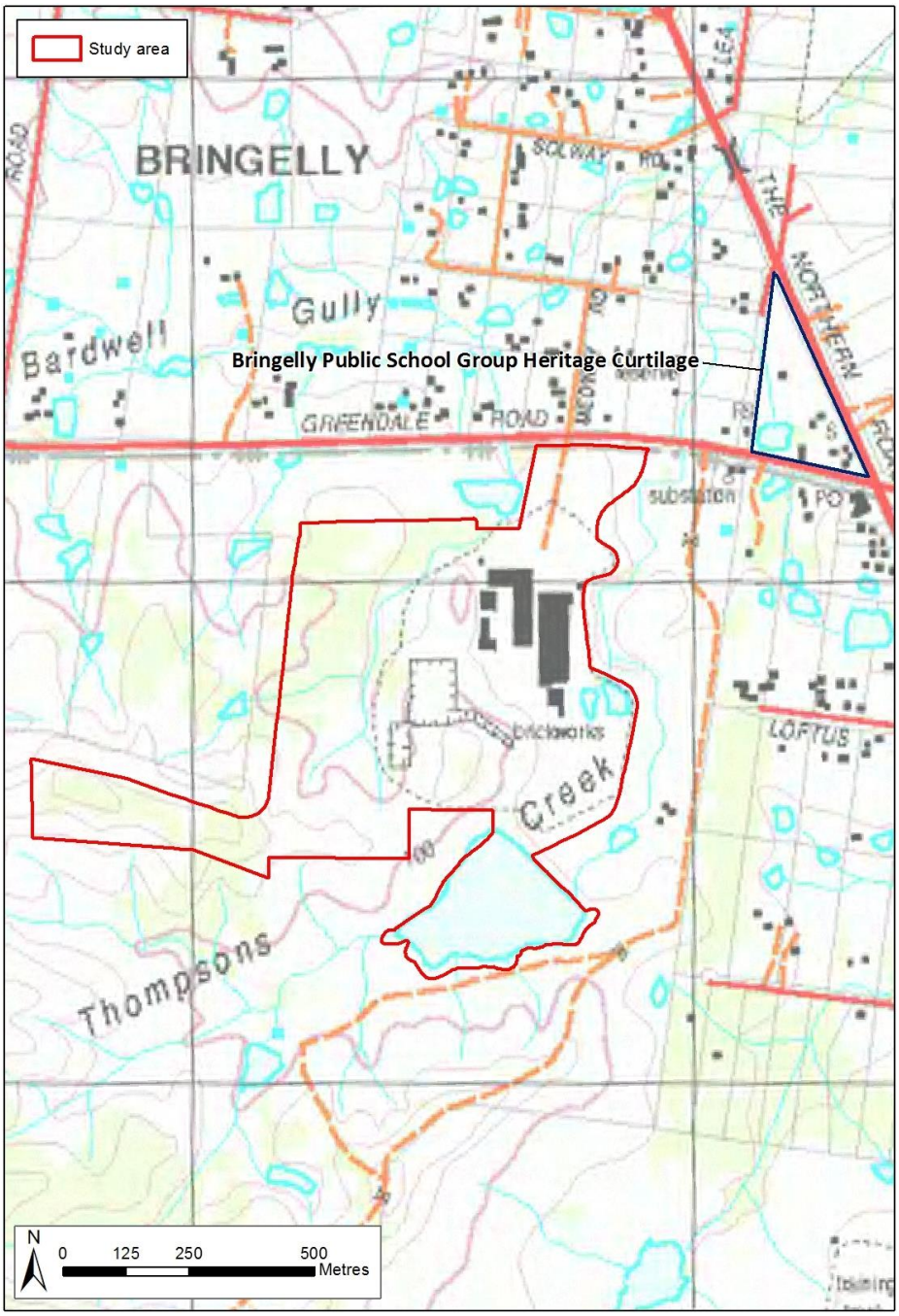


Figure 7-37 Bringelly Public School Group in relation to the project site (Artefact Heritage 2013)

Maryland Estate

The northern boundary of Maryland is two kilometres from the project site (Figure 7-38). As there are such tall and thick plantings around the main homestead complex on the top of the

hill, there would be no clear views toward the project site. It was identified that even if glimpses were available toward the project site, the proposed brickworks and quarry expansion would not significantly alter the appearance of the Bringelly Brickworks site from such a distance and impacts on views from Maryland would be negligible.

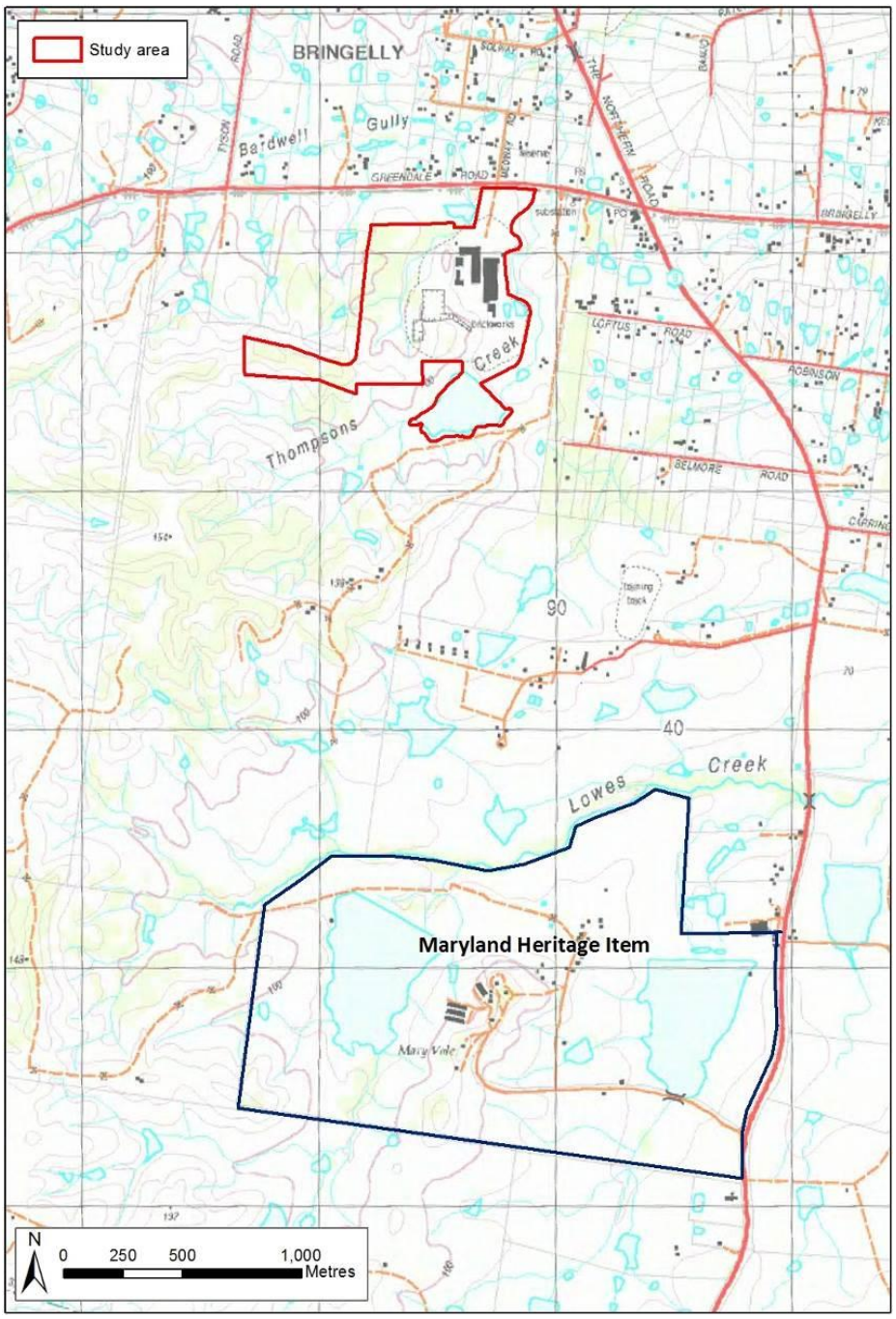


Figure 7-38 Maryland heritage item in relation to the project site (Artefact Heritage 2013)

Impacts on unlisted items of potential heritage value

A 200 metre long, 4.5 metre high noise bund is proposed along the northern boundary of the property extending westwards from the new site access (Figure 7-39). While the bund would be planted with locally occurring native species, it has been identified that its height and proximity to the road boundary would have some impact on views from Greendale Road and would alter the setting of the rural cultural landscape.

A new site access road is proposed in the north-eastern section of the study area. The road would provide access to the brickworks loading area from Greendale Road. This access road

would be visible from Greendale Road and would involve the removal or at least pruning of a small number of trees along the side of Greendale Road to accommodate the new access as well as the required line of sight. However due to the minimal amount of vegetation clearing required and the fact that the road will be constructed at existing ground level (not elevated), the proposed new site access road would not have a significant impact on views from Greendale Road or the heritage value of the Bringelly Road/Greendale Road cultural landscape.

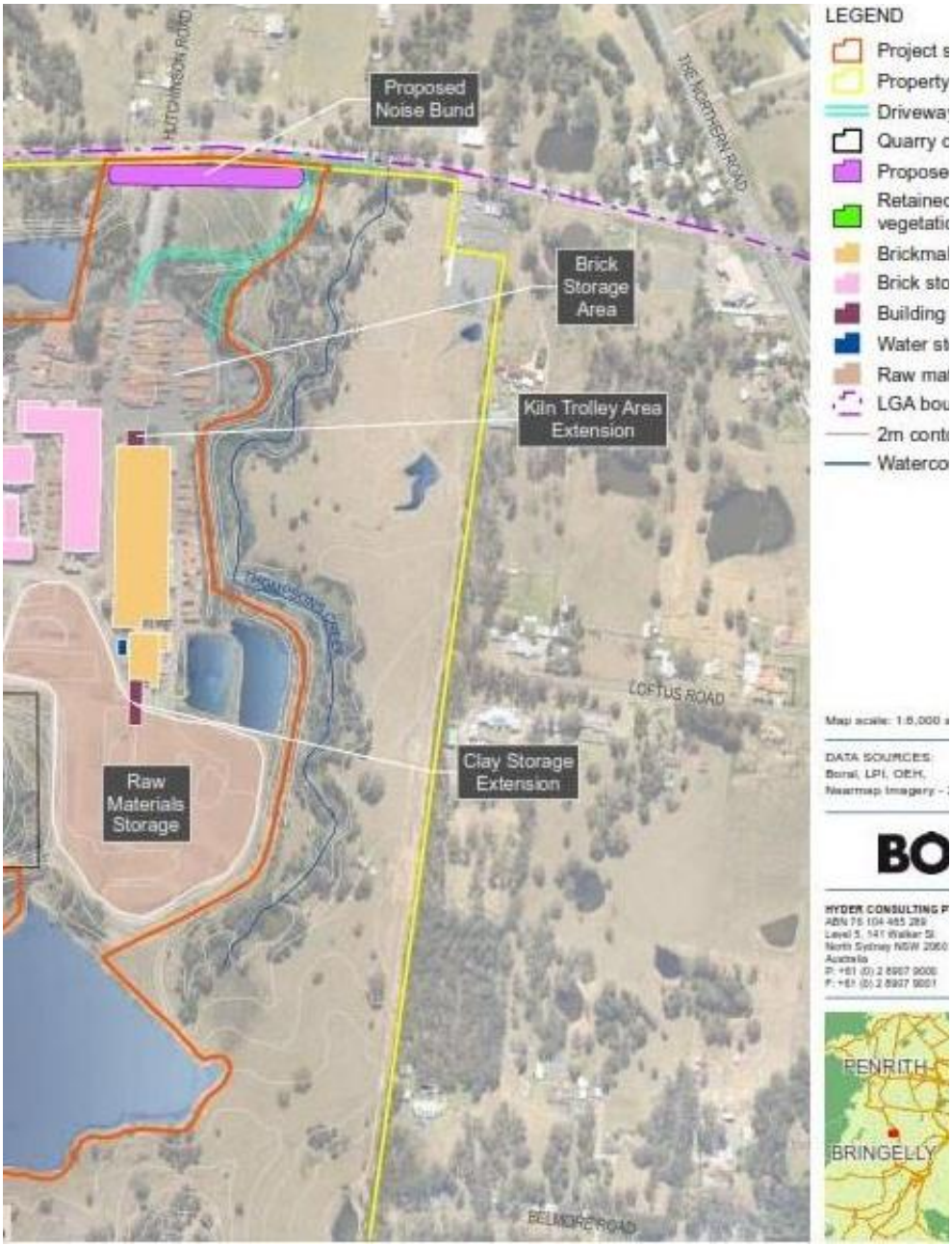


Figure 7-39 Excerpt from proposed site layout plan showing bund and access road near Greendale Road

7.10.4 MITIGATION MEASURES

To minimise visual impacts on the unlisted Bringelly Road/Greendale Road Cultural Landscape, the proposed bund along part of the northern boundary will be grassed and then planted with a mixture of locally occurring native trees and shrubs, particularly those of the Cumberland Plain Woodland variety, and once established is likely to entirely obscure the built form of the noise bund. The noise bund will also completely obscure the built structures of the brickmaking facility

from commuters along Greendale Road, which will result in a positive impact on the Bringelly Road/Greendale Road cultural landscape.

A procedure for unexpected Non-Indigenous archaeological finds shall be included in the CEMP and OEMP and should incorporate the following instructions should unexpected archaeological finds be encountered during works:

- All works in the immediate vicinity of the identified material must stop.
- The Heritage Branch (OEH) must be notified.
- An archaeologist must be contacted to assess the significance of the material and recommend whether further action is required.

7.11 WASTE

7.11.1 OVERVIEW

The Bringelly Brickworks project comprises the expansion of existing operations on the site. Operations involve the continued extraction of raw materials, and continued brickmaking activities, with an increase in brick production to 263,500 tonnes per annum (an increase of 103,500 tonnes from current operations). The project will as a consequence generate a greater volume of waste.

This section addresses the DGRs relevant to potential waste impacts, including:

- Accurate estimates of the quantity and nature of the potential waste streams of the development.
- A description of measures that would be implemented to minimise production of other waste, and ensure that the waste is appropriately managed.

The principles of the waste hierarchy as described in the *Waste Avoidance and Resource Recovery Act, 2001* (WARR Act) are considered in this section of the report. This hierarchy provides guidance on the most preferable approach to managing waste, starting with the most sustainable option (avoiding the creation of waste) and with the least desirable option being disposal to landfill. Waste generated from the project will be managed in accordance with the principles of the hierarchy.

7.11.2 EXISTING WASTE GENERATION AND ENVIRONMENT

Operations waste

Current operations generate waste materials that are managed by staff on site through recovery and recycling of brickmaking by-products, segregation of general waste, from cardboard and timber, and recycling of metals and oil. These operations are managed by a Standard Operating Procedure for Waste Management (2009). The aim of this procedure is to ensure the amount of waste to landfill is reduced, and waste generated on site is managed appropriately in line with relevant legislative requirements.

Based on existing operational data, six skip bins of general waste (each of three cubic metre capacity) are collected twice a week. The total volume of general waste material generated for disposal at the site is 36 cubic metres (approximately 32.5 tonnes) per week equating to 1873 cubic metres (approximately 1,690 tonnes) per annum. The estimated volume of solid waste material recycled at the site per annum is 579 tonnes. Table 7-54 outlines the current waste generation and its management at the site.

Table 7-54 Current operational waste and management measures

Waste material and description	Volume/ weight per annum	Management method
Clean brick waste (non-fired) Clay and water-based material not containing metals and has not been fired.	6240 tonnes	Placed in green bins provided on the project site. Green bins are emptied in the Clean Waste Storage Area. Waste is crushed for reuse in the brickmaking process.
Waste Bricks	20,000 tonnes	Clean green bricks with inclusions or imperfections. This is disposed into extracted pits and voids on-site through a landfilling operation.
Fired brick waste Fired bricks, bricks spoiled with foreign bodies and rejected bricks.	15,900 tonnes	Fired waste brick is placed in the red steel bins provided on the project site. These red bins are emptied in the Waste Storage Area. 15,000 tonnes are disposed into extracted pits and voids on-site through a landfilling operation. 900 tonnes of this waste is collected by Boral Recycling and recycled into products at their recycling facility.
Waste oil Oils used in maintenance of equipment.	2400 litres per month	Waste oil is collected by Eclipse Environmental Services for recycling at No Fuss Liquids, Emu Plains who are a licensed waste oil recycler.
General waste Includes strapping, plastic wrapping, raw material bags, solid building waste, oily rags, gloves, wood and waste from lunchroom and office.	1690 tonnes based on a weekly generation of 36 cubic metres[1]	Placed in green or blue wheelie bins, which are subsequently loaded into blue Veolia bins. This waste is collected by Veolia and sent to Woodlawn, Goulburn for disposal.
Timber	48 tonnes, based on a monthly generation of 8 cubic metres[2]	This waste is collected by Veolia recycling and sent to Woodlawn, Goulburn for recycling.
Cardboard	7.2 tonnes, based on a weekly generation of 3 cubic metres[3]	This waste is collected by VISY recycling and sent to Woodlawn, Goulburn for recycling.
Scrap metal Scrap steel from used tooling, off-cuts and redundant equipment.	52 tonnes	This waste is sorted into steel, copper wire and electric motors. Copper wire and electric motors are separated, stacked and stored separately. The scrap metal waste is collected and recycled by SIM's Metal Management.

Waste material and description	Volume/ weight per annum	Management method
Empty oil drums Metal containers used to store oil.	48 drums	Empty oil drums are purged to ensure residual oil is removed and to prevent content seepage. The drums are crushed then placed into the scrap metal bins for recycling.

[1] Density of typical industrial waste (mixed scrap) 899kg/m^3
[2] Density of typical mixed wood waste 498kg/m^3
[3] Density of typical cardboard 50.4kg/m^3

7.11.3 POTENTIAL WASTE GENERATION AND MANAGEMENT

Construction Waste Generation

The main construction and demolition (C&D) waste arising from the project will be associated with the new driveway alignment, and extensions to the manufacturing plant and the clay preparation buildings. The waste from vegetation and tree clearance will generate 1159 tonnes of green waste, which will be mulched to be used on the two proposed noise bunds on the site. The total quantity of C&D waste that will be generated cannot be quantified until further design information is developed. However, when considering the 4.7 million tonnes of C&D waste generated in Sydney during 2009-2009 (EPA 2010), the volume generated would be relatively small.

The construction phase is anticipated to create various waste streams at the site, with the main activities being:

- Demolition of existing walls in the manufacturing plant and clay preparation building;
- New driveway alignment;
- Packaging material associated with construction activities;
- Construction of a two building extensions (manufacturing plant and clay preparation buildings); and
- Construction of two recycled water storage tanks.
- Vegetation and tree clearance within the quarry footprint

Table 7-55 identifies the waste types that are anticipated to be produced throughout the course of the construction phase of the project.

Table 7-55 Waste materials that will potentially be generated during construction

Typical construction waste materials		
Excavated materials	Tiles	Plasterboard
Garden organics	Concrete	Metals
Bricks	Timber	Packaging
Other waste. E.g. ceramic tiles, paints, PVC tubing, fittings	Pallets	Glass
Vegetation	Trees	

All vegetation that is cleared will be mulched and stockpiled in disturbed areas for use in landscaping on the noise bunds and rehabilitation, further detail is provided in Section 5.3 and 7.8 of the EIS as well as Appendices C and J.

Operational waste generation

The waste materials identified in Section 1.3.2 will still be generated from the on-going operations. While the waste composition is expected to remain relatively constant, there will be an increase in the overall volume of waste generated.

Table 7-56 below identifies the increased waste generation expected during the on-going operational phase of the project. The projected volumes have been calculated based on a 65 per cent increase in brick production and available date relating to current waste generation.

Table 7-56 Waste generation during operational phase

Waste material	Anticipated additional volume/ weight per annum	Total volume/ weight per annum
Clean bricks	4056 tonnes	10,296 tonnes
Green waste bricks	13,000	33,000
Fired Bricks	10,335 tonnes	26,235 tonnes
Waste oil	1560 litres	3960 litres
Empty oil drums	31 drums	80 drums
General waste	1099 tonnes	2789 tonnes
Scrap metal	34 tonnes	86 tonnes
Timber	31 tonnes	80 tonnes
Cardboard	4.7 tonnes	12 tonnes

The clean brick waste will increase by 4056 tonnes per annum; however, a large portion of this material will be re-used in the brick production process. The waste bricks will increase by 13,000 tonnes, which will be landfilled on site in accordance with the rehabilitation operations.

The fired brick waste will increase by 10,335 tonnes per annum. Although the increased volumes will require additional management and handling on-site, 95 per cent of this waste will be disposed in the voids on site through a landfilling operation. Five per cent all of this waste will be recycled off-site by Boral Recycling.

The general waste stream cannot be readily reused or recycled, and will therefore have the largest impact. The expanded operations at the site will result in an estimated 1100 tonne increase in waste requiring off-site disposal per annum.

Timber, cardboard, scrap metals and empty oil drums will be managed and recycled using the current systems, which may result in an increase in the frequency of collection, or an increase in the storage area provision for scrap metals.

There may also be an increase in the amount of waste oil generated. This will also be managed through an increase in the frequency of collection, or an increase in the storage area provision for waste oil.

Not accounting for the oil waste and oil drums, an estimated total of 14,750 tonnes per annum of waste will be generated of which 83.5 per cent will require off-site disposal and 16.5 per cent will be recycled.

7.11.4 MITIGATION MEASURES

Construction phase mitigation

All waste will be managed in accordance with the principles of the waste hierarchy, such that waste avoidance and reduction will be a top priority, while disposal to landfill will be the least favoured option.

Every opportunity will be taken to segregate and reuse the materials generated during construction. Any surplus Virgin Excavated Natural Materials (soils) will be suitable for reuse during the landscaping process, and for constructing embankments. The old driveway will be removed and suitable select fill material will be used in the construction of the new driveway. The remaining materials, which cannot be beneficially re-used on site, will be sent off-site to appropriately licensed waste management facilities for processing and/or disposal.

A CEMP will be prepared prior to construction, and this CEMP will document volumes of waste anticipated and the best practice management procedures, in accordance with relevant legislation, and taking into account the waste hierarchy principles.

Operational phase mitigation

All waste will be managed in accordance with the principles of the waste hierarchy, such that waste avoidance and reduction will be a top priority, while disposal to landfill will be the least favoured option.

Every opportunity will be made to minimise and reuse the materials generated during operations using the existing *Standard Operating Procedures Waste Management* (Boral 2009) implemented on site. A review of the Standard Operating Procedures will be undertaken to account for the increased waste management required on site. This will be revised as necessary and updated regularly as more detailed information becomes available.

All clean brick waste will be re-used back into the brickmaking process, negating the need to dispose of any waste material. Every effort will made to eliminate any metals or impurities entering the clean brick waste streams at all stages of the process.

If recyclable waste materials become contaminated with non-recyclable materials, the contaminated area shall be localised to avoid further contamination and minimise the quantities of rejected fired and un-fired brick waste requiring off-site disposal. Any such waste will be kept segregated and stored correctly in order to avoid further contaminating clean, green and dry waste. This waste will be disposed off-site in accordance with relevant legislation; or, when appropriate, disposed of in the pits on-site through a landfilling operation in accordance with the rehabilitation strategy for the site (Hyder Consulting 2013). The majority of fired bricks will also be disposed of in the pits on-site.

Waste oil will be stored in secure containers and kept in the existing bunded and covered area. The oil will be transported to a facility that is appropriately licensed to receive and recycle or treat the oil. Scrap metal and oil drums will be fully recycled through transporting to a facility that is appropriately licensed to receive and recycle the metal.

Any other waste materials that cannot be used on site will be sent off-site to appropriately licensed management facilities for processing where appropriate, or for disposal at an appropriate waste disposal facility (landfill). Waste to be disposed off-site will be classified, transported and disposed of in accordance with the Waste Classification Guidelines (DECCW 2008).

7.12 GREENHOUSE GASES

7.12.1 BACKGROUND

An increase in the brick production process will result in an increase in the combustion of natural gas, electricity use and diesel consumption. These activities will result in an increase in greenhouse gas emissions as a result of the project expansion. A detailed greenhouse gas (GHG) assessment has been undertaken for the project. This assessment addressed the DGRs relating to greenhouse gases:

- A quantitative assessment of potential scope 1 and 2 greenhouse gas emissions.
- A qualitative assessment of potential impacts of these emissions on the environment.
- An assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency.

A summary of the greenhouse gas assessment is presented below. The full report is included in Appendix H.

7.12.2 METHODOLOGY

The greenhouse gas assessment is based upon the methods outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development Greenhouse Gas Protocol.
- National Greenhouse and Energy Reporting (Measurement) Determination 2008.
- The NSW Department of Infrastructure, Planning and Natural Resources – Department of Energy, Utilities and Sustainability Guidelines for Energy and Greenhouse in EIA.
- The National Greenhouse Accounts Methods and Factors workbook (DCCEE 2012).

Three 'scopes' of emissions (Scope 1, Scope 2 and Scope 3) are defined for greenhouse gas accounting and reporting purposes. These include:

- **Scope 1** – Direct greenhouse gas emissions: Scope 1 emissions are direct emissions that occur from sources on site. This would include emissions arising from the combustion of fuels in equipment on-site (e.g. boilers, furnaces, generators, vehicles, machinery, fugitive emissions etc.).
- **Scope 2** – Electricity indirect greenhouse gas emissions: Scope 2 emissions account for greenhouse gas emissions arising from the generation of purchased electricity consumed on-site. Scope 2 emissions are considered indirect as they occur at an off-site facility where electricity is generated.
- **Scope 3** – Other indirect greenhouse gas emissions: Scope 3 emissions are an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities on, but occur away from the development site and are not under Boral control.

Emission factors are standardised and expressed as carbon dioxide equivalent ($CO_{2\text{-}e}$) which is calculated by multiplying the individual greenhouse gas emissions factor by its respective Global Warming Potential (GWP).

7.12.3 POTENTIAL IMPACTS

Greenhouse gas emissions from the operational phase of the project are the largest contributor to emissions. Emissions estimated from all sources are summarised in Table 7-57. The project's contribution to projected climate change, and associated impacts will be in proportion to its contribution to global greenhouse gas emissions. Total emissions for the project were estimated to increase from 23,132 t CO_2-e to 34,275.8 tCO_2-e, or 0.03 Mt CO_2-e per year based upon the maximum level of production. Total annual potential emissions associated with the project (0.03 MtCO_2-e) represent approximately 0.37 per cent of the total emissions from the mining non-energy sector in Australia (8.1 Mt CO_2-e) and 0.004 per cent of total Australian emissions (756 Mt CO_2-e). Accordingly, the contribution of the project to Australia's annual greenhouse gas emissions is not considered to be significant. Also the contribution of the project to global greenhouse gas emissions is a very small portion, given that Australia contributed approximately 1.5 per cent of global greenhouse gas in 2005 (Commonwealth of Australia, 2011).

The major source of emissions from the Bringelly Brickworks proposed expansion project are those associated with the combustion of natural gas in the production process (Scope 1 emissions), followed by electricity use (Scope 2 and 3 emissions) accounting for 66 per cent and 33 per cent respectively of total greenhouse gas emissions. Greenhouse gas emissions from natural gas combustion are lower than those associated with the combustion of other fossil fuels.

Table 7-57 Greenhouse gas emissions summary by source

Source	Activity	Scope 1 Estimated emissions (tCO_2-e)	Scope 2 Estimated emissions (tCO_2-e)	Scope 3 Estimated emissions (tCO_2-e)	Total (tCO_2-e)
Site preparation	Vegetation clearing to prepare site for construction of buildings, noise bund and driveway (including emissions from transport and decomposition).	74.0	n/a	n/a	74.0
	Scraping and spreading of material for construction of noise bunds	176.1	n/a	n/a	176.1
Construction of buildings	Concrete transport fuel use	0.9	n/a	n/a	0.9
	Concrete paving fuel use	16.1	n/a	n/a	16.1
	Building construction fuel use	45.2	n/a	n/a	45.2
	Steel transport fuel use	0.1	n/a	n/a	0.1
Construction of driveway	Asphalt transport fuel use	1.4	n/a	n/a	1.4
	Roadbase transport fuel use	6.2	n/a	n/a	6.2
	Fuel use from asphalt paving	3.2	n/a	n/a	3.2
	Fuel use from roadbase paving	12.9	n/a	n/a	12.9

Source	Activity	Scope 1 Estimated emissions (tCO_2-e)	Scope 2 Estimated emissions (tCO_2-e)	Scope 3 Estimated emissions (tCO_2-e)	Total (tCO_2-e)
Total construction GHG emissions					**336.1**
Operations	Natural gas use for production	17,421.6	n/a	4,831.8	22,253.3
	Electricity use for production	n/a	9295.7	1901.4	11,197.1
	Diesel fuel for production	454.3	n/a	33.8	488.1
Total operations GHG emissions per annum					**33,938.5**
Total GHG from the project		***18,212.4***	***9,296.5***	***6,768***	***34,274.6***

Total emissions from construction are relatively low and only represent one per cent of total emissions for the project. Key sources of construction greenhouse gas emissions include site preparation activities such as clearing of vegetation, construction of buildings and construction of the driveway located in the north-eastern corner of the project site. Total estimated emissions for construction activities are 336.8t CO CO_2-e. Construction of the noise bund is estimated to be the most significant source of emissions during the construction phase, accounting for 52 per cent of total emissions. Emissions from site preparation (22 per cent) and construction of the buildings (19 per cent) are also significant sources of construction greenhouse gas emissions.

Although there would be an increase in CO_2 production as a result of the expanded project, this increase in emissions would not be significant in terms of the overall greenhouse gas emissions of the mining industry and is even less significant on a national or international scale. The increase in CO_2 production as a result of the project is unlikely to cause substantial environmental impacts.

7.12.4 MITIGATION MEASURES

Mitigation measures to reduce greenhouse gas emissions associated with the construction and operational phases of the project are presented in Table 7-58.

Table 7-58 Recommendations for mitigation of greenhouse gas emissions

Relevant phase	Mitigation measure(s)
Construction	Where possible, use locally sourced materials to reduce emissions associated with transport.
	Recycle waste materials (e.g. use of reject bricks to support void rehabilitation) wherever possible.
	Plan construction works to avoid double handling of materials.
	Develop construction/transport plans to minimise the use of fuel during each construction stage. For example throttling down and switching off construction equipment when not in use.
	Where practical, use equipment with the highest fuel efficiency which use lower greenhouse gas intensive fuel (e.g. gas, ethanol).

Relevant phase	Mitigation measure(s)
	Incorporate energy efficiency design aspects wherever possible to reduce energy demand. Examples could include modification to increase kiln efficiency systems and use of other renewable forms of energy (e.g. co-generation/tri-generation on site).
Operation	Investigate the procurement of energy efficient equipment for the site (i.e. vehicles, forklifts, lighting etc.).
	Plan quarry campaigns, haulage routes and stockpiles locations carefully to ensure shortest possible travel distance for trucks and to avoid double handling of materials.
	Investigate route options and vehicle efficiencies for product export and materials import.
	Investigate the feasibility of on-site renewable energy, such as photo-voltaics to reduce demand from the grid.
	Regular maintenance of equipment to maintain optimum operations and fuel efficiency.
	Implement further training of brick manufacturing, delivery and quarry campaign staff to implement energy saving activities on site e.g. turning off equipment, machinery, vehicles and lighting when not in use and avoiding excessive idling.

7.13 VISUAL

7.13.1 OVERVIEW

The majority of the residential receivers are located to the north of the project site (north of Greendale Road), and to the east of the project site (to the east of Thompsons Creek). Although the brickmaking facility and quarry may be visible from some of these neighbouring residential receivers, their views of the project site are likely to be highly obscured as a number of them are situated at a lower elevation than the project site. Also, the southern side of Greendale Road and riparian corridor of Thompsons Creek are well-vegetated, with dense stands of trees and shrubs. This section addresses the DGRs for potential visual impacts. These DGRs require a detailed assessment of the:

- Changing landforms on the site during the various stages of the project.
- Potential visual impacts of the project on private landowners in the surrounding area as well as key vantage points in the public domain, including lighting impacts.
- A detailed description of the measures that would be implemented to minimise the visual impacts of the project.

7.13.2 EXISTING ENVIRONMENT

Surrounding landscape context

Land surrounding the project site is generally characterised by rural residential development interspersed with agricultural enterprises and industry. The landscape context is characterised by cleared land, open woodland and grasslands with some remnant regrowth vegetation, particularly along Thompsons Creek, a tributary of the upper South Creek catchment.

The topography surrounding the project site is undulating and with a rise towards the south west, reaching a maximum elevation of 160 metres AHD. From the high point, the land generally slopes in a northeast direction. The lowest elevation within the property boundary, excluding the quarry, is 76 metres AHD which occurs in the north-eastern corner of the property where Thompsons Creek crosses Greendale Road.

Project site

The project site occupies approximately 56.75 hectares of undulating, mostly cleared land. The landscape of the project site is dominated by pits, voids, stockpiles and lay down areas associated with quarrying activity, as well as structures and facilities purpose built for brick manufacturing.

From the 2011 survey, the maximum elevation within the project site is 146 metres AHD and occurs within Cell I. The lowest point occurs in Cells A and B and is 69 metres AHD. Vegetation along Greendale Road, Thompsons Creek and the western property boundary provides screening of the project site from neighbouring properties. Also, existing bunds and overburden stockpiles provide additional screening.

The closest receiver to the quarry and brick manufacturing facility is approximately 220 metres.

7.13.3 METHODOLOGY

A site visit was undertaken by Hyder Consulting in May 2013 to assess the visual impacts of the project. It has been assumed that the receivers who may be visually impacted by the redevelopment of the Bringelly site are the nearest receivers adjacent to the site. In this analysis, only residential receivers have been assessed.

GIS Methodology

The Geographic Information System (GIS) software package ArcGIS 10.1 and ArcScene were used to perform a visual assessment. A two metre Digital Terrain Model (DTM) was created from the one metre contours from 2011 survey and two metre contours for the area surrounding the quarry. The extent of the DTM covered a 2.5 kilometre radius from the project site.

The GIS procedure for visual analysis comprised the following elements:

- Create DTM (3D model) – inputs – 2011 Survey one metre contours and two metre contours.
- Construction 3D buildings (building heights provided by Boral and extruded from DTM).
- Construction 3D building extensions (building heights provided by Boral and extruded from DTM).
- Construct 3D noise bunds.
- Create sight lines – straight lines between observers/receivers (1.5 metres) and targets (new structures and high points in Quarry).
- Derive line of sight for observers/receivers to targets with structures such as buildings and bunds as obstruction.
- Generate visible sight lines and obstructions points for identify potential impacts.
- Validation via site visit (Monday 6th May 2013).

The image presented in Figure 7-40 below has been generated to reflect the targets for visual receivers and includes:

- Existing and proposed building facilities.

- Existing and proposed noise bunds.
- Existing stockpiles.

Figure 7-40 Output from ArcScene identifying targets and lines of sight to the project site

7.13.4 VISUAL RECEIVERS

Analysis of topographical information and aerial imagery (NearMap September 2012) has determined the extent of the visual catchment. Some parts of the project site may be seen by receivers. Flat topography, abundant vegetation and existing obstructions such as bunds, limits the visual impact to the properties adjacent to the property boundary and along Greendale Road and to the east of the project site. Table 7-59 identifies the visual receivers surrounding the site.

Table 7-59 Visual receivers identified surrounding the site

Receiver No.	Receiver address	Location
1	55 Loftus Road	On Loftus Road adjacent to eastern property boundary.
2	54 Loftus Road	On Loftus Road adjacent to eastern property boundary.
3	20 Greendale Road	On Greendale Road adjacent to eastern property boundary.
4	9 Greendale Road	On Greendale Road opposite side of the road.

5	5 Greendale Road (Preschool)	On Greendale Road, opposite substation and west of Thompsons Creek.
14	23 Greendale Road	On Greendale Road opposite side of the road.
15	27 Greendale Road	On Greendale Road opposite side of the road.
16	29 Greendale Road	On Greendale Road opposite side of the road.
17	25 Greendale Road	On Greendale Road opposite side of the road.
18	31 Greendale Road	On Greendale Road opposite side of the road.
19	35 Greendale Road	On Greendale Road opposite side of the road.
21	196 Greendale Road	On Greendale Road adjacent to western property boundary.
35	108 Belmore Road	On Belmore Road adjacent to Property boundary.

7.13.5 POTENTIAL IMPACTS

Potential impacts were identified by performing a line of sight analysis for the receivers described above. Photographs and information collected during the site visit also informed part of the analysis. Targets in the visual assessment included all new infrastructure and high point in the quarry where quarry activities that may have the potential to visually impact on the neighbouring receivers.

Figure 7-41 identifies the visual line of sight analysis from receivers to target points of the site. This plan has been used to assess the visual impacts potentially encountered by receivers as a result of the proposed Bringelly Brickworks expansion project.

Changing landforms

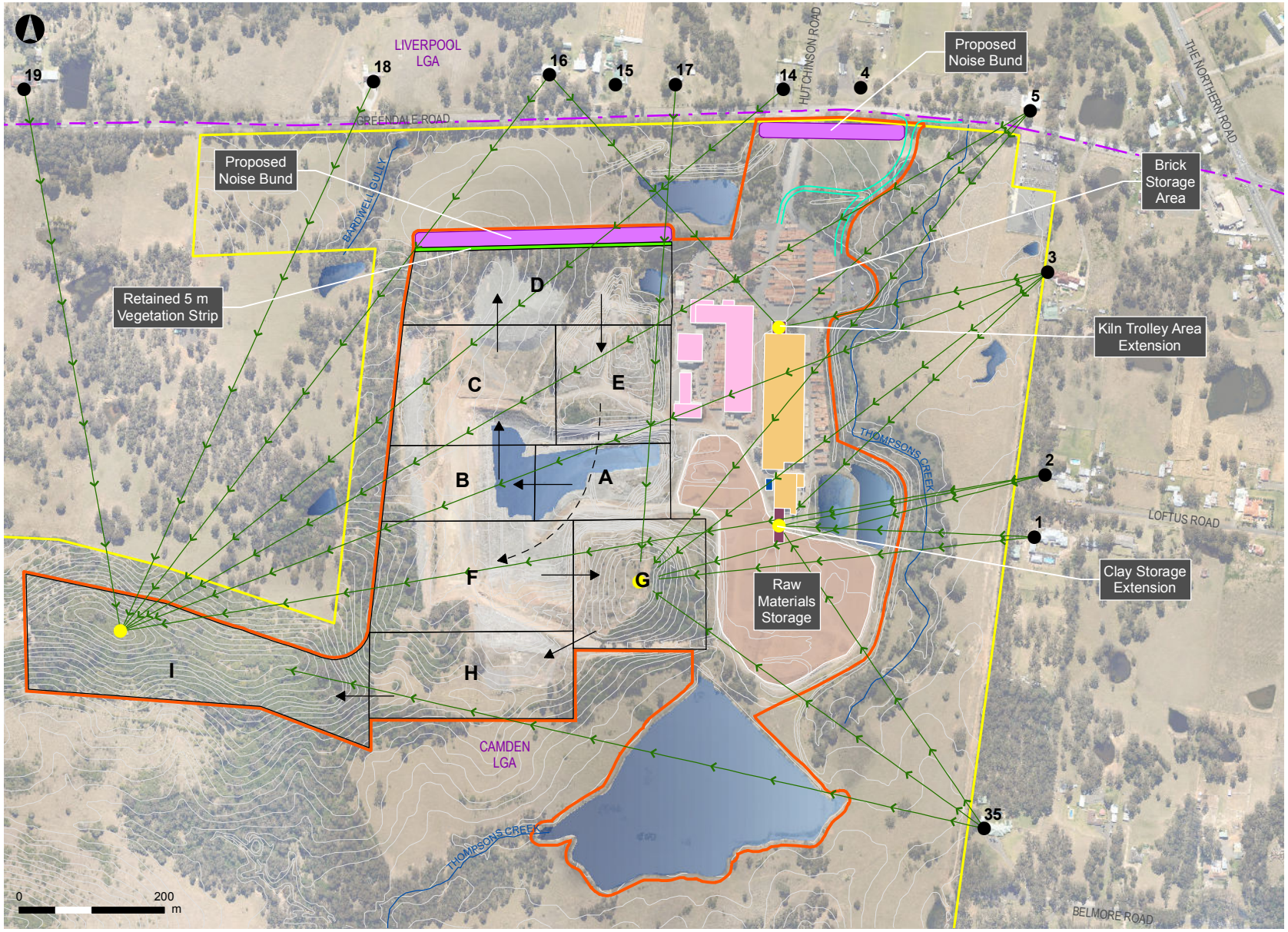
Quarry extraction area

Quarrying activities will change the existing landform of the proposed quarry extraction areas. A Eucalypt dominated vegetation strip along the southern boundary of Greendale Road as well as on the undulating hills extending southwards, provide sufficient cover to visually screen the proposed quarry cells, in particular Cells D, G and I which are currently the highest points of the project site. This will preserve the wooded visual amenity of the Greendale Road corridor.

Northern noise bund

A noise bund will be constructed along the northern boundary of Greendale Road which will change the existing landform of the project site. The purpose of the northern noise bund is to reduce noise generated from heavy vehicles arriving at and leaving the project site. It will also screen the proposed extensions to the brickworks buildings, the new driveway and the expanded quarry operations from residential receivers opposite the noise bund on the northern side of Greendale Road. In addition to the earth barrier, the noise bund will also be grassed and then planted with suitable, locally occurring native tree and shrub species to integrate the bund

with the adjacent vegetated environment and to preserve the wooded visual amenity of the Greendale Road corridor.



LEGEND

- Project site
- Property boundary
- Observer location
- Target location
- Line of sight
- Driveway realignment
- Quarry cells
- Proposed noise bund
- Retained 5 m vegetation strip
- Brickmaking facility
- Brick storage facility
- Building extensions
- Water storage tanks
- Raw materials storage
- LGA boundary
- 2m contours
- Watercourse

Map scale: 1:8,000 at A4

DATA SOURCES:
Boral, LPI, OEH,
Nearmap Imagery - 2 September 2012

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Figure 7-41: Visual line of sight analysis

Impacts on receivers

Receiver 1 and 2 (54 and 55 Loftus Road)

Figure 7-42 shows views from Receivers 1 and 2 at the end of Loftus Road looking westwards towards the project site. A Eucalypt dominated vegetation strip along both of these properties western boundaries combined with the vegetated eastern boundary of the project site (along Thompsons Creek and the eastern noise bund) provide substantial screening of the existing brickworks buildings and the project site. The proposed extensions to the brickworks buildings as well as the quarry operations in Cells G and I will be barely visible from Receivers 1 and 2.

The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receivers 1 and 2.

Figure 7-42 View west from the end of Loftus Road towards the project site

Receiver 3 (20 Greendale Road)

Figures 7-43 and 7-44 show the view from Receiver 3 looking westwards towards the project site. A Eucalypt dominated vegetation strip along the eastern boundary of the project site (along Thompsons Creek and the eastern noise bund) provides substantial screening of the existing brickworks buildings and the project site. Although portions of the existing brickworks are visible through gaps in the trees, the proposed extensions to the brickworks buildings are not visible from Receiver 3. The large eucalyptus trees on the highest portion of the proposed quarry Cell G are visible from Receiver 3. However as the base of these largest trees i.e. ground level was not visible from Receiver 3 due to screening by the dense vegetation along Thompsons Creek in the foreground, it is unlikely that Receiver 3 will be able to view the quarrying activities at Cell G. The top of the proposed quarry Cell I was not visible from receiver 3 being screened by taller Eucalypt trees in the foreground along Thompsons Creek.

In addition to the above, the house at 20 Greendale Road is orientated in such a way that their main views extend north and southwards (Figure 7-43), further reducing any potential impact on the visual amenity experienced by this receiver as a result of the proposed Bringelly Brickworks and quarry expansion. The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receiver 3.

Figure 7-43 View west from fence of Receiver 3 towards brickmaking facility, just visible through trees

Figure 7-44 Receiver 3 showing house and windows orientated northwards (no windows facing west)

Receiver 4 (9 Greendale Road)

No photos were taken from Receiver 4 as a 4.5 metre high earth noise bund is proposed to be constructed within the Bringelly Brickworks property, immediately south of Greendale Road, which will entirely obscure the brickmaking facility and quarry from the view of Receiver 4 (refer to Figure 7-41 for line of site analysis). Although the purpose of this noise bund is to reduce noise generated from heavy vehicles arriving at and leaving the project site, it will also screen the proposed extensions to the brickworks buildings, the new driveway and the expanded quarry operations from residential receivers opposite the noise bund on the northern side of Greendale Road. In addition to the earth barrier, the noise bund will also be grassed and then planted with suitable, locally occurring native tree and shrub species to integrate the bund with the adjacent vegetated environment and to preserve the wooded visual amenity of the Greendale Road corridor.

The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in negative impacts on the view or visual amenity of Receiver 4.

Receiver 5 (5 Greendale Road – Bringelly Community Centre)

Figure 7-45 shows views from the Bringelly Community Centre looking south-westwards towards the project site. As a result of the orientation of the Community Centre building and the architectural design (only one laterally elongated window positioned on the upper quarter of the southern wall of the building – Figure 7-45), it is unlikely that anyone inside the Community Centre would be able to see the project site. When standing at the front door of the Community Centre (in the car park) looking south-westwards, a Eucalypt dominated vegetation strip along the northern boundary (Greendale Road) and the eastern boundary (along Thompsons Creek and the eastern noise bund) of the project site, provide substantial screening of the existing brickworks buildings. The proposed extensions to the brickworks buildings as well as the quarry operations in Cells G and I will be barely visible from the car park of Receiver 5.

The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receiver 5.

Figure 7-45 View southwest from Bringelly Community Centre towards Bringelly brickmaking facility

Figure 7-46 View north of Bringelly Community Centre from Greendale Road

Receiver 14 (23 Greendale Road)

No photos were taken from Receiver 14 as a 4.5 metre high earth noise bund is proposed to be constructed within the Bringelly Brickworks property, immediately south of Greendale Road which will entirely obscure the brickmaking facility and quarry from the view of Receiver 4 (refer to Figure 7-41 for line of site analysis).

This noise bund will screen the proposed extensions to the brickworks buildings, the new driveway and the expanded quarry operations from Receiver 14. The dense stand of tall Eucalypt dominated trees on the project site, immediately south of Greendale Road and north of Dam 1, will obscure the view of the proposed quarry expansion including the elevated Cell I, from Receiver 14. The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in negative impacts on the view or visual amenity of Receiver 14.

Receiver 15 (27 Greendale Road)

Figure 7-47 shows the view from Receiver 15 at 27 Greendale Road looking southwards towards the project site. Views south-eastwards towards the existing and proposed brickworks buildings are interrupted by elevated topography (stormwater management bund) and dense vegetation immediately south of Greendale Road as well as a five metre strip of dense Eucalypt dominated vegetation that is to be retained along the northern boundary of the expanded quarry i.e. along the northern boundary of Cell D (refer to Figure 7-41). The existing brickworks, the proposed building extension and the quarry are therefore not visible from Receiver 15. The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receiver 15.

Figure 7-47 View south from Receiver 15

Receiver 16 (29 Greendale Road)

Figure 7-48 shows the view from Receiver 16 at 29 Greendale Road looking south-westwards towards the proposed quarry Cell I. Although the tallest trees that are visible on the horizon will be cleared during quarrying activities at Cell I, the mature woodland trees on the slopes extending from Cell I towards Greendale Road, will form the new skyline and will hide quarrying operations from the view of Receiver 16.

Figure 7-49 shows the view from Receiver 16 south-eastwards towards the existing and proposed brickworks buildings, which are interrupted by elevated topography (vegetated stormwater management bund) and vegetation immediately south of Greendale Road, as well as a patch of dense Eucalypt dominated vegetation that is to be retained immediately south of Dam 1.

The existing brickworks, the proposed building extension and the quarry are therefore not visible from Receiver 16. The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receiver 16.

Figure 7-48 View southwest from Receiver 16 towards proposed quarry Cell I

Figure 7-49 View southeast from Receiver 16 towards the brickmaking facility

Receiver 17 (25 Greendale Road)

No photos were taken from Receiver 17 at 25 Greendale Road looking southwards towards the project site as views towards the existing and proposed brickworks buildings as well as the proposed quarry expansion areas were completely obscured by elevated topography (vegetated stormwater management bund and the dam wall of Dam 1) and dense vegetation immediately south of Greendale Road as well as along the northern boundary of the northernmost quarry Cell D. A five metre strip of existing woodland will be retained along the northern boundary of the quarry.

The existing brickworks, the proposed building extension and the quarry are therefore not visible from Receiver 17. The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receiver 17.

Receiver 18 (31 Greendale Road)

Figure 7-50 shows the view from Receiver 18 at 31 Greendale Road looking southwards towards the project site. Views south-eastwards towards the brickworks buildings, the existing active quarry and proposed quarry Cell G are interrupted by elevated topography (spur) immediately south of Greendale Road. The existing brickworks as well as the proposed building extension are therefore not visible from Receiver 18. A Eucalypt dominated vegetation strip along the southern boundary of Greendale Road as well as on the undulating hills extending southwards, provide sufficient cover to visually screen the proposed quarry Cell I from Receiver 18.

The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receiver 18.

Figure 7-50 View south from Receiver 18 towards proposed quarry Cell I

Receiver 19 (35 Greendale Road)

Figure 7-51 shows the view from Receiver 19 at 35 Greendale Road looking southwards towards the project site. Views south-eastwards towards the brickworks buildings, the existing active quarry and proposed quarry Cell G are interrupted by elevated topography (spur) immediately south of Greendale Road. The existing brickworks as well as the proposed building extension are therefore not visible from Receiver 19. A Eucalypt dominated vegetation strip along the southern boundary of Greendale Road as well as on the undulating hills extending southwards, provide sufficient cover to visually screen the proposed quarry Cell I from Receiver 19.

The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receiver 19.

Figure 7-51 View from Receiver 19 southwards towards the project site

Receiver 35 (108 Belmore Road)

Figure 7-52 shows views from the western fence of Receiver 35 at the end of Belmore Road, looking westwards towards the project site. Receiver 35 is located at a slightly lower elevation than the ridgeline on the Boral property to the west. Views from Receiver 35 towards the project site are therefore obscured by this elevated ridge. It may be possible for Receiver 35 to see the tops of the tallest trees within the proposed quarry Cells G and I, which will be cleared during quarrying activities. The elevated ridge and trees in the foreground between Receiver 35 and

the project site form the dominant skyline feature and will hide quarrying operations from the view of Receiver 35.

The existing brickworks, the proposed building extension and the quarry are therefore not visible from Receiver 35. The proposed expansion to the Bringelly brickworks and quarry are therefore unlikely to result in significant impacts on the view or visual amenity of Receiver 35.

Figure 7-52 Views from western fence of Receiver 35, looking westwards towards the project site

7.13.6 MITIGATION MEASURES

Although the potential visual impacts arising from the project are not considered to be significant, noise bunds will be constructed so that once vegetated, they will obscure views from most receivers along Greendale Road to the brickworks and quarry.

7.14 HAZARDS

7.14.1 OVERVIEW

This section assesses the proposed Bringelly Brickworks expansion project in relation to the regulatory framework for the assessment of hazard and risk and provides an assessment of the potential impacts of the project in relation to hazard and risk according to the relevant guidelines, as well as in accordance with the DGRs for the project, which expressly stated that Hazards, including bushfire, be assessed as part of the EIS.

The *Applying SEPP 33 - Hazardous and Offensive Development Application Guidelines*, prepared by the Department of Planning in 2011, provides advice on interpreting and implementing SEPP 33. This guideline has been primarily developed for councils and authorities, but can also assist industry and consultants in identifying the broad assessment requirements for proposed developments.

The guidelines recommend a risk screening method for determining whether a project is hazardous, and provide guidance on assessing potentially offensive development projects. The screening process considers the class and volume of materials to be stored on the project site, and the distance of the storage area to the nearest site boundary.

The guidelines state that in order to determine whether SEPP 33 applies, that the proponent must consider whether the project use falls within the definition of ‘potentially hazardous industry’ or ‘potentially offensive industry’ adopted by the planning instrument that applies.

The proposed Bringelly quarry and brickmaking facility expansion is defined as an industry use under the CLEP 2010, (see chapter 7.1); therefore the provisions of SEPP 33 do not apply.

However, for clarity this section provides an assessment of the hazards and risks in relation to the project in accordance with the SEPP 33, and corresponding guidelines.

7.14.2 EXISTING ENVIRONMENT

The following potential hazards have been identified in relation to the existing operations on the project site:

- Bushfire.
- Storage and handling of dangerous goods.
- Refuelling of vehicles and plant.
- Contaminated run-off.

The natural vegetation of the area comprises dry sclerophyll woodland/forest. The woodland has been cleared from much of the project site which is currently grassed agricultural land, or former agricultural land now infested with dense stands of the weeds Olea and Privet. The land is generally undulating with gently sloping areas adjacent to creeks. According to the Camden Council, the project site is mapped as containing 'Bushfire Prone Land'. It is noted that Section 79BA of the *Environmental Planning and Assessment Act 1979* does not apply to State Significant Development, as such the *Planning for Bushfire Protection 2006* requirements do not apply to this application. However, an assessment of the bushfire hazards has still been undertaken in an effort to promote safety and access on the site.

Although the grassed pasture is assessed at Bushfire Prone Land, it does not pose a threat to the operation of the quarry or plant because the grassland is readily managed to reduce fuel loads; for example, by mowing regularly. Boral also have bushfire management measures incorporated into the Site Emergency Response Procedure. These measures include:

- The appointment of fire wardens.
- A warning communications system, featuring a siren and two-way radio.
- Display of the emergency site plan and relevant emergency numbers on notice boards and signposting of assembly areas.
- Conducting six monthly drills as well as testing and maintenance of fire protection/detection systems.
- Availability of portable fire extinguishers, hose reels, hydrants, town water supply and water retained in the on-site dams.
- Clear signage of fire exits, with all doors able to be unlocked from the inside.

Dangerous goods stored on the project site are limited to fuel, oils, lubricants and a number of additives used in the brickmaking process. Refuelling of vehicles and plant is carried out within the eastern corner of the brickmaking facility, where a bunded diesel tank with 15,000 litre capacity is located. Approximately 170,000 litres of diesel is consumed at the project site per annum.

A 1000 litre die lubricant tank servicing the extrusion machine is located within the brickmaking facility. Various other oils and lubricants are stored in a bunded area at the southern end of the brickmaking facility.

Other chemicals and additives used and stored at the project site are listed in Table 7-60.

Table 7-60 Chemicals and additives stored at the Bringelly site

Chemical/Additive	Dangerous Goods Class	Total (kg)	Exceeds SEPP 33 Criterion	Storage Type
Ball Clay	-	43,000	No	Bulk Bag
Red Oxide	-	350	No	25 kg Paper Bag
Mulite	-	13,950	No	Bulk Bag
Calgon	-	50	No	25 kg Paper Bag
Clay Ceram	-	32.700	No	Bulk Bag
Charcoal	-	9.900	No	Bulk Bag
Diesel	C1	15,000L	No	Bunded storage tank
Frit KBG 3801 (granular)	-	600	No	25 kg Paper Bag
Frit KBF 3880 (Flake)	-	200	No	25 kg Paper Bag
Cullet	-	52.800	No	Bulk Bag
Sawdust	-	240	No	Stockpiled inside
Manganese Dioxide	-	30.000	No	Bulk Bag
White Sand 1.5mm	-	24.000	No	Bulk Bag
White Sand 5mm	-	19.500	No	Bulk Bag
Dextrin TW	-	75.000	No	Bulk Bag
White Sand 3mm	-	236.700	No	Bulk Bag
30/60 Fine Sand	-	50.500	No	Bulk Bag
Colormax N70	-	57.375	No	Intermediate bulk container
Tiona	-	1.325	No	25 kg Paper Bag
Additive ZA	Class 6.1	7.522	No	IBC

As demonstrated above, the chemicals and additives which will be contained on site do not exceed the thresholds listed in Table 1 and Table 2 of the SEPP 33. As such, there is no requirement for a Preliminary Hazard Analysis to be undertaken.

7.14.3 POTENTIAL IMPACTS

The process of extracting clay and shale from the quarry and the production of bricks is described in Section 5.2 of this report. Potentially hazardous operations identified in relation to quarrying and brickmaking activities at the project site include spillage of dangerous goods, refuelling of vehicles and plant, the storage of fuel and other chemicals used in the processing and manufacturing of bricks, stockpile stability and potentially contaminated run-off being produced as a by-product of operations at the project site. The use and storage of flammable goods has the potential to result in off-site impacts including grass fires in the surrounding areas.

Potential impacts or risks associated with the identified hazards are detailed in the following sections and are related to risks to human health, life or property and the biophysical environment.

Bushfire hazard

There exists the potential for bushfire hazard in the grassed land to the north and south of the quarry footprint on the project site. Likewise, bushfire hazard may exist on the perimeter of the project site where vegetation has been used as a noise, dust or visual amenity mitigation measure. The building extensions have been designed and positioned to ensure that the project doesn't encroach any further toward the Bushfire Prone Land, or outside of the existing operational footprint. The proposed expansion to the quarry extraction areas and consequent vegetation clearing will not enhance any risks to adjoining land, nor make the facilities any more likely to be subject to bushfire hazard.

Storage and handling of dangerous goods

In the event of a spill or leak from the diesel tank, spilled diesel would be contained within the bunded area. Although unlikely, damage to the bund could result in a spill not being contained and potentially contaminating the surrounding area.

Chemical storage areas, as well as fuel storage areas are a potential source of contamination and therefore pose a risk to the human and natural environments. Leakage of chemicals from storage areas could potentially result in the addition of chemicals to surface water run-off and may result in contamination run-off.

In appropriately bunded areas, spills could potentially occur, although the impacts associated with spills in these areas would generally be limited in magnitude. The magnitude and impact of a spill in a chemical storage area that is not bunded, depending upon the volume of material stored, would be much greater. A spill or leak of the die lubricant could result in the contamination of surrounding areas.

Refuelling of vehicles and plant

Fuel spills could potentially occur where the refuelling of vehicles and plant is carried out. The magnitude of a spill would be restricted by the bunding in place. Fuel spills could also act as a potential fuel source and could contribute to a spark or fire.

In the event of a fuel spill during refuelling of vehicles and plant at the project site there is the potential for ignition or fire. Heat radiation from such fires could impact vegetation adjacent to Thompsons Creek, potentially resulting in fire.

Contaminated run-off

Contaminated run-off could potentially be sourced from stockpile areas, from the truck refuelling facility and diesel storage areas, and from areas where vehicles are stored and/or refuelled.

Hydrocarbon contamination would generally be associated with the addition of fuels including diesel run-off, due to a spill or leakage from vehicles. High concentrations of heavy metals in surface runoff may occur as a result of the presence of naturally occurring high concentrations of heavy metals in the soil and the underlying geology present on the project site. Sediment sourced from stockpile areas may contribute to highly turbid conditions in surface water run-off, which may have detrimental impacts to surface drainage systems.

7.14.4 MITIGATION MEASURES

Mitigation measures that would be adopted as part of the project in relation to the management of hazard and risk include the following:

- Spill kits would be maintained on the project site in the vicinity of the liquid storage bund and the diesel storage bund. An additional mobile spill kit would be kept on the site where quarry machinery and plant equipment is stored during quarry campaigns.
- All on-site staff would be informed of the site's Emergency Response Plan procedures to be undertaken on-site as part of their training.
- Fire extinguishers would be maintained on the project site in appropriate locations.
- Refuelling of vehicles and plant on the project site would be carried out in the designated refuelling area.
- All bunded areas storing chemicals, lubricants, fuels and oils would be well maintained.
- The perimeter road around the existing and proposed quarry areas will be maintained for use as fire breaks.
- The existing bare fuel-free perimeter strip around the manufacturing plant will be maintained.
- A road watering tanker would be used as an initial response fire tanker.
- Water hydrants are maintained at strategic points around the manufacturing plant.

7.15 SOCIAL AND ECONOMIC

7.15.1 OVERVIEW

The project has the potential to create positive economic benefits for the region in terms of employment creation, use of local business services and the supply of bricks at a competitive price to the growing regions of Sydney. This section assesses the social and economic environment within which the Bringelly Brickworks expansion project is located and the potential interactions of the project with this environment. Specifically, it addresses the relevant DGRs, which include:

- An assessment of the potential direct and indirect economic benefits of the project for local and regional communities and the State.
- An assessment of the potential impacts on local and regional communities, including:
  - Increased demand for local and regional infrastructure and services (such as housing, childcare, health, education and emergency services); and
  - Impacts on social amenity.
- A detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the project, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism.
- A detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community (refer to Chapter 10).

7.15.2 EXISTING ENVIRONMENT

Camden City Council is located in the South West subregion of the Sydney Metropolitan area, and is approximately 60 kilometres from the Sydney CBD. The Camden LGA boundary is bound by the City of Liverpool to the north, Campbelltown City Council to the east and Wollondilly Shire to the west.

Camden Council is a rapidly growing area, with significant increases in residential development, as well as a substantial provision of employment lands (for industrial, commercial and rural purposes). Camden Council is approximately 206 square kilometres in area, and has traditionally maintained a historic and rural atmosphere in the area. Included within the jurisdiction are the University of Sydney veterinary and agricultural schools and Camden Airport.

Community profile

In the period between 2006 and 2011, the Camden LGA experienced significant population growth from 49,644 persons to 56,720 persons. It is estimated that between 2010 and 2011, population growth occurred at a rate of 2.83 per cent (ABS, 2011). It is anticipated that the Camden LGA will continue to experience growth as a result of significant land releases over the next 30 years as urban development continues in the SWGC.

A comparison of the age breakdown of the Camden LGA in 2011 with New South Wales shows that Camden has a comparatively young population, with a higher percentage of people aged under 54 and fewer mature aged adults over 54 as shown in Table 7-61. Additionally, the median age is significantly lower at 34, compared to the State median which is 38.

Table 7-61 Age composition for Camden LGA (2011 Census data)

Characteristic	Camden LGA		NSW Average	
	No. of persons	% of persons	No. of persons	% of persons
Infants (0-4)	4,576	8.1	458,735	6.6
Children (5-14)	9,188	16.2	873,776	12.6
Young Adults (15-24)	7,749	13.7	893,103	12.9
Adults (25-54)	24,094	42.5	2,863,576	41.4
Mature Adults (55-64)	5,604	9.9	810,290	11.7
Aged (65+)	5,508	9.7	1,018,178	14.7
Population (total)	56,720		6,917,658	
Median age of persons	34		38	

Source: Australian Bureau of Statistics, Regional Population Growth, Australia (3218.0).

Economic profile

Employment

Camden LGA has a greater proportion of its workforce in full time employment compared to the NSW State average, as evident in Table 7-62. The economic structure of the area is reasonably diverse with almost one third of the total labour force employed as follows: technician and trade work (15.2 per cent), machinery operation/driving (8.4 per cent) and labouring (7.4 per cent). The continued operation of the Bringelly quarry and brickmaking facility offers further employment opportunities within these respective industries.

Table 7-62 Camden LGA employment status

Employment Status	Camden LGA		NSW Average	
	No. of persons	% of persons	No. of persons	% of persons
Full time	19,295	64.4	2,007,924	60.2
Part time	7,762	25.9	939,465	28.2
Employed Away*	1,702	5.7	190,944	5.7
Employed (total)	*28,760*	*96.0*	*3,138,333*	*94.1*
Unemployed (total)	*1,210*	*4.0*	*196,525*	*5.9*
Total labour force	29,969		3,334,858	

Australian Bureau of Statistics, Regional Population Growth, Australia (3218.0).

Income

Table 7-63 demonstrates that the individual median weekly income in the Camden LGA was $690, which is higher than the NSW State average of $561.

Table 7-63 Camden LGA Average Income

Median income ($/week)	Camden LGA	NSW Average
Personal	690	561
Family	1805	1477
Household	1727	1237

Predicted growth in the South West Subregion

The South West Subregion is comprised of four LGAs including Camden, Campbelltown, Wollondilly and Liverpool. As discussed in Chapter 7.1, the South West Subregion includes the SWGC under the new Draft Metropolitan Strategy (released for public comment in March 2013).

According to the Draft Metropolitan Strategy, the SWGC will need to accommodate the following into their existing employment lands or urban release areas:

- 141,000 new dwellings.
- 134,000 new jobs.
- 469,000 additional people.

Further to this, Camden's population is set to significantly increase in the next 20 to 30 years. The *NSW Statistical Local Area Population Projections 2006 – 2031* (2010 release) issued by the Department of Planning outlines the projected population for LGAs as part of the SWGC. This projection is demonstrated in Table 7-64. Consequently, many of the area's rural suburbs have been set aside for medium density residential housing development.

Table 7-64 Population Growth in the SW Growth Centre

LGA	Year						
	2006	2011	2016	2021	2026	2031	2036
Camden	50,900	67,200	93,600	124,800	172,300	219,700	249,800
Campbelltown	147,400	154,400	167,500	184,500	201,100	218,100	233,800
Liverpool	170,900	186,300	202,000	230,900	259,300	284,600	324,400

Camden maintains the lowest population of all LGAs within the SWGC and has a rapidly growing population. The predicted growth in the SWGC provides a ready market for product from the Bringelly brickmaking facility. The proximity of the Bringelly brickmaking facility to this large potential market would ensure that travel costs and impacts such as greenhouse gas emissions and added road traffic are minimised. Furthermore, demand for bricks would also be expected from new industrial and commercial premises to be located close to the project site.

7.15.3 POTENTIAL IMPACTS

The Bringelly quarry and brickmaking facility has been operating from the project site since 1968 without significant adverse impact on surrounding land uses or socioeconomic environment. However, the location of the project site within the SWGC means that the development surrounding the project site is likely to change significantly over the life of the project. Consequently, sensitive receptors may be located closer than at present resulting in changing social impacts. To ensure that these impacts are not significant a number of management and mitigation measures would be required. These measures are detailed in Chapter 9 of the EIS.

Social

The potential social impacts of the project relate largely to impacts on general amenity such as visual, noise, air quality (dust), traffic and potential land use impacts.

A range of mitigation measures are recommended in Sections 7.3 and 7.5 of the EIS that would be implemented as part of the project to ensure that potential noise and air quality impacts are minimised and are not perceived as a nuisance to neighbouring residences, the Bringelly Community Centre or the Public School.

Although the proposed increase in brick production will result in an increase in traffic, particularly heavy vehicles along Greendale Road, the traffic impact assessment has concluded that the project is unlikely to have a significant negative impact on the capacity of Greendale Road or the functioning of the Greendale Road/The Northern Road intersection; however, the increase in heavy vehicles will lead to a faster rate of deterioration of the road pavement of Greendale Road.

Visual impacts are not expected to be significant due to:

- The existing character of the project site.
- The lack of visibility of the brickmaking facility and quarry from sensitive receptors.
- The additional screening that will be developed through the establishment of well vegetated noise bunds along the northern property boundary, as well as planting of select areas along Greendale Road, where there are gaps in the existing vegetation strip.

Continued operations at the project site would remain consistent with future industrial land uses identified for the SWGC.

Economic

As discussed previously throughout this report, the importance of securing cost-effective material supply to meet the demands of future residential, commercial and industrial development is considered vital to the social and economic growth of the SWGC. Continued operations at the project site would enable this supply to be maintained.

The broader clay brick manufacturing industry generates over a billion dollars in revenue per year. Boral is one of the largest clay brick manufacturing companies and has the opportunity to maximise its resources in order to meet future demands.

The project would have continued positive economic impact on the local area and wider South West Sub-Region through the direct flow of construction and operational expenditure to staff and contractors. Continued operations would generate approximately five million dollars in capital investment value expenditure and employ approximately 72 staff related to the expanded quarry operations, the operation of the brickmaking facility and general transport works such as forklift or heavy vehicle drivers. Indirect employment would also be generated through demand for goods and services from local businesses by staff and contractors associated with the works.

Where possible, construction equipment, goods and services and technology is sourced from local or regional suppliers, benefiting both the local and Western Sydney economies. This practice is expected to continue into the future.

As development in the south west accelerates, it will be increasingly vital that the supply of product is able to meet the growing demand. Should works at the project site cease, this supply to the local community would be lost. Additionally site closure would lead to a loss of jobs directly at the project site, as well as indirectly through flow on effects within the community.

7.15.4 MITIGATION MEASURES

To minimise any potential impacts on businesses and the community during construction, a complaints handling procedure and register would be included in the CEMP.

As the proposed works will increase the volume of heavy vehicles using Greendale Road, the site will be required to fund a proportion of the road maintenance costs incurred by Council. Hyder Consulting completed a pavement impact assessment and considered the proposed pavement loadings associated with the project (as outlined in section 7.4.3). Using data provided by Liverpool Council, road maintenance costs were calculated and allocated according to the proportion of usage of the pavement design using Equivalent Standard Axles. This report will be used for ongoing consultation with Camden City Council to calculate ongoing annual road maintenance contributions.

Safeguards addressing potential social impacts related to land use, noise, traffic, air quality (dust) and visual impacts are provided in Sections 7.2, 7.3, 7.4, 7.5 and 7.13, respectively. Provided that the recommended safeguards are implemented, the social impacts of the project are considered to be acceptable, particularly when considered in the context of the significant contribution to the development of the SWGC.

8 CUMULATIVE IMPACTS

Cumulative impacts can result from a number of different elements within a project, as well as from other projects in the same locality. The cumulative impact of a project is a combination of each elemental impact of the project and the surrounding projects on the environment. Cumulative impacts can be considered on a project basis, taking into account the impact of each element on a locality or regional basis, as well as taking into account the interacting impacts of other projects in the immediate locality and the region.

8.1 CUMULATIVE IMPACTS OF CONTINUED AND EXPANDED OPERATIONS

The cumulative impacts of the continued and expanded operation of the quarry and brickmaking facility at Bringelly have been considered in relation to each of the identified issues in Chapter 7 of the EIS. Impacts of the project, particularly with respect to noise, traffic, air quality, ecology and water management have been considered in technical studies undertaken as part of this environmental assessment. The mitigation measures proposed in each of the chapters have been designed to:

- Ameliorate potential impacts associated with individual risks.
- Minimise the overall cumulative impacts of the development.

The project involves the continuation and expansion of existing quarrying and brickmaking activities at the Bringelly brickworks. It has been identified that:

- The project will not have a significant traffic impact on the local road network, nor will it have a significant noise-related impact on nearby sensitive receivers.
- Existing management measures such as air quality, greenhouse gas and dust management would be amended with additional measures to suit the proposed development so as to ensure that air quality impacts resulting from the continued operations are maintained at acceptable levels.
- Visually, the character of the project site would remain generally the same.
- Although the increase in brick production will result in an increase in waste, the existing waste management and recycling measures can easily be applied to the additional waste produced.
- The project would increase on-site water storage capacity and establish clean water divergence systems, reducing the amount of water from the quarry and brickmaking facility discharged to Thompsons Creek over time.
- 1.16 hectares of Existing Native Vegetation within non-certified areas would be affected by the project. This impact would be offset with the retention and conservation of 1.16 hectares of Moderate Condition CPW and 0.81 hectares of Poor Condition CPW in a certified area in the north-west of the project site.
- A rehabilitation strategy will guide short and medium term rehabilitation activities at the project site and provide a conceptual final land form for the end of the proposed 30 year life of the proposed development. Implementation of the rehabilitation strategy will result in a reduction in noise and dust levels at nearby sensitive residential receivers, an improvement in the visual amenity of the Bringelly brickworks site, an increase in fauna habitat over time, and an improvement in water quality in Thompsons Creek.

Overall, with the implementation of recommended mitigation measures, the cumulative impacts of the project are not expected to be significant given that the project involves the continuation and expansion of the existing quarry and brickmaking facility that has operated alongside surrounding rural residential and commercial development without conflict since 1968.

8.2 CUMULATIVE IMPACT WITH OTHER PROJECTS

The cumulative impacts of the continued operation and expansion of quarrying and brickmaking at Bringelly Brickworks have been considered with respect to existing development and operations, as well as major development planned for the local area.

Of the major projects identified within Camden and Liverpool LGAs, some have potential to be in construction at the same time as the project, including the South West Rail Link. This project is located outside the geographic range of the project site and would therefore not combine with the works at the project site to create a cumulative stress on transport infrastructure or cumulative environmental impacts.

The traffic impact assessment that was conducted for the cemetery proposed for 41 Greendale Road identified that the development would generate up to 91 vehicle movements in any peak hour and 396 vehicle movements daily (LCC 2011). The traffic impact assessment considered that the intersection of The Northern Road/Greendale Road/Bringelly Road would be adequate to cater for this additional traffic. Greendale Road would need to be upgraded at the intersection of the site and Greendale Road, which would include widening of 127.5 metres of pavement.

In addition, Liverpool Council had provided information on a project submitted in March 2013 for the construction of a 4,533 plot Muslim cemetery to be located on the northern side of Greendale Road further west of the Bringelly Brickworks site. The access road to the cemetery will be located some 400 metres west of the Bringelly site and on the northern side of Greendale Road. The Traffic Impact Assessment reported that when all plots are fully sold out, the project is expected to attract a maximum of 30 vehicles per hour during the peak hour when at full capacity. The expected peak hour traffic generation can occur anytime between their operating hours of 9am–4pm during a weekday and occasionally on weekends.

The cumulative impacts of the project have been considered with respect to the impacts associated with the continuation of operations in the context of existing surrounding development, as well as in relation to other approved projects in the region.

Mitigation measures have been recommended throughout this EA to minimise any impacts associated with the project. Provided these mitigation measures are adopted, the project would have negligible cumulative impacts given the project involves the continuation of an existing operation.

9 SUMMARY OF MITIGATION AND MONITORING MEASURES PROPOSED

This Chapter presents a consolidated summary of how the project will be managed and monitored to avoid, minimise and where necessary offset the potential environmental impacts of the project. The proponent is committed to the preparation and implementation of environmental management and monitoring plans as outlined in this Chapter.

Table 9-65 summarises the mitigation measures proposed on an issues basis, in accordance with the DGRs.

Table 9-65 Summary of mitigation and monitoring measures proposed

Issue	Management/monitoring measures proposed
General	All environmental management/monitoring measures will be incorporated into the following documents: ▪ Construction Environmental Management Plan (CEMP). ▪ Operational Environmental Management Plan (OEMP). ▪ Relevant contractor environmental management documentation. Any work covered by this approval may be subject to environmental audit(s) and/or inspection(s) at any time during their duration. All businesses and residences identified as a sensitive receiver in this EIS must be notified at least five working days prior to the commencement of the proposed activities. The rehabilitation strategy will be reviewed every five years as stipulated in Section 5.3 of this EIS.
Land resources	▪ Stockpiles and batter faces will be stabilised and erosion and sediment controls such a silt fencing used to ensure that impacts are confined to distinct areas. ▪ Exposure of saline sub-soils will be avoided/minimised wherever practicable. ▪ Vegetation will be retained and disturbance will be avoided in riparian zones and poorly drained areas. ▪ Vegetation will be retained and established in areas subject to erosion and disturbance, where practicable. ▪ Boral will continue to implement the Pollution Reduction Program to minimise impacts associated with off-site saline discharges to Thompsons Creek. ▪ Temporary structural methods (including silt fencing) will be used where required to protect newly treated areas, which are generally highly susceptible to erosion. ▪ Bunding and batter slopes for new quarry cells will be designed to minimise the potential for erosion in accordance with the Rehabilitation Strategy and Soil and Water Management Plan for the site. This will include the implementation of clean water diversion along the western boundary of the project site and revegetation of quarry benches. ▪ Haul roads will be maintained for the productive life of the quarry. ▪ Sediment fencing will be used on site as a temporary measure in the mitigation of sediment movement to down slope lands and waterways. ▪ Rehabilitation of the project site will be carried out in accordance with the Rehabilitation Strategy for the project site (Appendix D). ▪ Overburden and unusable material will be used to rehabilitate the unused pits wherever practical, such that no new stockpiles will be created. ▪ Water carts will be used to assist with control of dust.

Issue	Management/monitoring measures proposed
Noise	During construction: ▪ The quietest available plant and equipment that can economically undertake the work required will be selected. Mobile plant such as excavators, front-end loaders and other diesel-engined equipment will be fitted with residential class mufflers and other silencing equipment, as applicable. ▪ Noise emission levels of all critical items of mobile plant and equipment will be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service. ▪ Operators will be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission. ▪ Where practical, the layout and positioning of noise-producing plant and activities on each work site will be optimised to minimise noise emission levels. ▪ An effective community relations programme will be put in place to keep the community that has been identified as being potentially affected updated on progress of the works, and to forewarn potentially affected groups (e.g. by letterbox drop, updating site website, meetings with community groups, etc.) of any anticipated changes in noise emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms. ▪ Close liaison will be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. During operation – processing and manufacturing facilities: ▪ The crusher and box feeder buildings will be acoustically insulated to ensure compliance with the relevant INP criterion. ▪ The driveway will be relocated and a 4.5m high noise barrier/bund will be installed along Greendale Road. ▪ Front end loaders will be treated and mitigated (maximum sound power level of 102 decibels). ▪ Forklifts fitted with standard beeper alarms will be replaced with broadband alarms on decommissioning of the old plant equipment. During operation – quarrying activities: ▪ A noise management plan will be developed and implemented for the site. The noise management plan will be informed by a noise audit undertaken during a quarrying campaign. This will include a thorough review of meteorological conditions, including SSW winds and validation of noise predictions to develop effective noise mitigation. ▪ A 4.5 metre noise bund will be constructed on the northern end of cell D prior to excavation in this cell. ▪ Quarrying of the hill in cell G will start from the western side so that the hill shields noise of the excavator and bulldozers from eastern residences.
Traffic and transport	Prior to the commencement of construction of the new access road, including the dedicated 60 metre left turn lane on the westbound lane on Greendale Road:

Issue	Management/monitoring measures proposed
	▪ A Construction Traffic Management Plan will be developed and implemented in accordance with RMS Guidelines and will be submitted to Camden Council for review. The Construction Traffic Management Plan will outline arrangements for the safe management of construction traffic entering and exiting the site and working along the westbound lane on Greendale Road during the construction of the dedicated 60 metre left turn lane. ▪ Vegetation on the southern side of Greendale Road, east of the proposed new access road, will be carefully cleared and/or pruned in order to meet the sight distance requirements as required by the Guide to Road Design, Part 3 – Geometric Design (Austroads 2009). The extent of vegetation clearing and/or pruning will be determined in consultation with Camden Council prior to the commencement of construction of the new site access and left turn lane. ▪ Boral will fund a proportion of the road maintenance costs incurred by Council as outlined in Section 7.4.3. The following mitigation measures will be implemented during operation of the project: ▪ Personnel operating trucks and vehicles to and from the project site will be required to undertake a site-specific health and safety induction specifying operating hours, speed limits along Greendale Road, safe access and egress, and the avoidance of the morning and afternoon peak periods where practicable. ▪ A heavy vehicle protocol will be developed for the project site and distributed to relevant staff and contractors during induction procedures. The protocol would deal with such issues as timing of vehicle movements, idling of vehicles, speed limits on Greendale Road and parking. ▪ Deliveries would be scheduled on larger capacity 'truck and trailer' vehicles rather than 'truck only' vehicles where possible to minimise truck movements. ▪ Where non-routine vehicular movements are required, such as for the transport of oversized loads, where practical and subject to appropriate standards, Boral would undertake these tasks outside of normal working hours and/or the peak morning and afternoon periods. ▪ Where feasible, Boral trucks servicing the site will be fitted with speed monitoring system via GPS tracking software.
Air quality	▪ Ground disturbance will be restricted to the minimum area practically possible in accordance with the staging plan. ▪ Exhausted quarry pits will be rehabilitated as soon as practicable (refer to Rehabilitation strategy, Section 5.3 and Appendix G). ▪ Stockpiles will be restricted to the designated raw material stockpile area to the south of the brick making facility. ▪ Unusable material will be used as backfill in exhausted quarry pits (refer to Rehabilitation strategy, Section 5.3 and Appendix G). ▪ Temporary topsoil stockpiles will be located in previously disturbed areas (devoid of vegetation) within the proposed quarry footprint. Topsoil stockpiles that remain in place for more than a month will be covered by establishing vegetative cover to minimise dust lift-off (refer to Rehabilitation strategy, Section 5.3 and Appendix G). ▪ Active haul roads and manoeuvring areas will be watered to minimise dust.

Issue	Management/monitoring measures proposed
	▪ Vehicle speeds will be limited. ▪ A 5 m strip of mature woodland will be retained along the northern boundary of quarry Cell D. ▪ Dense vegetation cover (mixture of locally occurring native trees and shrubs) will be established on the two 4.5 m high noise bunds to be established along the northern boundary of quarry Cell D and to the east of the proposed new site access.
Surface water	▪ The catchment will be reconfigured to apportion runoff to storage pits according to their storage capacity. ▪ Boral will investigate options for the reuse of water stored on-site for beneficial use in order to increase the on-site water extraction regime, improve on-site storage capacity and reduce discharges to Thompsons Creek. ▪ Monitoring under PRP will continue to determine background salinity levels in the Thompsons Creek catchment. ▪ Drains, silt fences and bunding will continue to be used to direct site runoff into appropriate sediment basins and to control erosion. ▪ Temporary stockpiles will be stabilised in accordance with the Rehabilitation Strategy to minimise the risk of erosion. ▪ Flocculants will be used in sediment basins to increase sediment removal rates, where required. ▪ Routine maintenance of silt curtains located in Dams 4 and 5 will be undertaken, when required. ▪ Routine maintenance and inspection of drains, sediment basins and bunds will be undertaken. ▪ The brickmaking process will continue to use a combination of town water and recycled industrial water.
Groundwater	▪ Boral will engage a regular (biannual) water quality sampling and groundwater level monitoring program in order to establish seasonal trend records of water quality and identify outliers in any key parameters. ▪ Depth to groundwater will be measured and reported during each monitoring event. Field physic-chemical measurements of groundwater, including EC, pH, temperature and dissolved oxygen will be collected during purging and sampling using a calibrated water quality meter. Groundwater samples will be analysed at a NATA accredited laboratory for EC, pH, TDS, major cations (Na, K, Ca, Mg) and major anions (Cl, SO_4, alkalinity). ▪ Trigger levels, regarding declines in groundwater levels and the degradation of groundwater quality, will be established to manage the potential impacts as part of the project environmental management plan. Where monitoring results indicate levels in excess of the trigger values, an investigation appropriate for the situation will be conducted to assess the need to implement management/mitigation/remedial measures. ▪ The monitoring and exploration wells are designed, constructed and decommissioned to limit the risk of interaction between aquifers/saturated zones according to the Australian guidelines/standards. ▪ Fuel and chemical storages will be constructed and adequately bunded to the relevant Australian Standard. Accurate records of oil volumes, purchased, used, disposed, and recycled will be maintained. Spill containment procedures will be implemented to prevent migration and exposure of chemicals. Boral will ensure correct protocols regarding cleaning up of spills or leaks. Spill clean-up kits will be in accordance with Australian Standards (AS1940 and AS3780) and will be kept on site. Any significant leaks or spills of hazardous

Issue	Management/monitoring measures proposed
	materials will be cleaned up according to appropriate emergency clean-up operations. Immediate clean-up of spills, which is standard practice and/or a legislated requirement at mine sites, will prevent contamination of shallow strata and subsequent leakage to the groundwater system. ▪ The proposed rehabilitation management and monitoring plans will be reviewed and altered as necessary.
Biodiversity	▪ A Flora and Fauna Management Plan for the project site will be prepared to manage impacts to flora and fauna as a result of the project across the construction and operational stages. The Flora and Fauna Management Plan will be appended to the CEMP and OEMP addressing: ▪ Sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitat. ▪ Fauna injury/mortality. ▪ Weed establishment and invasion. ▪ Topsoil removal and site rehabilitation. ▪ Impacts to threatened hollow dependent fauna (microbats and Little Lorikeet). ▪ Loss of fauna habitat. ▪ Loss and degradation of native vegetation including Cumberland Plain Woodland CEEC. ▪ Reduction in water quality as result of sediment laden runoff, chemical spills/plant leaks reaching Thompsons Creek. ▪ Degradation of riparian zones. ▪ Disruption of fauna foraging, nesting or roosting behaviours.
Aboriginal heritage	▪ Where possible, Aboriginal sites will be conserved. If conservation is not possible, measures will be taken to mitigate against impacts to Aboriginal sites. ▪ During construction and operation, measures will be taken to avoid inadvertent impacts to newly recorded site BB OS3 just south of the project site. These measures will be included in the CEMP and OEMP. ▪ The CEMP and OEMP will also include a procedure for unexpected finds and a site induction (refer to Section 7.9.6).
Non-Aboriginal heritage	▪ The proposed bund along the northern boundary will be grassed and then planted with a mixture of locally occurring native trees and shrubs, particularly those of the Cumberland Plain Woodland variety. ▪ A procedure for unexpected Non-Indigenous archaeological finds will be included in the CEMP and OEMP and will incorporate the following instructions should unexpected archaeological finds be encountered during works: ▪ All works in the immediate vicinity of the identified material must stop. ▪ The Heritage Branch (OEH) must be notified. ▪ An archaeologist must be contacted to assess the significance of the material and recommend whether further action is required.

Issue	Management/monitoring measures proposed
Waste	All waste will be managed in accordance with the principles of the waste hierarchy, such that waste avoidance and reduction will be a top priority, while disposal to landfill will be the least favoured option. During construction, the following mitigation measures will be employed: ▪ Where practicable, waste will be segregated and materials reused during construction. ▪ The CEMP will document volumes of waste anticipated. ▪ Any surplus VNM will be suitable for reuse during the landscaping process, and for constructing embankments. ▪ The old driveway will be removed and suitable select fill material will be used in the construction of the new driveway. The remaining materials that cannot be beneficially re-used on site will be sent off-site to appropriately licensed waste management facilities for processing and/or disposal. During operation, the following mitigation measures will be employed: ▪ Where practicable, waste will be minimised and materials re-used in accordance with the existing Standard Operating Procedure – Waste Management (Boral 2009). ▪ The Standard Operating Procedure – Waste Management (Boral 2009) will be reviewed and updated as necessary to account for changes in the waste produced on-site and more detailed information becomes available. ▪ Where practicable, clean brick waste will be re-used in the brickmaking process. Where possible, contaminants will be prevented from entering the clean brick waste streams at all stages of the process. ▪ Any contaminated waste will be kept segregated and stored correctly in order to avoid further contaminating the clean waste. This contaminated material will be disposed off-site in accordance with relevant legislation. ▪ If recyclable waste materials become contaminated with non-recyclable materials, the contaminated area will be localised to avoid further contamination and minimise the quantities of waste requiring off-site disposal. ▪ Waste oil will be stored in secure containers and kept in the existing bunded and covered area. The oil will be transported to a facility that is appropriately licensed to receive and recycle or treat the oil. ▪ Scrap metal and oil drums will be transported to a facility that is appropriately licensed to receive and recycle the metal. ▪ Rejected bricks and un-fired bricks will be placed in the quarry pits on-site in accordance with the rehabilitation strategy for the site. ▪ Any other waste materials that cannot be used on-site will be transported to appropriately licensed management facilities for processing and/or disposal.
Greenhouse gases	During construction, the following mitigation measures will be employed: ▪ Where possible, locally sourced materials will be used to reduce emissions associated with transport. ▪ Waste materials will be recycled (e.g. use of rejected bricks to support void rehabilitation wherever possible). ▪ A CEMP/ traffic management plan will minimise the use of fuel during each construction stage (e.g. throttling down and switching off

Issue	Management/monitoring measures proposed
	construction equipment when not in use). ▪ Where practical, equipment with the highest fuel efficiency that uses lower greenhouse gas intensive fuels will be used. During operation, the following mitigation measures will be employed: ▪ The procurement of energy efficient equipment for the site (i.e. vehicles, forklifts, lighting, etc.) will be investigated. ▪ Quarry campaigns, haulage routes, and stockpile locations will be planned carefully to ensure shortest possible travel distance for trucks and to avoid double handling of materials. ▪ Route options and vehicle efficiencies for product export and materials import will be investigated. ▪ The feasibility of on-site renewable energy, such as photo-voltaics to reduce demand from the grid will be investigated. ▪ Equipment will be maintained regularly to maintain optimum operations and fuel efficiency. ▪ Further training of brick manufacturing, delivery and quarry campaign staff will be implemented to bring about energy saving activities on site; e.g., turning off equipment, machinery, vehicles and lighting when not in use and avoiding excessive idling.
Visual	▪ Construction of the noise bunds that, once vegetated, will obscure views from most receivers along Greendale Road to the brickworks and quarry.
Hazards	Mitigation measures that would be adopted as part of the project in relation to the management of hazard and risk include the following: ▪ Spill kits will be maintained on the project site in the vicinity of the liquid storage bund and the diesel storage bund. An additional mobile spill kit will be kept on the site where quarry machinery and plant equipment is stored during quarry campaigns. ▪ All on-site staff will be informed of the site's Emergency Response Plan procedures to be undertaken on-site as part of their training. ▪ Fire extinguishers will be maintained on the project site in appropriate locations. ▪ Refuelling of vehicles and plant on the project site will be carried out in the designated refuelling area. ▪ All bunded areas storing chemicals, lubricants, fuels and oils would be well maintained. ▪ The perimeter road around the existing and proposed quarry areas will be maintained for use as fire breaks. ▪ The existing bare fuel-free perimeter strip around the manufacturing plant will be maintained. ▪ A road watering tanker would be used as an initial response fire tanker. ▪ Water hydrants are maintained at strategic points around the manufacturing plant.
Social and economic	▪ A complaints handling procedure and register will be included in the CEMP. ▪ Boral will fund a proportion of the road maintenance costs incurred by Council as outlined in Section 7.4.3. ▪ Other safeguards addressing potential social impacts related to land use, noise, traffic, air quality (dust) and visual impacts are provided in Sections 7.2, 7.3, 7.4, 7.5 and 7.13, respectively.

10 JUSTIFICATION AND CONCLUSION

This chapter provides the justification for the project taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the project is in the public interest. The project is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the EP&A Regulation 2000.

10.1 JUSTIFICATION

Boral has operated two brickmaking facilities in Sydney at Badgerys Creek and Bringelly for over 40 years. With the current uncertain economic conditions Boral reviewed market demand against its bricks production capacity in NSW. Following this review, Boral 'mothballed' operations at Badgerys Creek in 2012 as there was insufficient demand for bricks to keep two brickmaking facilities in full production. Mothballing the Badgerys Creek site gives Boral the option to review its commercial position at a future stage and, if market conditions and business needs allow, recommence production. During the shutdown period, it is proposed that the Bringelly brickmaking facility will supply the Sydney market demand. This operational consolidation will require an increase in the manufacturing process (i.e. the number of bricks produced) at the Bringelly brickmaking facility. Without an increase in production at Bringelly, Boral will not be able to meet the anticipated demand for bricks, hence the proposed quarry and brickmaking facility expansion project is necessary.

Not only has the potential environmental, social and economic impacts of the proposed quarry and brickmaking facility expansion project been thoroughly assessed as presented in the EIS, but the project has been undertaken with consideration of the principles of ESD as discussed below.

10.1.1 THE PRECAUTIONARY PRINCIPLE

The precautionary principle requires evaluation of the threat of serious or irreversible harm to the environment. The project has been assessed with the purpose of reducing the risk of serious and permanent impacts on the environment.

A number of alternatives have been considered for the continuation and expansion of operations at the project site (see Chapter 4), including:

- Do nothing.
- Cease quarrying and brick production on site.
- Cease extraction of raw materials and import all raw material for brick production on site.
- Varying the location and scale of proposed future cells.
- Extracting from deeper geological units from within the existing pits.

Specialist studies were undertaken to provide accurate information to assist with the evaluation and development of the project:

- Noise.
- Traffic and transport.
- Air quality.
- Stormwater management.
- Groundwater.

- Biodiversity.
- Aboriginal heritage.
- Non-Aboriginal heritage.
- Greenhouse gases.

Where uncertainty in the data used in the assessment was identified, a conservative worst-case scenario analysis was undertaken. These specialist studies did not identify any issues that may cause serious and irreversible environmental damage as a result of the project. A Rehabilitation Strategy (Hyder Consulting 2013) has been produced to guide the staged rehabilitation process.

10.1.2 INTERGENERATIONAL EQUITY

The intergenerational equity principle is concerned with ensuring that the current generation preserves natural and built assets so that wellbeing and productivity are not compromised for future generations. Although the site doesn't support a significant amount of natural assets (limited native vegetation cover within the proposed quarry expansion area), an area that offsets environmental impacts such as native vegetation clearance to ensure that such areas are conserved for future generations has been proposed.

A thorough stormwater management and water quality assessment has also been undertaken to assess potential impacts on the downstream drainage systems such as Thompsons Creek and Bardwell Gully. Stormwater management measures have been proposed, which would limit negative impacts on these drainage systems.

In addition, the project will provide construction material for the future development of the Sydney Growth Centres. Should the project not proceed, the principle of intergenerational equity may be compromised, as future generations could inherit a higher cost of building as brick supply would potentially not meet demand and bricks may need to be transported from further afield, driving up brick prices.

10.1.3 CONSERVATION OF BIOLOGICAL DIVERSITY AND ECOLOGICAL INTEGRITY

This principle reinforces the previous two principles in requiring that the diversity of genes, species and communities, as well as the ecosystems and habitats to which they belong, be maintained and improved to ensure their survival. A comprehensive assessment of the existing local environment has been undertaken in order to recognise and manage any potential impacts of the project on local biodiversity.

No threatened flora or fauna listed under the EPBC Act or TSC Act were recorded within the ecological study area. Several threatened fauna species listed as Vulnerable under the TSC Act have the potential to occur in the ecological study area. However, impacts to threatened fauna species are not deemed to be significant.

The Critically Endangered Ecological Community Cumberland Plain Woodland (CPW), as defined by the TSC Act, was found in the ecological study area. The project would have direct impacts on 2.87 hectares of CPW within non-certified areas. However, an assessment of significance concluded that the project will not have a significant impact on this Critically Endangered Ecological Community.

The project will require removal of 1.16 hectares of vegetation mapped as Existing Native Vegetation within non-certified areas. A suitable offset has been proposed in accordance with the Biodiversity Certification Order for the Growth Centres SEPP as well as the *Principles for the Use of Biodiversity Offsets in NSW* (OEH 2011a).

The project is not considered to significantly impact on biological diversity or ecological integrity. An ecological assessment and appropriate site-specific safeguards are provided in Section 7.8 and are further detailed in Appendix K.

10.1.4 IMPROVED VALUATION, PRICING AND INCENTIVE MECHANISMS

This principle requires that costs to the environment are incorporated or internalised in terms of the overall project costs. This EIS has examined the environmental consequences of the project and identified mitigation measures for areas which may possibly experience adverse impacts. Implementation of these mitigation measures would result in an economic cost to Boral. The implementation of mitigation measures would increase both the capital and operating costs of the project. This signifies that environmental resources have been valued in economic terms during the planning and development phase of this project.

10.2 CONCLUSION

The project, identified as a State Significant Development, has been subject to an environmental impact assessment in accordance with Section 78A(8A) of the *Environmental Planning and Assessment Act 1979* and the Director General's Requirements (Appendix A). This EIS has examined and taken into account all matters affecting or likely to affect the environment by reason of the proposed activity.

The environmental impact assessment that was undertaken concludes that whilst the project would have some impacts on biodiversity, Aboriginal heritage and noise, the mitigation measures identified would effectively reduce these to an acceptable level of environmental risk and enable the project to operate without detriment to the existing or future land uses.

The project will provide significant public benefit in terms of the provision of a vital resource for the construction industry. This resource would contribute to meeting current and projected future demand for such materials associated with the future growth planned for the Sydney Metropolitan Area, and in particular, the identified Growth Centres within which the project site is located. The expansion of the Bringelly Brickworks will also double employment on the site and provide revenue to the State of New South Wales. These economic and social benefits are considered to outweigh the residual environmental impacts identified in this EIS.

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