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Boral Badgerys Creek

Continued Operation of Quarry and Brick Making Facility

Volume 1

ENVIRONMENTAL ASSESSMENT

Continued Operation of Quarry and Brick Making Facility
Boral, Badgerys Creek

Prepared for Boral Bricks
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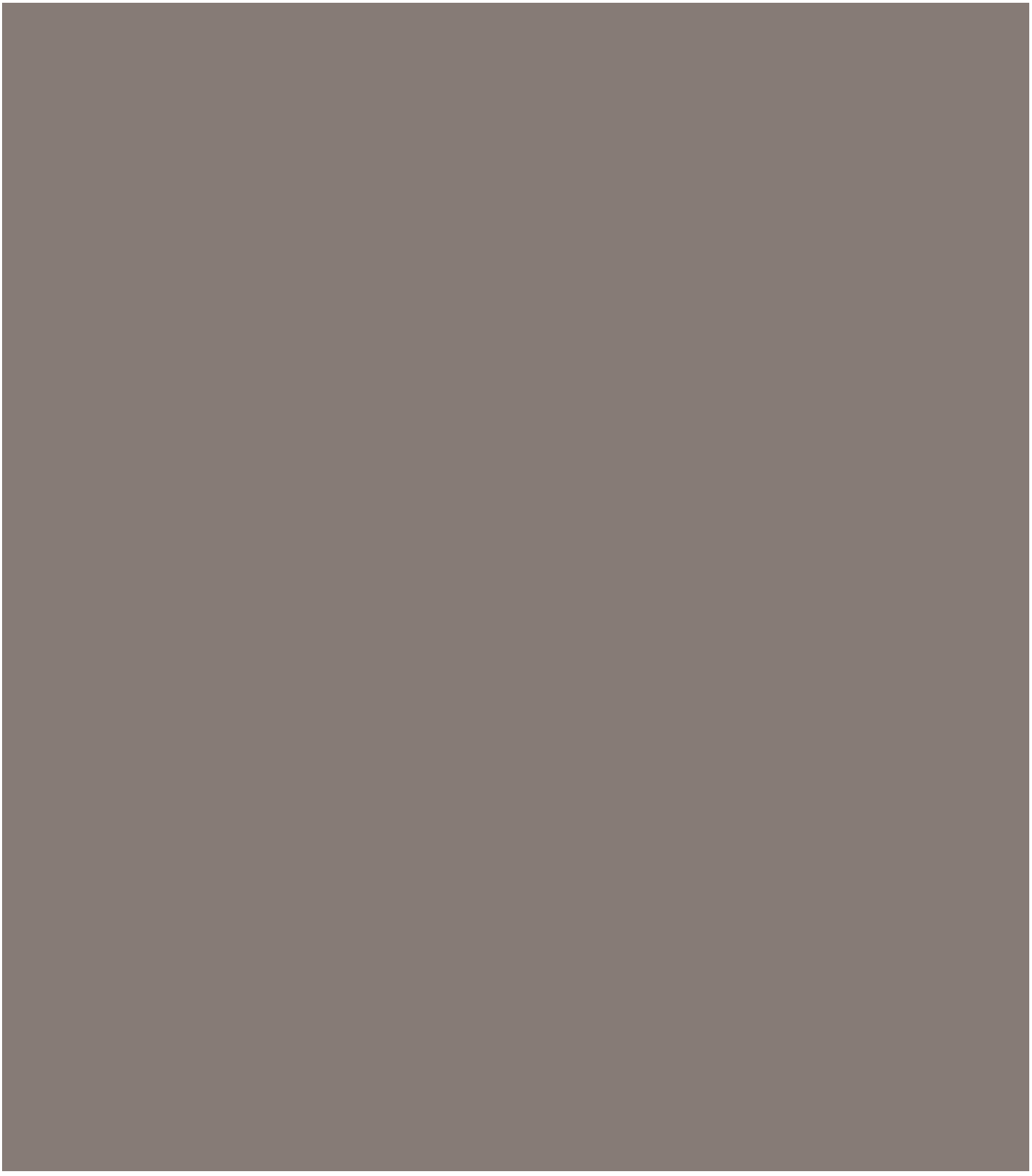
BORAL



Certification Page

Submission of Environmental Assessment (EA) prepared under the *NSW Environmental Planning and Assessment Act 1979* Section 75F

EA prepared by:		
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Title	Principal Planner	Associate Director
Address	AECOM Level 8, 17 York Street Sydney NSW 2000	
in respect of	Continuation of operations – Boral Quarry and Brick Making Facility, Badgerys Creek	
Project application	CP 10_0014 and CP 10_0033	
Applicant name	Boral Bricks Pty Ltd	
Applicant address	235 Martin Road, Badgerys Creek NSW	
Land to be developed lot no., DP/MPS, vol/fol etc Proposed project	The proposed project is to be carried out on land at 235 Martin Road, Badgerys Creek, as shown in Figure 2 of this EA.	
Environmental Assessment	an Environmental Assessment (EA) is attached	
Certification	I certify that I have prepared the contents of this Environmental Assessment and to the best of my knowledge it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.	
Per:		
	Signature	Signature
	Name: Erin Saunders	Name: Catherine Brady
	Date 3 November 2010	Date 3 November 2010

Quality Information

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Reviewed by	Catherine Brady Technical Peer Reviewer Signature 

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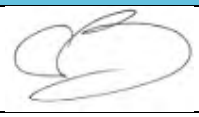
Revision History

Revision	**Revision Date**	**Details**	**Authorised**	
			Name/Position	**Signature**
1	3/11/2010	EA for Exhibition	Catherine Brady	

Contents

Volume 1

Volume 2

Volume 3

List of Tables

Body Report

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Acronyms

Acronym	Definition
AADT	Average Annual Daily Traffic
ABS	Australian Bureau of Statistics
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
ANL	Australian Native Landscapes
AQIA	Air Quality Impact Assessment
AQMP	Air Quality Management Plan
ASS	Acid Sulphate Soils
bgs	below ground surface
BoM	Bureau of Meteorology
CBD	Central Business District
CEC	Cation Exchange Capacity
Cl	Chlorine
CLM Act	*Contaminated Land Management Act 1997*
CPW	Cumberland Plain Woodland
CSM	Coal seam methane
DA	Development Application
DACHA	Darug Aboriginal Cultural Heritage Assessments
DCAC	Darug Custodian Aboriginal Corporation
DCC	Department of Climate Change
DEC (formerly EPA)	Department of Environment and Conservation NSW
DECC	Department of Environment and Climate Change NSW (now DECCW)
DECCW	Department of the Environment, Climate Change and Water NSW
DEWHA	Department of the Environment, Water, Heritage and the Arts
DGPS	Differential Global Positioning System
DGRs	Director-General's Requirements
DII	Department of Industry and Investment NSW
DoP	Department of Planning NSW
DoS	Degree of Saturation
DIPNR	Department of Infrastructure, Planning and Natural Resources NSW (now DoP and DECCW)
DLO	Darug Land Observations
DMR	NSW Department of Mineral Resources

Acronym	Definition
DPI	Department of Primary Industries NSW
DTAC	Darug Tribal Aboriginal Corporation
EA	Environmental Assessment
ECRTN	DECCW's *Environmental Criteria for Road Traffic Noise*
EEC	Endangered Ecological Community
EMP	Environmental Management Plan
EPA	Environment Protection Agency (Now DEC)
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPI	Environmental Planning Instrument
EPL	Environmental Protection License
ESD	Ecologically Sustainable Development
FM Act	*Fisheries Management Act 1994*
GHG	Greenhouse Gas
GLALC	Gandangara Local Aboriginal Land Council
GLC	Ground Level Concentrations
GPS	Global Positioning System
GSNSW	Geographical Society of NSW
HF	hydrogen fluoride
H_2SO_4,	Sulfuric acid
ICCRs	Interim Community Consultation Requirements for Applicants
ICNG	NSW Interim Construction Noise Guideline (DECCW)
IGAE	Intergovernmental Agreement on the Environment
INP	NSW Industrial Noise Policy (DECCW)
Kg	Kilogram
L	Litre
LCC	Liverpool City Council
LGA	Local Government Area
LLEP	*Liverpool Local Environmental Plan* 2008
LoS	Level of Service
MHRDC	Maximum Harvestable Right Dam Capacity
M4	Western Motorway
NEPM	National Environment Protection Measures
NES	National Environmental Significance

Acronym	Definition
NGA	National Greenhouse Accounts
NO	nitric oxide
NO_x	Nitrogen Oxides
NO_2	Nitrogen Dioxide
NOW	NSW Office of Water
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	National Parks and Wildlife Service
NV Act	*Native Vegetation Act 2003*
NW Act	*Noxious Weeds Act 1993*
O_2	Oxygen
OH&S	Occupational Health &Safety
PEA	Preliminary Environmental Assessment
PFM	Planning Focus Meeting
PHA	Preliminary Hazard Analysis
PM_{10}	Particulate Matter of 10 Microns (diameter)
POEO Act	*Protection of the Environment Operations Act 1997*
PPM	Parts per million
RBL	Rated Background Level
REP	Regional Environmental Plan
RFEF	River Flat Eucalypt Forest
RNE	Register of the National Estate
RP	Rehabilitation Plan
RTA	Roads and Traffic Authority
SAWT	SITA Advanced Waste Treatment Facility
SCRFF	Sydney Coastal River Flat Forest
SEPP 2005	*State Environmental Planning Policy (Major Development) 2005*
SEPP 2007	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*
SEPP 2006	*State Environmental Planning Policy (Sydney Region Growth Centres) 2006*
SEPP 33	*State Environmental Planning Policy No. 33 – Hazardous and Offensive Industries*
SEPP 44	*State Environmental Planning Policy No. 44 – Koala Habitat Protection*
SEPP 55	*State Environmental Planning Policy No. 55. – Remediation of Land*
SITA	SITA Environmental Solutions Australia Pty Ltd

Acronym	Definition
SO_2	Sulfur dioxide
SoC	Statement of Commitments
SPW	Shale Plains Woodland
SREP	Sydney Regional Environmental Plan
SWGC	South West Growth Centre
SWMP	Soil and Water Management Plan
TDS	Total Dissolved Solids
TEOM	Tapered Element Oscillating Microbalance
tpa	tonnes per annum
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total suspended particulates
WIRES	Wildlife Information Rescue and Education Service Inc, NSW
WM Act	*Water Management Act 2000*
WMP	Waste management plan
WONS	Weeds of National Significance
YA	Yarrawalk

Executive Summary

Introduction

AECOM Australia Pty Limited (AECOM) has prepared this Environmental Assessment (EA) on behalf of Boral Bricks Pty Limited (Boral) to assess the potential environmental impacts of continued extraction of the Badgerys Creek quarry (the Project Site) beyond September 2010 to meet continued demand for its products. Boral currently carries out quarrying and brick making activities at the Project Site, which lies within the Liverpool Local Government Area (LGA) to the south-west of Sydney.

The proposal has been declared by the NSW Director General of the Department of Planning (DoP), as delegate of the Minister for Planning, as a 'major development' under the provisions of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) and *State Environmental Planning Policy (Major Development) 2005* (SEPP 2005), and is therefore subject to the provisions of Part 3A of the EP&A Act.

Existing operations on the Project Site involve the quarrying of clay and shale for the production of bricks and their dispatch to offsite locations. A substantial amount of valuable clay resource remains on the Project Site and it is important that this resource be fully utilised to ensure a steady ongoing supply of building materials for the construction industry. Current operations on the Project Site involve the following key activities and infrastructure:

- Three existing quarry pits (Pits 1, 2 and 3);
- A brick handling and production facility (brick making facility);
- A bricks finished goods storage yard;
- Raw material and unusable material stockpiles;
- Water storage and sedimentation ponds; and
- Access roads.

Boral is seeking Concept and concurrent Project Approval for the continuation of operations on the Project Site, comprising:

- Extraction from existing and future new pits across the Project Site in the order of 420,000 tonnes per annum (tpa); and
- Brick making activities in the order of 252,000 tpa.

Key works and ancillary activities included in the project are:

- Continuation of extraction of raw materials from Pit 3;
- Establishment of new quarry areas commencing with Pit 4 to the north of the existing Pit 3 and then extending into the area further to the north (Pit 5);
- Stockpiling of raw and unusable materials;
- Rehabilitation works ; and
- Other ancillary activities such as loading/unloading, brick storage and delivery and receipt of raw materials.

This EA has been prepared by AECOM on behalf of the Proponent to support an application for approval for the continuation of operations on the Project Site as described in **Chapter 4**. It has been prepared in accordance with Part 3A of the EP&A Act and the Director Generals Requirements (DGRs) issued for the Project by the Director-General of the DoP.

Site Description and Context

The Project Site is located in the suburb of Badgerys Creek within the Liverpool LGA. Badgerys Creek is approximately 41 km south west of Sydney and 17 km west of Liverpool. It is a small community comprising rural residences, agricultural activities, quarrying and industry. The locality supports a number of small rural residential holdings and a limited number of larger agricultural properties, agricultural enterprises (chicken farms, nurseries) and market gardens. The region forms part of the South West Growth Centre (SWGC) under the *City of Cities: Sydney Metropolitan Strategy* (DoP, 2007, *Sydney Metropolitan Strategy*) with Liverpool identified as a major centre and the Project Site earmarked for 'future industrial' development.

The Project Site is some 200 ha in area and is currently used for quarrying, brick production and associated activities. Existing features of the Project Site include two completed quarry pits (known as Pits 1 and 2), an active quarry pit (known as Pit 3), three large sediment basins in the eastern and northern portions of the Project Site, two smaller dams in the eastern and northern parts of the Project Site, a brick making facility, various administration buildings, a bricks finished goods storage yard, car parks and internal road network. These features are generally contained within the western part of the Project Site with the far eastern portion of the Project Site adjacent to South Creek being undeveloped and used for stock agistment and grazing.

Strategic Context and Project Need

The proposed Project involves the continuation of quarrying and brick making activities within the Project Site which is currently operating as a quarry and brick making facility. Quarrying and brick making activities at the Project Site currently yield approximately 250,000 tpa of shale and sandstone and produce bricks in the order of 200,000 tpa. A draft discussion paper prepared by the NSW Department of Mineral Resources (DMR) as part of structure planning for the *Sydney Metropolitan Strategy* states that Bringelly Shale is the primary source of structural shale for the manufacture of bricks and pavers for the Sydney region.

Boral is Australia's second largest producer of clay brick and pavers and also exports a small proportion of clay products to New Zealand and Japan and increasingly to other countries within the Asia region. In Australia, demand for Boral's clay and concrete products is primarily driven by the construction of multi-unit and attached/detached housing.

Badgerys Creek is located within the SWGC, an area identified as part of the *Sydney Metropolitan Strategy* as a major growth area. The Growth Centres are expected to accommodate 30 to 40 percent of Sydney's new housing by 2031. The Project Site has been earmarked under the *Sydney Metropolitan Strategy* as 'future industrial' employment land. Surrounding areas have been earmarked for either 'future industrial' or 'residential' land use. Continuation of quarrying at the Project Site and the subsequent production of clay bricks and pavers, would support proposed future urban development within the SWGC and predicted growth across the broader Sydney region and align with the proposed rezoning of the land to 'future industrial'.

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

- *Extraction from deeper geological units.* It is expected that in order to extract resource from within deeper geological units, and to penetrate the dense, Minchinbury Sandstone, alternative extraction techniques such as blasting would likely be required. At this stage, given the availability of more readily accessible resource across the Project Site, it is not economically viable to extract material deeper than the current average of 35 m, therefore it is not proposed to extract deeper than this under the current proposal.
- *Location of proposed future Pits 4 and 5.* The proposed pit locations have been chosen to target the required resource whilst avoiding areas of environmental constraint. Proposed Pits 4 and 5 represent the most economically viable and environmentally sustainable locations for quarrying to take place over the next 20 years.
- *Extraction in the east of the Project Site.* Suitable resource may exist in the eastern portion of the Project Site to justify future extraction in this location, however extensive geological investigation has not yet been undertaken on this part of the site. Quarrying may take place in the eastern part of the site at some point in the future subject to geological and environmental investigations, market conditions and planning approval, however under the current proposal, this part of the site would not be subject to quarrying activites.

Use of the Project Site

- *Cessation of extraction and rehabilitation of the land for a 'future industrial' land use in accordance with the intent of the Sydney Metropolitan Strategy*. This option was discounted as it would not allow for the full utilisation of resources existing on the Project Site and the sterilisation of the land for future extraction. This would have implications for the availability of construction materials and potentially broader impacts upon the cost of housing development in the Sydney region.
- *Cessation of quarrying and brick making operations at the Project Site and closure of the Project Site.* Similar to the above, this would leave a valuable natural resource on the Project Site. This option is not considered to have economic or social merit given that the Project Site is already operating as a successful business, with strong future potential given the growing housing market in the greater Sydney region.

Upon consideration of these alternatives, the continued use of the Project Site for extraction and brick making was considered to be the highest and best use of the land in the foreseeable future.

Do Nothing

The 'Do Nothing' option would comprise Boral continuing to operate until the expiration of its existing consent in September 2010, beyond which operations at the Project Site would have to cease as they would no longer have the required approval. This option would have the same implications as those discussed above, with the loss of a regionally significant natural resource and subsequent flow-on effects for the local and regional economy.

Project Description

Concept and concurrent Project Approval is sought for the continuation of operations on the Project Site beyond September 2010. Operations would involve continued extraction of raw materials and continued brick making activities with some increase in total volumes extracted and throughput of the brick making facility. The Project includes the following components:

- Extraction of raw materials from the Project Site in the order of 420,000 tpa, involving:
  - Extraction from Pit 3 to an approximate depth of 35 m; and
  - Establishment of Pits 4 and 5 and extraction in these pits to a depth of approximately 35 m.
- Brick production in the order of 250,000 tpa;
- Import of raw materials required for brick making in the order of 20,000 tpa;
- Associated handling, packaging, storage and transport of bricks;
- Associated construction of bunds and stockpiles;
- Maintenance and rehabilitation works.

The Project is separated into three key components: Quarry activities, brick making activities and ancillary activities/works such as stockpiles, stormwater management works and rehabilitation.

Quarrying on the Project Site is expected to progress in the following manner:

- Continued quarrying of Pit 3 (existing) including the lateral progression of the pit towards the east. It is anticipated that extraction from Pit 3 would continue until approximately 2016.
- Establishment of proposed Pit 4 would commence in approximately 2014. It is anticipated that extraction from Pit 4 would continue until approximately 2022.
- Establishment of proposed Pit 5 would commence in approximately 2020. It is anticipated that extraction from the Pit 5 would continue until approximately 2028.

Ancillary infrastructure and activities on the Project Site include:

- Storage, handling and dispatch of bricks;
- Delivery of raw materials for brick making;
- Associated administrative, office and sales activities; and
- Rehabilitation works.

Rehabilitation works would aim to both stabilise land on the Project Site in order to minimise environmental impacts and to enable use of the land for an appropriate, productive land use upon completion of the proposed quarrying operations. This future land use is yet to be determined and would be informed by environmental conditions, market conditions and planning policy and direction at the time.

Statutory Approvals

Commonwealth Legislation

The Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* came into effect in July 2000 and requires the approval of the Commonwealth Minister for the Environment, Water, Heritage and the Arts 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 proposed 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

The proposed Project has been declared by the Minister as a 'major development' under the provisions of the EP&A Act and SEPP 2005 and is therefore subject to the provisions of Part 3A of the EP&A Act with the Minister being the 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 development at a State, regional and local level.

In accordance with Clause 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 a discretionary matter for the Minister, a range of EPIs have been considered in relation to the Project, including:

- *SEPP 2005;*
- *SEPP (Mining, Petroleum Production and Extractive Industries) 2007;*
- *SEPP (Sydney Region Growth Centres) 2006;*
- *SEPP No. 33 – Hazardous and Offensive Industries;*
- *SEPP No. 44 – Koala Habitat Protection;*
- *SEPP No. 55. – Remediation of Land; and*
- *Liverpool Local Environmental Plan 2008 (LLEP 2008).*

A discussion of the application of these instruments to the Project and the permissibility of the Project is provided in **Chapter 5** of the EA. The Project is generally characterised as an 'extractive industry' and permissibility is established under LLEP 2008.

Whilst extractive industries are permissible with consent in the RU1 zone, there is no fitting definition for the brick making component of the Project and it is therefore deemed a prohibited use within the zone by default. In order to clarify permissibility and to provide certainty regarding future operations at the Project Site, Concept Plan and concurrent Project Approval is sought for the Project.

Licensing

Should approval be granted for the Project, an application would be made for a mining lease in accordance with the relevant provisions of the *Mining Act 1992* (Mining Act). Clause 75V of the EP&A Act provides that subject to the issue of Project Approval, a mining lease for the Project cannot be refused and must be substantially consistent with the terms of Project Approval.

The Project Site is subject to an existing environment protection licence (EPL) under the *Protection of the Environment Operations Act 1997* (NSW) (POEO Act) which would need to be reviewed and updated based upon the proposed continued operations. An application would be made for a variation to the existing EPL to reflect the proposed future operations at the Project Site. Clause 75V of the EP&A Act provides that, subsequent to the granting of Project Approval, an EPL cannot be refused and must be substantially consistent with the terms of Project Approval.

Consultation

This EA has been prepared in accordance with Part 3A of the EP&A Act and its Regulation. Part 3A of the EP&A Act ensures that the potential environmental effects of the proposal are properly assessed and considered in the decision making process.

Statutory and Other Relevant Authorities

In preparing this EA, 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 EA are outlined in **Table 12** of the EA.

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 AECOM has consulted include:

- The DoP;
- The NSW Department of Environment, Climate Change and Water (DECCW);
- The NSW Office of Water (NOW);
- The NSW Department of Industry and Investment (DII);
- The NSW Roads and Traffic Authority (RTA); and
- Liverpool City Council (LCC).

Community Consultation

The Proponent regularly engages with adjoining landowners and has in the past received no substantial complaint in relation to the existing Project Site operations.

As part of the EA process, a program of targeted land owner consultation involving face to face meetings and discussions with potentially impacted landholders who reside within 250 m of the Project Site boundary, has been undertaken. The consultation process endeavoured to inform and discuss with local landowners planned quarrying activities including the continued extraction of raw materials from Pit 3 and the progression of quarrying activities into proposed Pit 4 and Pit 5 in the eastern and northern areas of the Project Site. Feedback from the consultation process has been taken into consideration in preparing this EA.

Issues Prioritisation

An Issues Prioritisation Matrix was prepared for the proposed continued operations, which is based on the need to recognise that the higher the potential severity of adverse environmental effects and the greater the consequence of those unmanaged effects, the higher the degree of environmental assessment required.

Table 1 below identifies that the prioritisation of environmental issues, and therefore the focus of assessment for the proposed project should be as follows:

Table 1: Environmental issue prioritisation

Low	Medium	High
Hazard and Risk	Air quality	None
Ecology	Water	
Socio-Economic	Noise and Vibration	
Cultural Heritage	Traffic and Transportation	
Visual	Land Use	
Geology and Soils (Soil erosion impacts)	Rehabilitation	

Air quality

An Air Quality Impact Assessment (AQIA) was undertaken as part of the EA in accordance with the DECCW's Approved Methods (DEC, 2005). Maximum predicted pollutant Ground Level Concentrations (GLCs) on a gridded modelling domain and 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 mist all met the stated assessment criteria at the discrete sensitive receptors for both isolated and cumulative predicted GLCs.

The dust modelling results indicated that TSP GLCs and dust deposition met the assessment criteria for all modelled scenarios. In relation to PM_{10} the modelling indicated the following:

- The predicted 24 hour PM_{10} GLCs in isolation from background concentrations and cumulatively showed exceedances of assessment criteria for all modelled scenarios (except scenario 1B (no quarrying activities) in isolation from background concentrations);
- The predicted annual PM_{10} GLCs in isolation from background concentrations met the assessment criteria for all scenarios; and
- The cumulative annual PM_{10} GLCs showed exceedances of assessment criteria for all scenarios (except scenario 1B).

A number of mitigation measures would be implemented as part of the Project to manage air quality impacts, including the following:

- Dust control measures would be employed, and
- An Air Quality Management Plan (AQMP) would be prepared for the Project Site, which would include measures to control dust and emissions from the Project Site and would include details of a dust mitigation program for the Project Site.

Further detail in relation air quality mitigation measures is provided in **Section 8.4** of the EA.

In relation to Greenhouse Gas (GHG) emissions, the total emissions from the facility were estimated to be approximately 0.041 Mt carbon dioxide equivalent (CO_2-e) per year, which is around 0.4% of total emissions from the mining non-energy sector in Australia, and 0.007% of total Australian emissions. As such, the contribution of the facility to GHG emissions overall is very small. The facility has been operating for many years, with GHG emissions at these approximate levels for at least the past three years. As such, the proposed development would not result in significant additional environmental impacts in this regard.

Approximately 60% of GHG emissions from the Project Site are generated from the combustion of natural gas in the production process. GHG emissions from natural gas combustion are lower than those associated with the combustion of other fossil fuels.

Surface Water

The potential water quality and management impacts associated with the proposed 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 increased duration of the existing quarrying activities. The Project Site does however currently operate with nil discharge and would continue to do so under the proposed operations.

Water balance modelling was undertaken as part of the EA and is detailed in **Chapter 10** and **Appendix C** to the EA. The modelling shows that there is sufficient on-site storage capacity for the proposed 20 years of operation on the site based upon a worst case scenario. Boral would also continue to investigate options for reuse of water stored on site for beneficial purposes.

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 10.3** of the EA.

Groundwater

The extraction of raw materials within the Project Site extends to a depth of approximately 35 m and targets the fine-grained Bringelly Shale of the Wianamatta Group. The Wianamatta Group is not considered a significant groundwater resource due to the poor primary porosity and permeability and high salinity is exhibits, and is not extracted and utilised in the vicinity of the Project Site.

Dewatering of the Bringelly Shale formation would have occurred at a result of quarrying operations to date and cumulative impacts as a result of the proposal are not considered likely to have a measurable impact on water levels in the vicinity of the Project Site.

In order to mitigate the potential impacts of the development on Badgerys Creek, a 50 m buffer zone would be implemented along the creekline (Badgerys Creek). Adverse impacts to groundwater contained within alluvial sediment associated with Badgerys Creek are not anticipated as a result of the development and further investigation of the extent of alluvial sediments through the implementation of a groundwater monitoring program would aim to ensure that unexpected impacts are readily identified and managed accordingly. In this regard, Boral would implement alluvial mapping and assessment and a Groundwater Monitoring Program at least two years prior to extraction in proposed Pit 4 to establish and map the location and extent of the alluvial aquifer associated with Badgerys Creek and monitor groundwater impacts. The location of proposed pits could be adjusted in response to the alluvial mapping if required to ensure that extraction does not encroach upon the alluvial aquifer such that impacts upon this system are minimised. A detailed methodology for the proposed alluvial mapping and groundwater monitoring program is provided in **Chapter 11** of the EA.

Noise

The Noise Assessment undertaken for the Project Site reveals that a number of residences to the north, west, 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 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.

Land Use

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

The Project Site and surrounding area is set to experience significant land use change over the life of the project and as such, the project has been designed to adapt and integrate with that change. 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.

Traffic and Transportation

A Traffic Impact Assessment (TIA) was undertaken in respect of the proposal to assess the potential impacts of the project on traffic and transport. During peak hours, the frequency of proposed project generated traffic is less than what is currently produced by the facility during peak hours due to the proposed extended operating hours of the storage yard. The extended operating hours has the effect of spreading the impact of the trucks over a longer period of time, thereby reducing the impact to the intersection of Martin Road and Elizabeth Drive in peak hours. In addition, the recent upgrade of packaging equipment within the plant (subject of a separate development consent issued by LCC) has resulted in significant improvements in the efficiency of brick transport with more bricks being transported per truckload. This has resulted in fewer truck movements to transport the same volume of brick product.

Project generated traffic is considered to have a negligible impact on the performance of the Martin Road and Elizabeth Drive intersection in a future year of 2029, as it accounts for a very small proportion of the forecast traffic volumes.

Geology and Soils

The Project Site is located in the Cumberland Lowlands subregion, one of the seven physiographic subregions of the Sydney Geological Basin. The Sydney Basin Region is underlain by Triassic sediments which dip gently from the east and north to a central lowland area southwest of Parramatta. The centre of the basin, the Cumberland Lowlands, consists of plains and gently undulating to low hills on the youngest of the Triassic rocks, the Wianamatta Group (DPI, 2005).

Disturbances to the soils and geology would occur during the continued operations on the Project Site. However these impacts would be locally confined and would be mitigated through the use of appropriate erosion and sediment controls and safeguards, as detailed in the SWMP (**Appendix C**) and **Section 14.3** of the EA.

Visual

The existing landscape of the general area is predominantly agricultural pastures and grasslands with some remnant or regrowth vegetation, particularly along drainage lines and creeks which include Badgerys Creek, South Creek and tributaries.

It is expected that the overall visual character of the site would remain largely unchanged as a result of the proposal, however the extent of disturbed areas would increase with the movement of extraction into Pits 4 and 5. Much of the Project Site would be screened from surrounding receivers by bunding along the northern and eastern site boundaries. Visually, the site would therefore be generally unobtrusive when viewed from surrounding properties and public roads. The proposal relates to an existing operation which has been in place on the site for some 30 years. The existing operation is generally integrated with the surrounding landscape and is not out of character with existing development which includes large-scale rural industrial and commercial operations such as Australian Native Landscapes. Future land use is likely to include increased industrial development which would result in significant change to the existing surrounding land use character, within which the proposed operations would integrate with minimal impact. Proposed bunding 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. Proposed visual management and mitigation measures are outlined in **Chapter 15** of the EA.

Heritage

One Aboriginal site (BC-01-09) consisting of a single stone artefact would be impacted by the construction of Pit 5. However, this site was determined to have low archaeological (scientific) significance and the loss of this site would not have a significant impact on the heritage values of the study area. Additionally, a review of potential European Heritage sites found no European Heritage items located within the study area.

Standard mitigation measures as described in **Section 16.3** of the EA would be implemented on the site to ensure that potential heritage impacts are adequately managed during quarrying activities.

Ecological

The ecological values of the proposed quarry footprint are limited as these areas have been largely cleared. The proposed works have been sited to avoid areas containing endangered ecological communities (EECs). The vegetation that occurs within the proposed Pit 4 and Pit 5 areas comprises exotic grassland with some isolated mature native trees and regrowth patches of vegetation.

The proposed works would not have a significant impact on the ecological values of the site. Rehabilitation works would be undertaken in the riparian areas adjacent to Badgerys Creek and the Badgerys Creek tributary to ensure impacts are minimised.

Socio-Economic

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 EA 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 GHG emissions, noise and congestion would be minimised.

The quarry and brick making facility has been operating on the Project Site for the last 30 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 socio-economic 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.

Waste

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 measures and through the continued implementation of the Waste Management Plan for the site.

Hazard and Risk

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 are generally centred on the 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 20.4**.

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 EA to minimise impacts associated with the proposed Project. Provided these mitigation measures are adopted, the Project would have negligible cumulative impacts.

Environmental Management and Commitments

Environmental Commitments are those environmental management measures formally established to mitigate and manage the potential environmental impacts of the Project. These commitments would be incorporated into an Environmental Management Plan (EMP) for the Project Site. The Proponent currently has a range of environmental policies and procedures under which the existing site activities operate including:

- Waste and Water Management Guidelines; and
- Energy and Greenhouse Gas Management Guidelines.

In accordance with the requirements under Part 3A and the DGR's, a Statement of Commitments (SoC) has been prepared and is provided in **Chapter 22** of the EA. The SoC states the Proponent's environmental commitments and details the environmental management and monitoring of the proposed Project. The SoC, prepared in respect of the Project, has been compiled on an issues basis and is informed by the environmental risk analysis and impact assessment undertaken as part of this EA.

The Proponent is committed to ensuring the preparation and implementation of the environmental management and monitoring plans, further investigations and studies and environmental mitigation measures detailed in the SoC for the proposed Project.

Project Justification

The proposed continuation and expansion of operations on the Project Site has been considered in the context of the principles of 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 EA 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 EA 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.

1.0 Introduction

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

1.1 Background

Boral Bricks Pty Ltd (Boral) currently carries out quarrying and brick making activities at 235 Martin Road, Badgerys Creek (Project Site) within the Liverpool Local Government Area (LGA) to the west of Sydney (refer **Figure 1**). The Project Site operates under consent issued by the Local Government Appeals Tribunal on 27 September 1976 (Council Ref: 1024/ 1976), as modified on 7 September 2006 (Council Ref: 921/2006).

The 1976 consent refers to a Deed of Agreement (the Deed) between Liverpool City Council (LCC) and Pacific Brick Company Pty Limited dated 30 September 1976. The Deed refers to the Tribunal award and contains conditions regulating extractive activities on the site and financial arrangements between the Company and LCC (refer to **Appendix A**).

The Deed imposes a 30 year lifespan for activities on the site from 27 September 1976 (cl. 12) and restoration of the land to the *'reasonable satisfaction of Council when operations on said land in connection with the development have been completed' (cl. 10).* During 2006, HLA Envirosciences Pty Limited (now trading as AECOM) assisted Boral with a Section 96(1A) application under the *Environmental Planning and Assessment Act 1979* (EP&A Act), to modify the consent to enable operations to continue on the site. A modification was granted by Council on 7 September 2006 for continued operations for a further four years. The modified consent is set to expire on 27 September 2010. Consequently, where it is stated that the Deed of Agreement is applicable for a 30 year period from 1976 onwards, the requirements of the Deed of Agreement remain during site operation up to the 27 September 2010 (refer to **Appendix A**). It is noted that a Section 96 modification lodged with LCC to extend site operations for a further 12 months as further security for site operations was approved by LCC on 3 September 2010.

Boral is now seeking approval for continued quarrying and brick making operations on the Project Site beyond 2011, the subject of this Environmental Assessment (EA).

1.1.1 The Proponent

The Proponent for the proposal is Boral Bricks Pty Ltd, a fully owned subsidiary of Boral Limited.

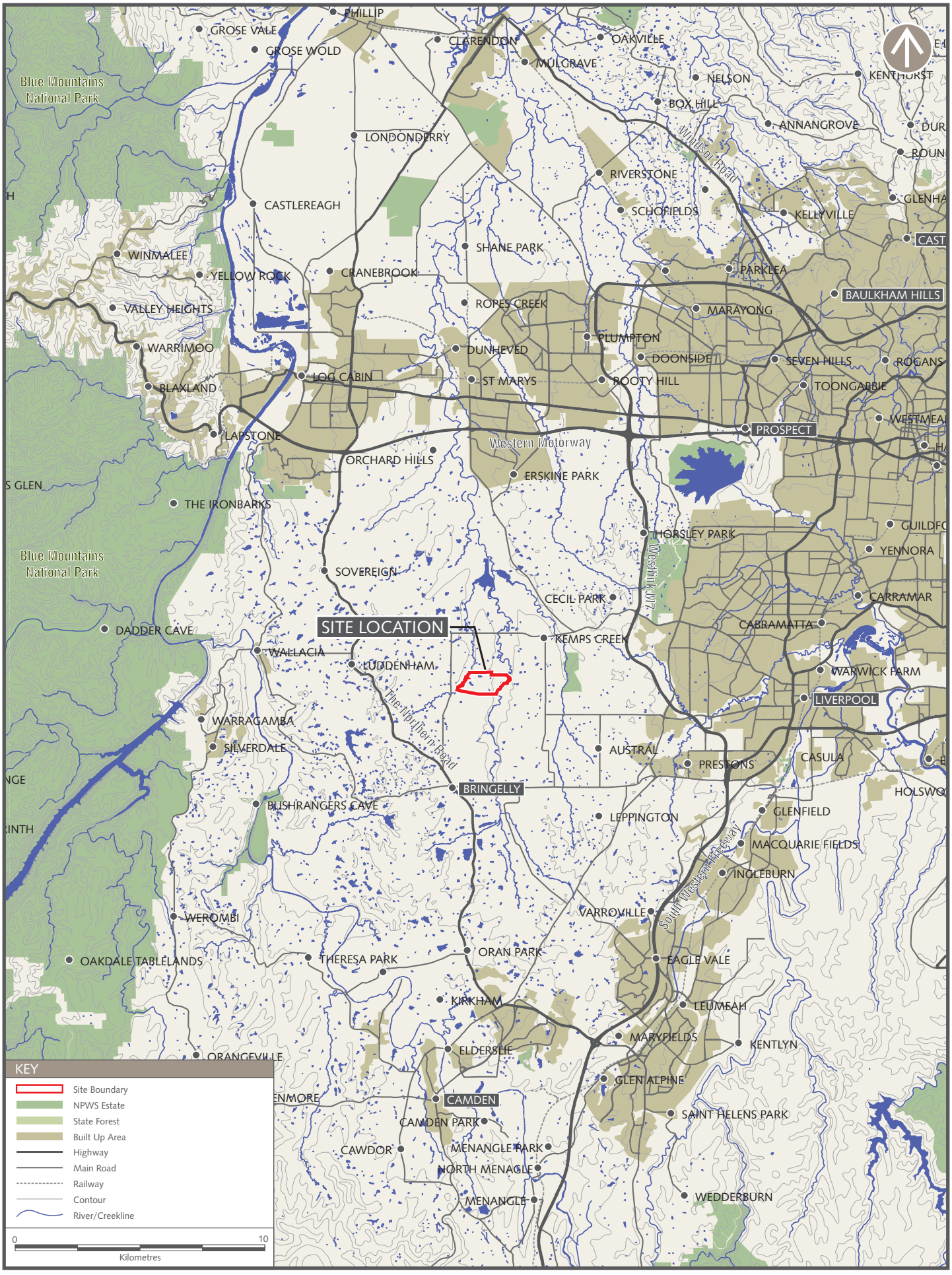
Boral Limited is Australia's largest building and construction materials supplier. It produces and distributes a broad range of construction materials, including quarry products, cement, flyash, pre-mix concrete and asphalt; and building products, including clay bricks and pavers, clay and concrete roof tiles, concrete masonry products, plasterboard, windows and timber.

1.1.2 Planning History

An outline of the planning history including modifications to consent and more recent development applications is provided in **Table 2**.

Table 2: Planning History of Boral Badgerys Creek

Name/Item	Issued by	Description	Status	Date
Consent 1024/1976	Government Appeals Tribunal	Consent granted subject to conditions of Deed of Agreement	Approved	27 September 1976
Section 96 Mod. Consent 921/2006	LCC	Modification to 1976 consent to extend operations on the site for a further four years.	Approved	7 September 2006
DA 764/2009	LCC	Development Application (DA) for the upgrade of the brick making facility to include a new brick unloading machine (Dehacker).	Approved	31 March 2009



AECOM

REGIONAL CONTEXT

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 1

Name/Item	Issued by	Description	Status	Date
Section 96 Modification DA1024/1976/B	LCC	Modification to consent to allow for a further 12 months of operation at the site.	Approved	NA

1.1.3 Existing Works and Infrastructure

The existing operations on the Project Site involve the quarrying of clay and shale for the production and packing of bricks and their dispatch to offsite locations. Key features of the Project Site are shown in **Figure 2**, including:

- Three existing quarry pits (Pits 1, 2 and 3);
- A brick handling and production facility (brick making facility);
- A bricks finished goods storage yard (brick product storage area);
- Raw material and unusable material stockpiles;
- Water storage and sedimentation ponds; and
- Access roads.

The quarrying activities currently yield approximately 361,000 tonnes per annum (tpa) and brick production is in the order of 200,000 tpa. Further detail on existing operations is provided in **Section 4.1** of this EA.

1.2 Project Context

The existing extraction works and brick making facility is a significant business unit of Boral Bricks and, subject to appropriate approvals, the facility is expected to continue to operate for many years into the future. The brick making facility would therefore require a continuing source of feedstock material to make bricks.

A substantial amount of valuable clay resource remains on the site and it is important that this resource be fully utilised to ensure a steady ongoing supply of building materials for the construction industry. This brick making facility would play a vital role in both providing resources to facilitate urban development in Western Sydney and the expanding future development of greenfield land in the vicinity of the subject site under the *Sydney Metropolitan Strategy - City of Cities: A Plan for Sydney's Future* (*Sydney Metropolitan Strategy*). The project would also contribute directly and indirectly to employment within Western Sydney.

Boral is therefore seeking approval to continue operations on the site beyond September 2010 to meet the continued demand for its products. Boral proposes to continue extraction across the site, including the continued extraction of raw materials from an existing pit located in the south eastern section of the site known as Pit 3, moving north to establish a new pit (Pit 4) and expanding operations in the future to land in the northern portion of its landholding (Pit 5). Boral has commissioned AECOM to prepare this EA in support of an application for approval for the continuation of operations on the site as described in **Chapter 4**.

1.3 Location

The Project Site is located in the suburb of Badgerys Creek within Liverpool LGA. Badgerys Creek is approximately 41 km south west of Sydney and 17 km west of Liverpool. It is a small community comprising rural residences, agricultural activities, quarrying and industry. The locality supports a number of small rural residential holdings and a limited number of larger agricultural properties, agricultural enterprises (chicken farms, nurseries) and market gardens. The region forms part of the South West Growth Centre (SWGC) under the *Sydney Metropolitan Strategy* with Liverpool identified as a major centre and the site earmarked for 'future industrial' development. The regional context of the site is shown in **Figure 1**.

The site is bound by Badgerys Creek to the west, Inghams Chicken to the south, South Creek to the east and a large commercial nursery and rural residential properties to the north. The site location is shown in **Figure 3**.

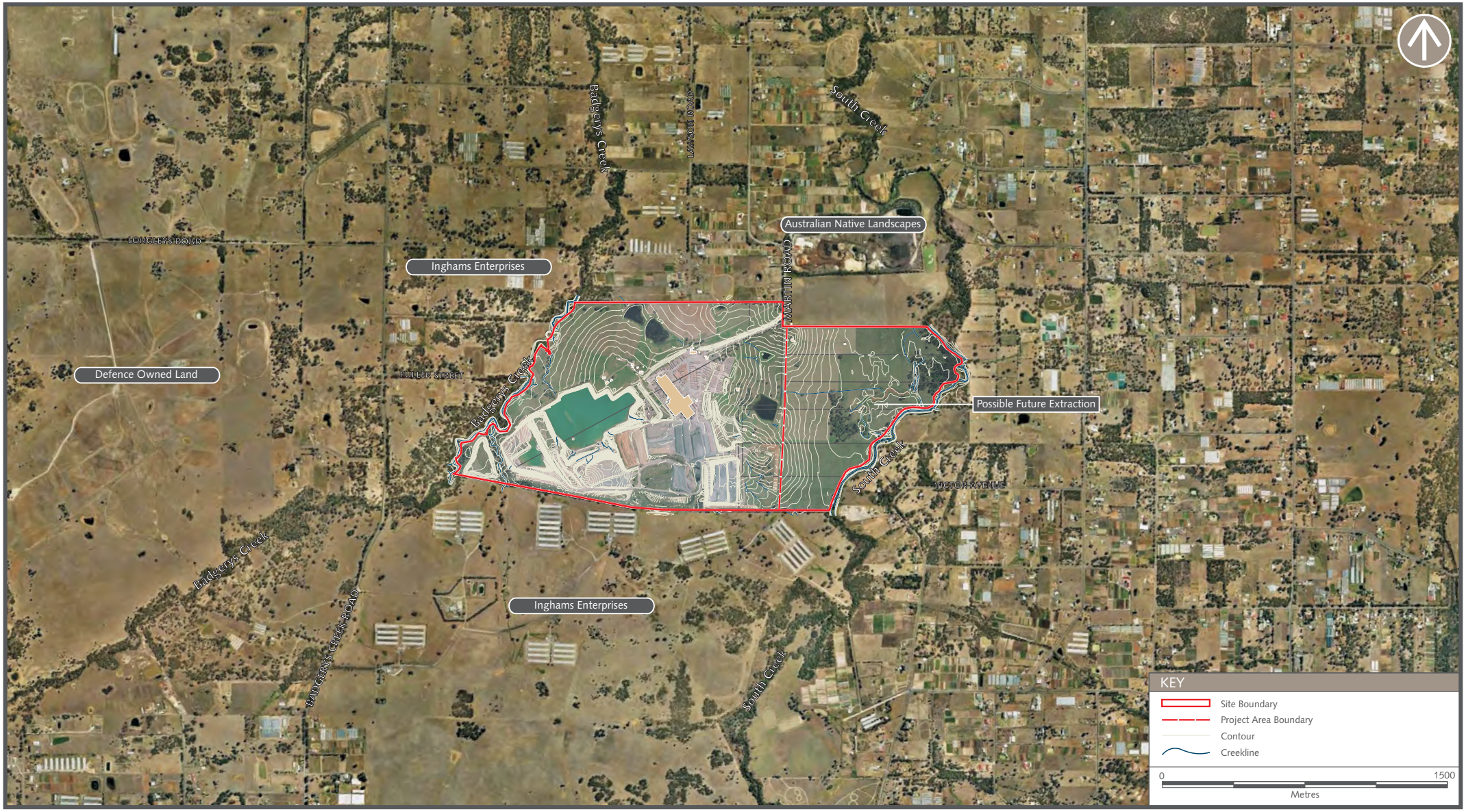
AECOM

EXISTING PROJECT SITE LAYOUT

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 2



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PROJECT SITE LOCATION

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 3

1.4 Approvals Process

The Project involves the extraction of clay, shale, and sandstone, associated brick making and ancillary activities as per current operations, however there would be some expansion of activities.

To enable continued operations on the site, Boral is seeking approval for:

- Extraction in the order of 420,000 tpa;
- Brick making activities; in the order of 252,000 tpa; and
- Ancillary activities as described in **Section 1.4.2** below.

The Project falls within the definition of an 'extractive industry' under Group 2, Clause 7 of Schedule 1 of the *State Environmental Planning Policy (Major Development) 2005* (SEPP 2005), being:

> *(1) Development for the purpose of extractive industry that:*
>
> *(a) extracts more than 200,000 tonnes of extractive materials per year, or*
>
> *(b) extracts from a total resource (the subject of the development application (or other relevant application under the Act)) of more than 5 million tonnes.*

The Project is therefore eligible for assessment as a Major Development under Part 3A of the EP&A Act. The Minister has issued a declaration that the project is a 'major development' and has issued authorisation for the submission of a Concept Plan (**Appendix B**).

Boral is therefore seeking approval to continue quarrying and brick making activities on the Project Site beyond the expiry of the existing consent.

1.4.1 Concept Plan Approval

The subject site is zoned RU1 under the relevant local environmental plan, being *Liverpool Local Environmental Plan 2008* (LLEP 2008).

Under LLEP 2008, the quarry component of the project is defined as 'extractive industry', a permissible use within the RU1 zone. The brick making component is undefined under LLEP 2008 and is subsequently prohibited in the RU1 zone.

The original consent/Deed of Agreement covered the extraction and brick plant components of the development, described as 'clay extraction and brick and clay products industry'. The Deed and associated consent was clearly issued prior to the gazettal of LLEP 2008 and the preceding instrument, *Liverpool Local Environmental Plan* 1997 (LLEP 1997) under which the zoning of the Project Site is/was established. Conditions of the Deed relating specifically to the brick making facility indicate that the brick making component has always been considered an intrinsic part of 'the development'. As such, it is considered likely that the site benefits from existing use rights. However, in order to remove ambiguity with regard to the permissibility of the brick making component of the project and to provide certainty for Boral regarding the future operations at the site, it is proposed that a Concept Plan Approval be sought for the project, to resolve the permissibility issues surrounding the brick making facility.

Part 3A of the EP&A Act allows the Minister for Planning to issue Concept Plan Approval for certain Major Development. Section 75O of the EP&A Act provides that the Minister has the discretion to consider the compliance of the proposal with Environmental Planning Instruments (EPIs), including proposals that would otherwise be prohibited by an EPI, as follows:

> *In deciding whether or not to give approval for the concept plan for a project, the Minister may (but is not required to) take into account the provisions of any environmental planning instrument that would not (because of section 75R) apply to the project if approved. However, the regulations may preclude approval for a concept plan for the carrying out of a class of project (other than a critical infrastructure project) that such an instrument would otherwise prohibit.*

There is currently no provision under the EP&A Regulation that precludes approval of a Concept Plan that would otherwise be prohibited by an EPI. The Proponent is therefore seeking Concept Plan Approval for the project. The Minister has issued authorisation for the submission of a Concept Plan for the project (see **Appendix B**).

1.4.2 Concurrent Project Approval

As described above, the Proponent is seeking concurrent Project Approval for the continuation of operations on the site, comprising:

- Extraction from existing and future new pits across the site in the order of 420,000 tpa; and
- Brick making activities; in the order of 252,000 tpa.

Key works and ancillary activities included in the project are:

- Continuation of extraction of raw materials from Pit 3;
- Establishment of new quarry areas commencing with the Pit 4 to the north of the existing Pit 3 and potentially extending into areas further to the north subject to geological and environmental considerations;
- Stockpiling of raw and unusable materials;
- Water management works ; and
- Other ancillary activities such as loading/unloading, brick storage and delivery and receipt of raw materials as described in **Chapter 4** of the EA.

1.4.3 Preliminary Environmental Assessment

A Preliminary Environmental Assessment (PEA) lodged with the DoP outlined the environmental interactions of the Project with the surrounding area. A risk analysis carried out as part of the PEA allowed the key environmental issues of significance to be identified and following the analysis, AECOM identified the level of environmental assessment required for inclusion in the EA.

The PEA identified the following environmental issues as having a medium priority for assessment in the EA:

- Air Quality
- Water
- Noise and vibration
- Traffic and transport
- Land use
- Rehabilitation

Additional environmental issues were identified in the PEA, however, the potential impacts associated with these were expected to be minimal or of low priority. Each of these issues is subject to a lower level of assessment as part of the EA and appropriate mitigation measures and environmental safeguards have been identified in the Statement of Commitments (SoC) (**Chapter 22**) to ensure potential impacts are minimised and managed.

1.4.4 Director-Generals Requirements

Section 75F of the EP&A Act requires an EA to be prepared in accordance with the requirements of the Director-General of the DoP. A request for these requirements was made in November 2009.

The Director-General's Requirements (DGRs) were issued on 4th March 2010, a copy of which is included as **Appendix B** to this EA.

1.4.5 Planning Focus Meeting

A Planning Focus Meeting (PFM) was held on the Project Site on 4th November 2009. Representatives of the DoP, the NSW Department of Environment, Climate Change and Water (DECCW) and LCC were in attendance. As part of this process, a copy of the PEA was distributed to relevant agencies and views were sought regarding issues to be included in the DGRs. This process provided the opportunity for key statutory authorities to establish the requirements for the form and content of the EA. The DGRs are included as **Appendix B** to this EA and are addressed in **Chapter 6** of this EA.

1.4.6 Stakeholder Consultation

During the preparation of this EA, key stakeholders were identified. These stakeholders included local community groups as well as key government agencies. Throughout the preparation of the EA, these stakeholders have been kept informed of the progress of the Project and issues raised by these stakeholders have been addressed as part of the EA. Further details on stakeholder consultation are provided in **Chapter 6**.

1.4.7 EA Exhibition

The EP&A Act requires that the EA be placed on exhibition for public review for a minimum period of 30 days.

1.5 Purpose of this Report

This EA has been prepared by AECOM on behalf of the Proponent as part of an application for Concept and concurrent Project Approval for the continuation of operations of the quarry and brick making facility at the Project Site.

In accordance with Part 3A of the EP&A Act, the DGRs for the Project were issued on 4th March 2010. This EA has been prepared pursuant to those requirements and addresses the matters listed by the Director-General.

The purpose of this EA is to:

- Explain the nature of the works and activities comprising the Project;
- Assess the potential environmental impacts of these works and activities on the physical, social and economic environment (having regard to both existing and future land use); and
- Identify mitigation measures to be implemented to minimise and manage potential impacts associated with the Project.

The key recommendations and management measures described in the EA have been incorporated into the SoC for the Project, detailed in **Chapter 22**. The SoC outlines the Proponent's commitment to environmental management and would form a key component of any conditions of approval issued for the Project.

1.6 Structure of the EA

The EA has been structured to provide information to address relevant statutory requirements as outlined in **Table 3**.

Table 3: Outline of Report Structure

Chapter	Issues Addressed
Chapter 1	Provides a background to the Project, including information about the Proponent such as location, licenses, existing and proposed works and activities. The purpose and structure of the EA is also outlined.
Chapter 2	A detailed description of the Project Site and surrounding area linked to the Project is given.
Chapter 3	Identifies the need for the Project, alternatives, and consequences of not proceeding.
Chapter 4	An overview of and description of the proposed activities and locations of the works.
Chapter 5	Describes the legislative context of the Project, including the approvals required.
Chapter 6	Discussion of formal procedures proposed and/or undertaken with other agencies, as well as the community, stakeholders, and relevant authorities as part of the approvals process.
Chapter 7	Provides a summary of the prioritisation process undertaken to identify the key environmental issues.

Chapter	Issues Addressed
Chapter 8-21	Reports and details environmental issues and assessment methods associated with the Project. This section: • Includes field and desktop studies; • Discusses environmental implications; • Considers cumulative impacts on the existing environment; • Outlines possible residual effects; and • Outlines environmental safeguards and mitigation measures.
Chapter 22	Details the Proponent's environmental management and commitments in relation to the Project.
Chapter 23	Provides an evaluation of the residual environmental risks associated with the Project.
Chapter 24	Provides a justification for the project in terms of environmental, economic and social considerations.
Chapter 25	Provides a conclusion to the environmental assessment.

2.0 Site and Context

The Project Site is located at Badgerys Creek, within the Liverpool LGA. As such, this chapter provides an overview of the Liverpool LGA, and a description of the physical characteristics of the Project Site and the location of project components across the site. The chapter also provides an overview of existing and future surrounding land use in order to provide an understanding of how the Project fits within the regional and local context.

2.1 Regional Context

The Project Site is situated within the Liverpool LGA which is bounded by Penrith and Fairfield to the north, Bankstown to the east, Sutherland to the southeast, Campbelltown City and Camden to the south, and Wollondilly to the west. Liverpool LGA covers an area of approximately 305 km² and comprises rapidly growing residential areas along with large industrial, commercial and rural areas and forms part of the SWGC under the *Sydney Metropolitan Strategy*. The Project Site is located in the suburb of Badgerys Creek, which is situated approximately 17km west of Liverpool, and is earmarked for 'future industrial' development under the Strategy. Badgerys Creek currently comprises rural residences, agricultural properties, market gardens, quarrying and industry. The Project Site is shown in its regional context in **Figure 1**.

The site is bound by Badgerys Creek to the west, Inghams Chicken to the south, South Creek to the east and Australia Native Landscapes (ANL) and rural residential properties to the north. The Blue Mountains National Park is located approximately 16 km to the west of the site.

The Project Site is located within the South Creek and Badgerys Creek catchments, which are part of the greater Hawkesbury Nepean catchment area. The eastern property boundary adjoins South Creek and the western property boundary adjoins Badgerys Creek. A small tributary of Badgerys Creek is located in the south-western portion of the site.

2.2 Concept Plan and Project Area

The Proponent is seeking Concept Plan and concurrent Project Approval for the continuation and expansion of its quarrying and brick making operations at the Project Site.

2.3 Project Site – Existing Environment

The Project Site is some 200 ha in area and is currently used for quarrying, brick production and associated activities. Existing features of the site include two completed quarry pits (known as Pits 1 and 2), an active quarry pit (known as Pit 3), three large sediment basins in the eastern and northern portions of the site, two smaller dams in the eastern and northern parts of the site, a brick making facility, various administration buildings, a bricks finished goods storage yard, car parks and internal road network. These features are generally contained within the western part of the site with the far eastern portion of the site adjacent to South Creek used for the agistment of stock and grazing by a dairy farmer who leases the land from the proponent. Additionally, the dairy farmer uses a single residence which is located in the north east of the Project Site on Martin Road adjacent to the northern boundary of the Project Site (see **Figure 2**). The underlying topography of the Project Site is relatively flat, however quarrying activities on the site have substantially altered the natural landform on the site with various voids and elevated stockpiles present in the active, western part of the site. The most prominent of these landforms is a rehabilitated stockpile in the far west of the site, known as the 'Western Stockpile'. This stockpile of unusable material is approximately 200m x 125m, with an average height of 10 m and has been revegetated with native grasses and trees. Other significant landforms on the site include the raw material stockpile in the centre of the site, as well as unusable materials stockpiles in the south and centre of the site.

Existing voids on the site comprise pits 1, 2 and 3. The largest of these – Pit 1 is located in the west of the site and is used as the main water storage for the Project Site as detailed in the *Soil and Water Management Plan* (SWMP) (ERM, 2002) for the site, included as **Appendix C** to this EA. Pit 2, adjacent to Pit 1 is also complete and is currently being backfilled and rehabilitated. Pit 3 is an active pit where quarry campaigns are currently focused. Three large sediment basins are located in the north and east of the site, along with two smaller dams in the vicinity of these basins.

Remaining land comprising the Project Site is vacant or used for grazing purposes. Part of the site is leased to a dairy farmer who utilises the existing dairy buildings and grazes stock largely to the north and east of the brick making facility. The site is generally cleared of vegetation with the exception of the creek lines and some isolated stands of trees scattered across the site.

Access to the site is via a private road off Martin Road which runs off Elizabeth Drive (a designated B-double route). The internal road network consists of a number of unsealed haul roads.

2.4 Surrounding Land Use

2.4.1 Existing Environment

Land use in the surrounding area comprises a mix of agricultural, rural industrial and rural residential development set within a rural landscape. Prominent commercial land uses in the surrounding area include ANL – a large commercial nursery to the north of the site and Inghams Chicken – a large poultry farm to the south of the site (refer to **Figure 3**).

Rural residential development is the dominant land use in the surrounding area to the north, east and west. The nearest residence to the Project Site is some 250 m to the north of the site on Lawson Road.

2.4.2 Future Land Use

The Project Site is located within the SWGC under the Metropolitan Strategy. The strategy is a framework developed to promote and manage Sydney's growth and outline a vision for the future to 2031 based on anticipated population, economic and demographic trends. Further detail on this Strategy is provided in **Chapter 5** of the EA.

The SWGC is comprised of a number of precincts each of which is designated for a particular future land use. The Project Site is earmarked for future industrial development under the strategy and is surrounded by other industrial and residential precincts.

3.0 Project Need and Alternatives

This chapter provides an explanation of the need for the project and outlines a number of alternatives considered by the Proponent in relation to the carrying out of the Project, including the consequences of not proceeding.

3.1 Need for the Project

The proposed Project involves the continuation of quarrying and brick making activities within the Project Site which is currently operating as a quarry and brick making facility. The Project comprises the progressive extraction of shale and sandstone resources from within the lower Bringelly Shale geological unit and the production of bricks in a manner that minimises environmental and social impacts and maximises the use of resources and existing infrastructure.

Quarrying and brick making activities at the Project Site currently yield approximately 361,000 tpa of shale and sandstone and produce bricks in the order of 200,000 tpa. A draft discussion paper prepared by the NSW Department of Mineral Resources (DMR) as part of Structure Planning for the Metropolitan Strategy states that Bringelly Shale is the primary source of structural shale for the manufacture of bricks and pavers for the Sydney region. This draft paper specifically identifies the Project Site as an operating quarry with known regionally significant clay/shale resource reserves of some one million tonnes and further resources likely to occur within the site.

The significance of the resource was also recognised in the now repealed *Sydney Regional Environmental Plan 9 – Extractive Industries* (SREP9) which identified the Project Site as land containing extractive material of regional significance.

Boral is Australia's second largest producer of clay brick and pavers and also exports a small proportion of clay products to New Zealand and Japan and is increasingly supplying other countries within the Asia region. In Australia, demand for Boral's clay and concrete products is primarily driven by the construction of multi-unit and attached/detached housing.

Badgerys Creek is located within the SWGC, an area identified as part of the Metropolitan Strategy as a major growth centre. The Growth Centres are expected to accommodate 30 to 40 per cent of Sydney's new housing by 2031.The Project Site has been earmarked under the Metropolitan Strategy as 'future industrial' employment land. Surrounding areas have been earmarked for either 'future industrial' or 'residential' land use.

Continuation of quarrying at the site and the subsequent production of clay bricks and pavers significantly supports the construction industry, thereby supporting urban development within the SWGC and aligning with the proposed rezoning of the land to 'future industrial'.

The proposed continuation of quarrying and brick making activities at the Project Site would utilise existing surface infrastructure and facilities and as such, no upgrades or new infrastructure would be required. Continued quarrying would involve the establishment of new quarry areas, however, quarrying would continue to occur on a campaign basis, with activities being focussed on a single pit at any one time. 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 into bricks and pavers. The transport route for trucks entering and exiting the site is already well established and, given that operations at the site would continue without the need for the addition of new infrastructure, the transport routes could satisfactorily support the continuation of operations into the future.

3.2 Alternatives Considered

A number of alternatives were considered in relation to the proposed Project in relation to the location and depth of extraction, the continued use of the site for its existing use or the use of the site for other purposes.

3.2.1 Location and Depth of Extraction

The alternatives considered in relation to the location and depth of extraction are detailed below:

- *Extraction from deeper geological units from within existing pits (Pits 1, 2 and 3)*. Considerable shale and sandstone resource has been identified and is present beneath the Bringelly Shale including the Ashfield Shale and the Hawkesbury Sandstone. The extraction of shale and sandstone from within deeper geological units would restrict the potential environmental and associated impacts of quarrying to a narrower geographic area. It is expected that in order to extract resource from within deeper geological units, and to penetrate the dense, Minchinbury Sandstone, alternative extraction techniques such as blasting may be required. At this stage, given the availability of more readily accessible resource across the site, it is not economically viable to extract material deeper than the average of 35 m. However, this option may become viable at some point in the future, beyond the twenty year life of the proposal. Boral wishes to preserve options for this form of extraction to occur in the long term on the Project Site and notes that this would be subject to further assessment and approval as relevant.
- *Location of proposed future Pits 4 and 5.* The locations of proposed Pits 4 and 5 have been chosen based upon geological and environmental considerations. The proposed pit locations have 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 from Pit 5 to Badgerys Creek proposed in excess of 50 m. Proposed Pits 4 and 5 represent the most economically viable and environmentally sustainable locations for quarrying to take place over the next 20 years.
- *Extraction in the East of the Project Site.* Suitable resource may exist in the eastern portion of the Project Site to justify future extraction in this location, however extensive geological investigation has not yet been undertaken on this part of the site. Sufficient resource exists in the western and northern portions of the site for continued production for the next twenty years, therefore quarrying is not proposed in the east over this time period. However, quarrying may take place in the eastern part of the site at some point in the future subject to geological and environmental investigations, market conditions and planning approval.

3.2.2 Use of the Project Site

The option of ceasing quarrying and brick production on the site in favour of another use was also considered.

- *Cessation of extraction and rehabilitation of the land for a 'future industrial' land use in accordance with the intent of the Metropolitan Strategy.* Rehabilitation options are many and varied and could include the retention of voids and utilisation for water storage (Pit 1) 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 the 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 the significant resource existing on the site would also have implications for the construction industry and potentially the cost of housing.
- *Cessation of quarrying and brick making operations at the site and closure of the site.* This option would leave the remaining valuable resource on site, rather than being productively used and is not considered to have economic or social merit given that the site is already operating as a well regarded business, with strong future potential given the growing housing market in the greater Sydney region.

3.2.3 Do Nothing

The 'Do Nothing' option would involve Boral continuing to operate until the expiration of its existing consent in September 2010, beyond which operations at the Project Site would have to cease as they would no longer have the required approval. This option would have the same implications as those discussed in **Section 3.2.2** above, with the loss of a regionally significant resource with subsequent flow-on effects for the local and regional economy. As discussed above, this option is not considered to have economic or social merit.

3.3 Consequences of Not Proceeding

Not proceeding with the continued operation of the Badgerys Creek quarry and brick making facility would result in the subsequent closure of the quarry and brick making facility with the following potential implications:

- Loss of employment for 76 full time staff and 10 contractors during quarry campaigns;
- Loss of construction material and associated contribution to the regional and State economy;
- Potential sterilisation of a valuable resource;
- Failure to satisfy increasing resource demand, particularly in response to potential future urban development within the SWGC; and
- Indirect impacts to local businesses, particularly those such as the service stations, cafes and other various small businesses within the area that service both permanent and transient workers to and from the site.

3.4 Conclusion

Given the location of the site within the SWGC and projected population growth for the area, the demand for products and services for the construction industry is expected to increase considerably. The quarry and brick making facility at Badgerys Creek is situated in an ideal location to service the construction industry, located within the SWGC, thereby reducing the need to import bricks from regions outside of the area, hence reducing road haulage of bricks. Reduced road haulage distances to service the growing residential areas would not only reduce transport costs and therefore be of economic benefit, but would also be of environmental benefit, subsequently reducing greenhouse gas (GHG) emissions.

The continued operation of the Project Site would maintain local jobs and provide revenue to the State. The consequences of the project not proceeding would therefore be the loss of these significant economic and social benefits.

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4.0 Project Description

*This chapter describes the Project in detail including the project objectives, the activities for which Concept and Project Approval are sought, details of the construction and operational phases of the Project and incorporated environmental controls. Rehabilitation works proposed as part of the Project are also outlined with further detail provided in the Rehabilitation Plan (RP) included as **Appendix D** to this EA.*

4.1 Existing Development

4.1.1 Overview

The Project Site currently operates as a quarry and brick making facility involving clay and shale extraction to obtain raw materials for the production of bricks at the on-site brick making facility. Key features of the site are shown on **Figures 2** and **4** and include:

- Gate house office (**Figure 2**);
- Administration area/sales office (**Figure 2**);
- Staff and visitor car parks providing 41 staff parking spaces and 11 visitor spaces (**Figure 2**);
- Brick making facility (**Figure 2**);
- Brick product storage area – located directly to the east of the brick making facility and used for the storage of packaged bricks as well as loading and unloading (**Figure 2**);
- Pits 1, 2 and 3 – Pit 1 is currently used for water storage, Pit 2 is currently being back-filled and rehabilitated and Pit 3 is currently actively used for quarrying (**Figures 2** and **4**);
- Raw material stockpiles – used for the storage of extracted materials to be used for brick making (**Figures 2** and **4**);
- Overburden and unusable material stockpiles – located across the western portion of the site. Some of these stockpiles have been rehabilitated whilst others are still active and used during current operations for the storage of material which is not suitable for use in brick making (**Figure 4**);
- Five sediment basins – including Pit 1. Pit 1 is used for the storage of stormwater runoff from across the site for reuse in various site activities. Two sediment basins located in the north of the site also contain general stormwater runoff from the site. The remaining sediment basin to the north of Pit 3 contains roof water from the brick making facility (**Figure 2**);
- Heavy vehicle storage area;
- Truck wash;
- A diesel tank and fill point; and
- Internal road/access network.

Martin Road provides the primary access to the site, adjoining the north-eastern corner of the site. Internal site access is facilitated via a sealed access road extending from Martin Road to the site office, sales office and brick making facility. Access to the brick making facility is restricted with a secure, manned gate house adjoining the visitor car park.

Certain areas of the site not used for quarrying and brick making operations are leased to other users for the purposes of dairying and stock agistment. In association with these uses, the site also accommodates a range of farm buildings including a working dairy.

Quarrying activities have previously been focused in the western portion of the site in Pits 1 and 2 which have now been completed. Pit 1 is used as the main water storage on the site, capturing stormwater runoff for reuse in various site activities. Rehabilitation and backfilling of Pit 2 has commenced, with the rebuilding of the western wall of the pit. Currently, quarrying activities are occurring in Pit 3, to the south-east of the brick making facility and storage area (refer to **Figure 2**).

The approximate areas of the pits on site are detailed below:

- Pit 1 – Approximately 9.1 hectares
- Pit 2 – Approximately 5.6 hectares
- Pit 3 – Approximately 8.9 hectares

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Proposed Operations

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 4

Approximate areas of stockpiles are summarised below (and detailed in the RP included as **Appendix D**):

- Raw material stockpile – 86,400m²
- Eastern stockpile – 22,500m²
- South-Eastern stockpile – 4,725m²
- Southern stockpile – 6,250m²
- Central stockpile – 45,900m²
- Western stockpile – 25,000m²

The remaining site area is occupied by the brick making facility, storage yard, gate house, administration office, internal access roads, ancillary buildings and vacant pasture land.

Existing pits range in depth and size however excavation on the site to date has generally been limited to a depth of approximately 35 m to the base of the Bringelly Shale. At this depth a hard sandstone unit known as Minchinbury Sandstone is encountered. Boral has advised that although significant resource is known to exist beneath the Minchinbury Sandstone, quarrying activities would continue at the site to date have not exploited this resource. Quarrying below this depth may occur at some point in the future if economically viable, however it is not anticipated that this would form part of operations over the next twenty years.

Quarrying activities at the site currently yield approximately 361,000 tpa of clay and shale for brick making purposes. Raw material is stored in layered stockpiles to the south of the brick making facility and supplementary material including coal wash fines (7,000 tpa) and off-site sources of clay, shale and non-clay materials (20,000 tpa) are trucked to the site as required.

Unusable material extracted from the pits is currently stored in the central stockpile (refer to **Figure 2**). With the exception of the central and eastern stockpiles, all other stockpiles on the site are no longer in use. The western stockpile, located to the west of Pit 2 has been rehabilitated and is now vegetated with local native grasses and trees. The South and South-Eastern stockpiles have been partially stabilised through natural revegetation.

The brick making facility is located generally in the centre of the site and comprises a large, single storey factory building accommodating various plant and equipment as described in **Section 4.2**.

4.2 The Project

4.2.1 Overview

Concept and concurrent Project Approval is sought for the continuation of operations on the site beyond September 2010. Operations would involve continued extraction of raw materials and continued brick making activities with some increase in total volumes extracted and throughput of the brick making facility. The Project can be summarised as follows:

- Extraction of raw materials from the site in the order of 420,000 tpa, of which 10% would be comprised of clay and 90% shale, involving:
  - Extraction from Pit 3 to an approximate depth of 35 m; and
  - Establishment of Pits 4 (14.21 ha) and 5 (19.5 ha) and extraction in these pits to a depth of approximately 35 m.
- Excavation of 3,000,000 tonnes of overburden in total over the life of the project and retention on site;
- Brick production in the order of 252,000 tpa;
- Import of raw materials required for brick making in the order of 20,000 tpa;
- Associated handling, packaging, storage and transport of bricks;
- Associated construction of bunds and stockpiles; and
- Maintenance and rehabilitation works.

The Project is appropriately separated into three key components: Quarry activities, brick making 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 4** providing a summary of the differences between current and proposed operations.

Table 4: Summary of key differences between proposed and existing operations

Project Element	Current Operation	Proposed Operation
Hours of operation	Quarry – Mon-Sat 7am-6pm for 2-3 months per year Brick making facility – 24 hours a day, seven days a week. Storage yard, deliveries and dispatch – Mon-Fri 6am-6pm/Sat 6am-12pm	Quarry – Mon-Sat 7am-6pm for 2-3 months per year Brick making facility – 24 hours a day, seven days a week. Storage yard, deliveries and dispatch – Mon-Fri 6am-10pm/Sat 6am-6pm
Extraction volume	361,000 tpa	420,000 tpa
Extraction location	Previous extraction in pits 1 and 2 in the western portion of the site. Current extraction in Pit 3, in the south of the site.	Continued extraction in Pit 3. Future extraction in Pits 4 and 5 to the north of Pit 3 and the far northern portion of the site.
Depth of extraction	35 m	35 m
Brick production	200,000 tpa	252,000 tpa
Water management	Pit 1 main water storage, 3 sedimentation basins and 2 small dams. Nil discharge.	Pits 1, 3, 4 and 5 maintained for water storage.
Truck movements	16 movements per hour	12 movements per hour
Disposal of overburden	Central stockpile	Pit 2
Receipt of raw materials	20,000 tpa	20,000 tpa
Total reserve extracted	NA	8,400,000 tonnes
Total overburden	NA	3,000,000 tonnes

4.2.2 Quarrying Activities

Quarrying on the site is expected to progress on the site in the following manner (as shown on **Figure 4**):

- Continued quarrying of Pit 3 (existing) including the lateral progression of the pit towards the east as shown in **Figure 4**. It is anticipated that extraction from Pit 3 would continue until approximately 2016 (refer to Table 5).
- Establishment of proposed Pit 4 would commence in approximately 2014. It is anticipated that extraction from Pit 4 would continue until approximately 2022 (refer to Table 5).
- Establishment of proposed Pit 5 would commence in approximately 2020. It is anticipated that extraction from the Pit 5 would continue until approximately 2028 (refer to Table 5).

The existing and proposed pit life spans are shown in the table below.

Table 5: Existing and Proposed Pit Lifespans and approximate area

Location	Proposed Start Date (Year)	Proposed End Date (Year)	Approximate pit areas (hectares)
Pit 3	Commenced	2016	8.9
Pit 4	2014	2022	14.21
Pit 5	2020	2028	19.5

Approval is currently sought for extraction on the site over the next 20 years, however it is important that options for future quarrying beyond this time be preserved. For the purposes of this application, the Project is defined as activities on the site over a twenty year period, beyond which environmental, land use and market conditions would be reviewed and the feasibility of continued quarrying/brick making activities on the site would be re-assessed.

The process of quarrying would be largely as per current operations with some increase in the volume of material extracted, in the order of 420,000 tpa. Quarrying activities would continue on a campaign basis, occurring for approximately two to three months each year. Three months of extraction generally provides sufficient raw material for 12 months of brick making. The availability of raw material for extraction, forecast market demand and brick plant output determine the duration of quarrying works.

Angles of extraction within the pits would be in accordance with existing operations on the site, based upon Boral's established practices and procedures in consideration of local geology and water drainage. Average batter slopes for Pit 1 are in the order of 1H:2V (approximately 60 degrees to the horizontal). The crest of the batters varied in slope, being in many instances cut back at 1H:1V. The batter slopes of Pit 2 are of similar configuration to Pit 1. It is proposed that future extraction in Pits 3, 4 and 5 be carried out in a similar manner.

A geotechnical assessment was prepared in 2005 assessing the batter slope stability of Pits 1 and 2 on the site. The assessment concluded that the batter slopes of pits 1 and 2 were acceptable. Boral's operations would be carried out in accordance with the applicable safety legislation including:

- The *Occupational Health and Safety Act 2000*
- The *Occupational Health and Safety Regulation 2001*
- The *Occupational Health and Safety Amendment (Application to Mining Workplaces and Coal Workplaces) Regulation 2008*
- The *Mine Health and Safety Act 2004*
- The *Mine Health and Safety Regulation 2007*

Quarrying at the site over the next twenty years is expected to involve the completion of extraction in existing Pit 3 and the establishment of two new pits as described above and shown in **Figure 4**. The establishment of a new pit involves the following works:

- Exploratory core drilling to a depth of 35 m below ground surface (bgs) across a 50 m square grid;
- Assessment of cores for suitability for brick making;
- If the core is suitable, the area is fenced off and appropriate signage placed around the area; and
- Removal of overburden and topsoil, using removed material to create bunding around the area.

New stormwater drainage systems and/or drainage pathways would be established in conjunction with the establishment of new quarry areas (where required) and would be incorporated into the existing SWMP for the site. The establishment of Pit 4 would result in the loss of an existing sediment basin which currently stores water draining from the roof of the brick making facility. Prior to the loss of this pond, roof water from the brick making facility would be diverted to Pit 1. Stormwater management is discussed further in relation to the Project in **Chapter 10**.

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

- Breaking up raw materials using a bulldozer 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;
- Transport and deposit of raw materials to the Raw Materials Stockpile area to the south of the brick making facility;
- Transport and deposit of unusable material to either the Central Stockpile or to an open void (Pit 2); and
- Creation of new stormwater drainage systems and/or drainage pathways (where required) to be incorporated into and consistent with the existing SWMP for the site.

Upon cessation of quarrying in the nominated areas, Boral would rehabilitate the Project Site in accordance with the RP included as **Appendix D** to this EA. These works would include progressive rehabilitation of stockpiles, planting and fencing of riparian areas and completion of rehabilitation works to Pit 2.

4.2.3 Brick Production

Brick production at the existing brick making facility is planned to continue largely as per existing operations with some increase of throughput to 252,000 tpa.

The primary machinery and equipment involved in the process include:

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

The brick making process is generally described as follows:

- The as-mined clay material is crushed from -500 mm to -1 mm through a four stage crushing process. This includes a profiled roll crusher, a wet pan and two sets of high-speed smooth rolls. Water is added at the wet pan to take the material from 6-10% moisture content to 12-14% moisture content.
- To make bricks, the crushed raw material has more water added to bring the mixture to 14-15% 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 drying racks on trays. The drying racks pass through an eight-laned drying chamber over the course of three days during which the moisture content is reduced to <1%. The dry bricks are stacked 16-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 half car every 20-30 minutes. One kiln car holds approximately 6000 bricks (or 10 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 1000^{o}C and cooled back to room temperature in less than two days. Waste heat is drawn from the initially produced heat and is 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 storage yard for dispatch. All equipment is housed within the brick making facility with the exception of the unloading conveyor.

Proposed additions and alterations to the brick making facility have been approved by LCC to enable an increase in the efficiency of the existing brick making process. The proposed additions and alterations include a dust collector, air receiver and brick dipping tanks. The additions and alterations are aimed at reducing dust in the brick making process and reducing the incidence of cracking in bricks, hence yielding a higher quantity and quality of product for export.

As detailed above, the proposed operations would produce bricks at a rate of some 252,000 tpa. The existing facility has sufficient capacity to produce bricks at this rate without the need for upgrade.

4.2.4 Deliveries and Dispatch

Raw materials required for brick making are received on site at volumes of approximately 20,000 tonnes per annum.

Packaging of the bricks is undertaken by the Dehacker within the brick making facility. The dehacker was installed at the plant to improve efficiencies in the packing and transportation of bricks. It allows for a greater number of

bricks to be transported per truckload, thereby reducing the number of truck movements needed to dispatch the same amount of product.

The Dehacker unpacks the bricks into individual units and then repacks them into pallet size packs for transport to customers, strapping them together with plastic belly strap. Once the belly strap is attached, the complete brick packs travel along a driven roller conveyor where they are picked up by forklift and transported to the storage yard. The unloading conveyor is external to the brick making facility.

The brick product storage yard is located to the north-east of the brick making facility and covers an approximate area of 41,500 m^2. Forklifts transport the bricks from the brick making facility to the yard, and load the bricks from the yard on to trucks for transport off site. The storage yard is shown in **Figure 2**.

Deliveries and dispatch occur by truck with approximately 60 pick-ups/deliveries per day during the week and 12 on a Saturday. Further details of truck movements associated with the Project Site and an assessment of the potential impacts of this are provided in **Chapter 13**.

4.2.5 Stockpiles

Stockpile areas within the Project Site are shown on **Figures 2** and **4** and include:

- Raw material stockpiles situated in the centre of the site which provide the feedstock for the brick making process;
- Overburden stockpiles which contain upper level excavated materials that is not suitable for brick making;
- Unusable material stockpiles which contain deeper level excavated material that is not currently suitable for brick making but may be suitable in the future if upgrades were made to the clay preparation equipment; and
- Rehabilitated stockpiles in the far west and along the southern boundary of the site.

It is proposed that project operations would continue to utilise the existing raw materials stockpiles for the temporary storage of raw materials, however the use of the existing overburden and unusable material stockpiles would be phased out under future operations, with this material being trucked to Pit 2 to continue the rehabilitation of this void. Existing stockpiles would be revegetated in accordance with the RP included as **Appendix D** to this EA and would remain as part of the final landform on the site.

4.2.6 Stormwater Management

In accordance with the SWMP (ERM 2002) prepared for the site, surface run-off flows via roads and open grassed drains from parts of the site to Pit 1 during periods of peak rainfall. Rainfall also contributes directly to water stored in Pit 1. Surface water detained in Pit 1 is reused for dust suppression activities across the site.

Roof water from the brick making facility is captured and piped to Sediment Basin 3 to the east of the brick storage area.

Existing site drainage and proposed surface water management is detailed in **Chapter 10** of this EA. Water balance modelling has been undertaken to assess the potential impacts of the project on surface water flows on the site and recommendations are made as to the management of these impacts.

Water use on the site includes:

- Dust suppression – water from Pit 1;
- Brick making process – potable water and recycled water (detailed below); and
- Offices and amenities – potable water.

The current operation uses some 30 ML pa of water. This may increase to up to 40 ML pa under the proposed project.

Boral currently sources 12 ML pa of water stripped from oily water wastes processed by Worth Recycling for use as forming water at the Brick Making Facility. The remaining 18 ML pa comprises water sourced from Pit 1 and potable water. Future opportunities for recycling are currently being investigated which, pending appropriate approval may be utilised for dust suppression and brick making activities. The flow diagram below illustrates water inflow and outflow for the site.

Inflow		
Direct rainfall onto pit surfaces	Initial system storage	Rainfall/runoff within catchment
Outflow		
Evaporation from pit surfaces	Controlled extraction for dust suppression or to manage storage levels	

4.2.7 Infrastructure and Servicing

The site is currently serviced with natural gas, electricity and reticulated water and sewerage. Existing infrastructure and services are expected to be sufficient to accommodate the continued and expanded operation of the quarry and brick making facility without the need for upgrade.

4.2.8 Hours of Operation

The proposal includes an extension to the operating hours of the storage yard and dispatch activities to allow greater opportunity for the avoidance of truck movements during peak times. Existing and proposed operating hours are summarised in **Table 6**.

Table 6: Current and Proposed Hours of Operation

Site Facility	Current Hours of Operation	Proposed Hours of Operation
Quarry	Monday to Saturday, 7 am to 6 pm for 2 to 3 months per year.	Monday to Saturday, 7 am to 6 pm for 2 to 3 months per year.
Brick making facility	24 hours a day, seven days per week.	24 hours a day, seven days per week.
Storage yard including deliveries and dispatch	Monday to Friday, 6 am to 6 pm. Saturday 6 am to 12 pm.	Monday to Friday, 6 am to 10 pm. Saturday 6 am to 6 pm.

4.2.9 Workforce

There are currently 56 people employed in the brick making facility and 20 in the administration/sales office. Up to ten contractors work two to four months per annum on a campaign basis to complete the quarrying activities. The existing workforce on the site is expected to be sufficient to accommodate the continued operations despite the expansion in throughput of the quarry and brick making facility.

4.3 Rehabilitation

4.3.1 Overview

The long term rehabilitation of the Project Site is of key importance to the proposal in order to adequately manage environmental issues such as dust and sedimentation and erosion and to allow for the productive use of the land in the longer term for an appropriate land use. As such, a RP has been prepared for the site which aims to promote an integrated approach to quarry rehabilitation and management (**Appendix D**).

Significant clay and shale resource is known to exist on the site below the 35 m depth of the existing pits, with investigations undertaken in 1993 finding Bringelly Shale, which is the major source of raw materials for Sydney's brick making industry at a depth of 51 m on-site.

Due to the presence of a hard sandstone layer at approximately 35 m in depth and the extent of a more readily accessible resource remaining on the site, it has not been economically viable for the resource below 35 m to be extracted from the site to date. However, at some point in the future the extraction of this resource may become

viable and indeed necessary to continue the supply of these raw materials in the Sydney region. It is therefore imperative that options for future extraction below 35 m depth be preserved on the site and that rehabilitation works on the site reflect this.

Rehabilitation works proposed are therefore focussed on the management of erosion and sedimentation and the liberation of wind-borne dust during the life of the quarry. This primarily involves the improvement of riparian areas and the stabilisation of existing stockpiles through revegetation and avoidance of the creation of new or larger stockpiles through the placement of overburden and unusable material into Pit 2. Over the twenty year life of the approval sought, Pit 2 would be filled and rehabilitated to as close as possible to natural ground level.

The rehabilitation works proposed have been designed to ensure that:

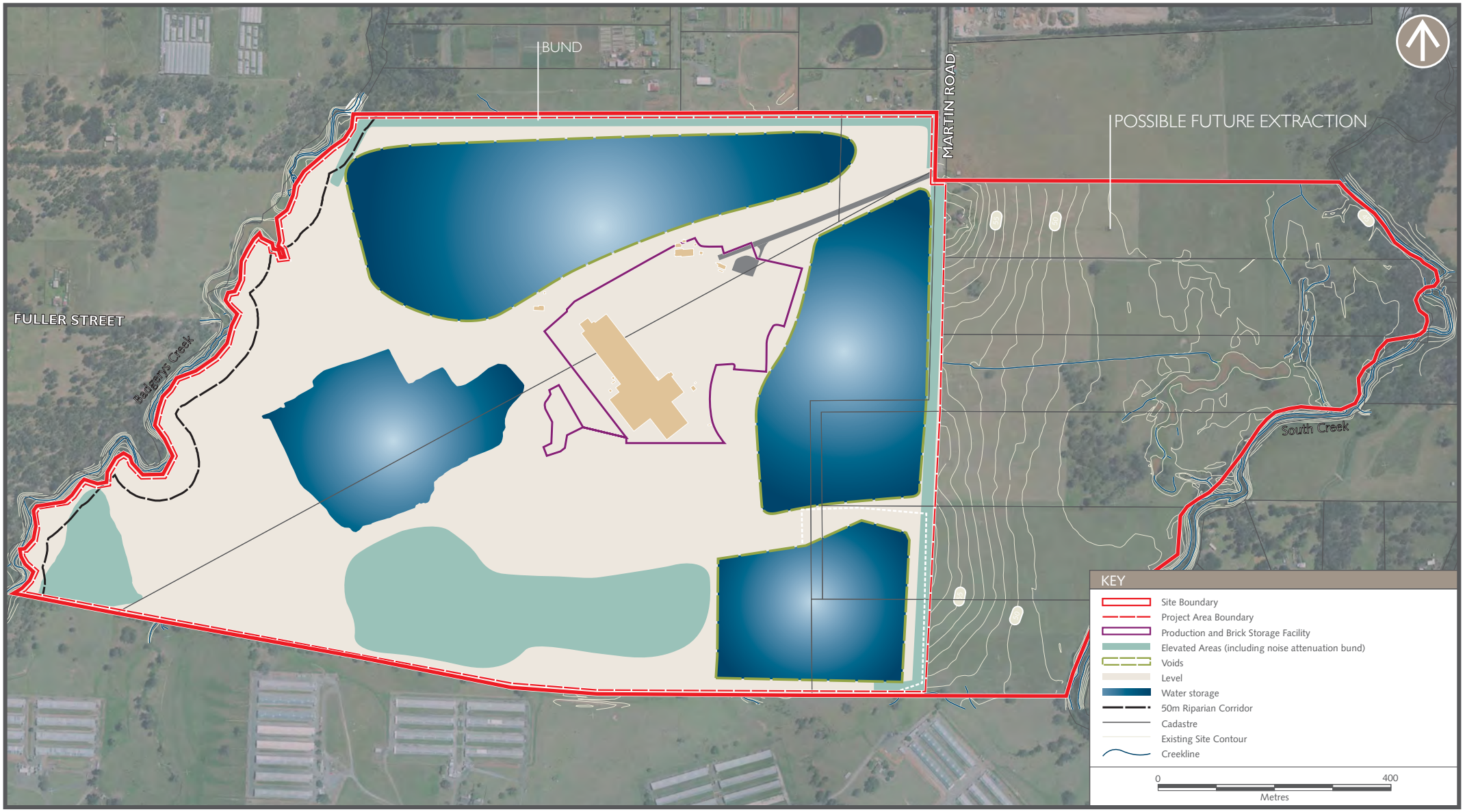
- Options for the extraction of the full resource existing on the site are preserved into the future;
- Options for the redevelopment of the site for future industrial use are maximised in line with the Metropolitan Strategy;
- The impacts of the continued operations at the quarry and brick making facility in terms of air quality, water quality and visual amenity are minimised;
- The continued operation of the quarry and brick making facility can integrate with existing surrounding land use and evolving future land use and development in the context of the SWGC.

4.3.2 Pits

The proposed rehabilitation works and final landform are summarised in **Table 7** and shown in **Figure 5**.

Table 7: Proposed Rehabilitation Works

Pit	Rehabilitation/Management	Final Landform
1	Fencing or bunding in conjunction with planting of the bund and appropriate warning signs to alleviate the potential danger to people and stock.	Pit 1 would be used as part of the water management system and would remain as a final void.
2	Pit 2 would receive unusable material from Pit 3 and dumping in the central stockpile would cease. Unusable material from Pits 4 and 5 would also be dumped in Pit 2 resulting in a floor level a few metres above original ground surface levels.	Pit 2 would be returned to near natural ground level.
3	Pit 3 is expected to continue being excavated for approximately six years (up to 2016). Upon completion of quarrying, Pit 3 would be retained as an open void with potential for water retention. Fencing or bunding in conjunction with planting and appropriate warning signs to alleviate the potential danger to people and stock. Topsoil from Pit 3 would be used in the rehabilitation of the stockpile areas.	Pit 3 may potentially be used as part of the water management system and would remain as a final void.
4	Pit 4 is proposed for quarrying in approximately four years (from 2014). Upon completion of quarrying, Pit 4 would be retained as an open void with potential for water retention. Fencing or bunding in conjunction with planting and appropriate warning signs to alleviate the potential danger to people and stock. Topsoil from Pit 4 would be used in the rehabilitation of the stockpile areas.	Pit 4 may potentially be used as part of the water management system and would remain as a final void.



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Conceptual Final Landform - 2030

Environmental Assessment

Boral Quarry and Brickworks, Badgerys Creek

Figure 5

Pit	Rehabilitation/Management	Final Landform
5	Pit 5 is proposed for quarrying from 2020. Upon completion of quarrying, Pit 5 would be retained as an open void with potential for water retention. Fencing or bunding in conjunction with planting and appropriate warning signs to alleviate the potential danger to people and stock. Topsoil from Pit 5 would be collected for rehabilitation of stockpile areas and Pit 2. Buffer of 50m to be preserved from Badgerys Creek.	Pit 5 may potentially be used as part of the water management system and would remain as a final void.

4.3.3 Stockpiles

Proposed stockpile management, rehabilitation works and final landform is summarised in **Table 8** below and shown in **Figure 5**.

Table 8: Proposed stockpile rehabilitation works

Stockpile	Rehabilitation/Management	Final Landform
Raw materials stockpile	The Brown Shale section of the Stockpile would be rehabilitated as soon as possible to aid dust suppression, if it is considered that the material is unlikely to be used. The Raw Material Stockpile and brick product storage area would be the final areas to be rehabilitated at or near original ground level.	Level.
Eastern Stockpile	Maintenance to manage erosion in addition to surface preparation and pasture revegetation. It may become cost effective in the future to use raw material from this stockpile.	Elevated.
South Eastern Stockpile	Reshaping and revegetation of the eastern portion. As part of final landform shaping this stockpile is to be subject to earthworks to link it to the stockpile to the east and to the Southern Stockpile the south west.	Elevated.
Southern Stockpile	Bulldoze the stockpile east to fill the void area south of the South Eastern Stockpile. Material may also be bulldozed to the west. This should be undertaken to allow a final slope of 1:3 in this section of the final landform leading to a toe drain to catch runoff. May be rehabilitated in 2010/2011 and has been described in upcoming vegetation works.	Level.
Central Stockpile	Reshaping by bulldozing material to the north to develop a near level surface.	Near level.
Western Stockpile	Rehabilitated in 2006 to prevent runoff and sediment entering the creeks. Maintenance works only.	Elevated.

Details of methods of reshaping, stabilisation, revegetation and weed control are provided in the RP included as **Appendix D** to this EA.

4.3.4 Creeklines

The project includes a rehabilitation program which consists of fencing, planting and weed control for the portion of Badgerys Creek (eastern side of creek for a length of approximately 900 m) and Badgerys Creek Tributary (both sides of the creek for a length of approximately 280 m) which are located on the Project Site with a fenced area of 50m from the top bank of the creek. Details of creek rehabilitation works are included in the RP prepared for the Project Site (**Appendix D**). The riparian areas would be rehabilitated to emulate the local community at a density that would naturally occur.

The eastern side of South Creek would also be fenced to prevent stock access.

4.3.5 Future Land Use

Planning for the end use of the quarry is best done in the last five years of quarry life, however consideration has been given to future use of the Project Site in determining the most appropriate rehabilitation strategy. It is not possible to determine precisely what the most appropriate future land use for the site is, particularly given the substantial landscape changes likely to occur on site over the next ten to twenty years. Future land use would need to take account of market conditions, strategic planning framework as well as surrounding land use (including the SWGC development).

Given the current nature of surrounding land uses and the gradual urbanisation of the area, the options for a final land use or uses include (but are not limited to):

- Light industrial, such as a Business Park.
- Continued quarrying and brickworks.

4.3.6 Final Landform

Figure 5 provides a conceptual final landform plan at 2030 based on the proposed stockpile development, pit infill projects and final void development.

The proposed final landform would consist of four final voids, being Pits1, 3, 4 and 5 as well as elevated areas in the far west (Western Stockpile). Pit 2 would be filled to ground level and a level area would remain in the centre of the site at the location of the brick making facility, storage yard and raw materials stockpiles.

The conceptual final landform has been designed to allow for maximum flexibility in the future use of the Project Site, preserving options for further quarrying of pits below the existing 35 m average depth, if this becomes economically viable beyond the 20 year life of the proposed project.

Geological investigations undertaken on the site as detailed in **Chapter 14** of the EA demonstrate that further clay/shale resource exists below a layer of sandstone at approximately 35 m depth. Whilst it is currently not economically viable to extract this resource due to the practices required to break through the sandstone layer, as finite resources become scarcer into the future, extraction below this depth may become viable. It is therefore of vital importance to Boral's business that opportunities to extract this resource are preserved into the future, as part of the proposed project. In the meantime, these voids would be used to replace existing water storages on the site which would be lost as a result of the establishment of proposed new pits, to ensure that the site continues to operate as a closed system with nil discharge to nearby waterways.

The retention of these voids would not sterilise or preclude the land from being redeveloped for other purposes, in line with land use and planning policy at the time.

The landform also provides for innovative building platforms within the voids for potential industrial uses as identified in the Metropolitan Strategy and elevated and filled areas which may be used for recreation or open space. In addition, the proposed landform allows for a pattern of future development on the Project Site which would facilitate redevelopment of certain areas of the site in conjunction with the potential continuation of quarrying and brick making into the future.

Future land use and development on the Project Site is however, best determined closer to quarry closure when market conditions, surrounding land use and development and relevant policy can be assessed and considered to establish the most appropriate future use of the land. As such, final landform on the Project Site is conceptual only and would be reviewed and further considered in the medium term.

4.4 Environmental Controls

The site is currently subject to environmental management and monitoring measures. Existing measures for soil and water management include:

- Soil and stormwater management measures as detailed in the SWMP for the site included as **Appendix C.** These measures include bunding, silt fences, use of emergency spill kits and stormwater reporting sheets for monitoring purposes. As part of the EA, the SWMP has been reviewed and updated to address the proposed continued operations on the site.
- Dust suppression practices including the use of water trucks along access tracks and working areas during quarrying campaigns and regular dust deposition monitoring.
- Potential impacts, preventative measures, monitoring and reporting requirements, and responsibilities documented in an environmental effects register kept on-site.

The site is subject to an Environment Protection Licence (EPL) issued under the *NSW Protection of the Environment Operations Act 1997* (POEO Act). The POEO Act includes the following requirements in relation to air quality and noise management and monitoring measures:

- Air emissions monitoring from the brick making facility including the kiln exhaust stack and the dryer exhaust stack;
- Load limits for pollutants including coarse particulates (air), fine particulates (air), fluoride (air), nitrogen oxides (air), nitrogen oxides – summer (air) and sulphur oxides (air).
- Noise from the premises (excluding mobile plant) must not exceed:
  - An $LA_{10\ (15\ minute)}$ noise emission criterion of 55 dB(A) (0700 to 2200) Monday to Saturday and 0800 to 2200 Sundays and Public Holidays; and
  - An $LA_{10\ (15\ minute)}$ noise emission criterion of 40 dB(A) at all other times, except as expressly provided by this licence.
- Noise from the operation of mobile plant must not exceed:
  - An $LA_{10\ (15\ minute)}$ noise emission criterion of 50 dB(A) > (0700 to 2200) Monday to Saturday and 0800 to 2200 Sundays and Public Holidays; and
  - An $LA_{10\ (15\ minute)}$ noise emission criterion of 40 dB(A) at all other times, except as expressly provided by this licence
- An emergency response plan must be prepared and implemented for the premises.
- The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

The EPL requires that the Proponent complete an Annual Return including a Statement of Compliance and a Monitoring and Complaints Summary for submission to the DECCW.

In addition, a Pollution Reduction Program has been completed on the premises consisting of the trial use of recycled water procured from the Worth Recycling plant at South Windsor for brick manufacturing at the premises.

A second Pollution Reduction Program consisting of the development of new load limits for coarse particulates and sulphur oxides emissions is also identified on the EPL.

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5.0 Statutory Planning

This chapter provides an overview of the statutory planning framework of this project. It includes a review of:

- *Local matters*
- *State matters; and*
- *Commonwealth matters.*

5.1 Local Matters

5.1.1 Liverpool Local Environmental Plan 2008

The site is subject to the provisions of LLEP 2008 (gazetted 29 August 2009), which is the primary local environmental planning instrument applicable to the site. In accordance with Section 75R(3) of the EP&A Act, Local Environmental Plans do not apply to approved projects under Part 3A of that Act.

However, under section 75J (3) and 75O (3) the Minister may take into account the provisions of any EPI. As such, this section provides a discussion of the permissibility and general principles of development control imposed under LLEP 2008.

Permissibility

Under LLEP 2008 the subject land is zoned RU1 Primary Production. This zone permits a range of development including agriculture, dwellings, hazardous storage establishments, rural industries and extractive industries. Development not identified as permitted with or without consent is deemed to be prohibited within the zone.

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

The most fitting definition for the quarrying component of the Project under LLEP 2008 is 'extractive industry', defined as:

> *'the winning or removal of extractive materials (otherwise than from a mine) by methods such as excavating, dredging, tunnelling or quarrying, including the storing, stockpiling or processing of extractive materials by methods such as recycling, washing, crushing, sawing or separating, but does not include turf farming'.*

The definition does not, however describe the brick making component of the Project, nor would the aspects noted as being involved in the 'processing of extractive materials' include the activities required for brick making. There is no specific definition for a brick making facility under LLEP 2008 and this part of this Project is therefore undefined.

Extractive industries are permissible with consent in the RU1 zone, therefore the quarrying component of the Project is permissible with consent. As there is no fitting definition for the brick making component of the Project listed as permissible development, the brick making facility becomes a prohibited use within the zone by default.

As discussed previously in **Chapter 1** of this EA, the quarry and brick making facility have been operating at the subject site for over thirty years under consent issued by the Local Government Appeals Tribunal in 1976. This consent and the associated Deed of Agreement specifically refer to the brick making facility component of the project as an integral part of the approved development, and the use was allowed to continue through the development of a number of EPIs applying over time to the land. It is therefore considered likely that the brick making facility would benefit from existing use rights as defined under Section 106 of the EP&A Act.

However, in order to clarify the permissibility issue and to provide Boral with certainty regarding future operations at the site, Concept Plan Approval is sought for the Project, which would allow the Minister to consider granting approval for the proposed Project irrespective of the provisions of LLEP 2008.

Concept Plan and concurrent Project Approval is therefore sought for the continuation of site operations. This is discussed further in **Section 5.2.1**.

Compliance with Zone Objectives

The objectives of the RU1 Primary Production zone are:

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

The proposed Project is consistent with the objectives of the RU1 Primary Production zone through the encouragement of sustainable primary production and maintenance of quarrying and brick making operations to ensure the diversity of primary production in an area that does not contain other quarries.

Furthermore the proposal would retain the land holding, avoiding fragmentation and minimise conflicts between land uses surrounding the site through the use of appropriate mitigation measures as proposed in this EA.

The proposal is generally consistent with existing operations and would not place an unreasonable demand on public services and facilities. The continued operation does not propose the establishment of tall structures or the creation of noise sensitive receivers that could conflict with potential future airport operations. Furthermore, the proposal does not release emissions that are likely to impact on aviation.

The Proponent has sought to maintain and protect existing natural features according to the provisions of the original Deed of Consent. Future quarry operations would include the continued extraction from Pit 3, followed by expansion into the northern portion of the site. An assessment of the potential ecological impacts of the Project has been undertaken as part of the environmental assessment process (refer to **Chapter 17**). Future quarry operations would be carried out subject to the environmental considerations identified in the ecological assessment and included in this EA, continuing to preserve bushland, wildlife corridors and natural habitat at the site where possible.

5.2 State Matters

State legislation and policies relevant to the Project are detailed in the following sections.

It is noted that, as of 1 July 2009, Regional Environmental Plans (REPs) are no longer part of the hierarchy of EPIs in NSW. Therefore REPs are not included in the following discussion with the exception of *SREP9 – Extractive Industries* which is considered to be of historical relevance to the Project.

5.2.1 NSW Environmental Planning and Assessment Act 1979

The EP&A Act and the EP&A Regulation provide the framework for environmental planning in NSW and include provisions to ensure that proposals which have the potential to impact the environment are subject to detailed assessment, and provide opportunity for public involvement.

The objects set out under Section 5 of the EP&A Act, and a consideration of the Project against these objects is provided in **Table 9**.

Table 9: Objects of the EP&A Act

Objects of the EP&A Act	Comment
(a) to encourage:	
(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment, and	The proposal involves continued extraction of shale and sandstone at the Badgerys Creek quarry and continuation of brick manufacturing on site. Shale and sandstone are an important natural resource and their extraction is required for continued supply of construction industry materials. This is particularly important as the site is located within the SWGC where significant urban development has been projected. The Proponent has, in the past, sought to ensure that activities on site have minimal impact on the natural environment, including both Badgerys and South Creeks and would continue to do so as part of proposed future operations at the site. The investigations undertaken as part of this EA conclude that, subject to the implementation of appropriate mitigation measures, operations on the site could continue into the future without significant environmental impact.
(ii) the promotion and co-ordination of the orderly and economic use and development of land, and	The Project proposes the continued extraction of a valuable natural resource in an environmentally responsible manner and the production of clay bricks to supply the construction industry. The Project Site is zoned to allow for extractive industry and operations at the site have existed successfully on the site for the past 30 years. The proposed continuation of operations is considered to represent orderly and economic use of the land in line with the objects of the EP&A Act.
(iii) the protection, provision and co-ordination of communication and utility services, and	The Project would not impact on communication and utility services.
(iv) the provision of land for public purposes,	The proposal would not impact upon the provision of land for public purposes.
(v) the provision and co-ordination of community services and facilities, and	The proposal would not impact upon the provision and coordination of community services and facilities.
(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and	The planning and design of the Project has been undertaken in consideration of the surrounding natural environment and feasible measures were taken during this phase to minimise impacts upon the environment. **Chapter 17** provides a consideration of the potential impacts of the Project on native animals and plants, including threatened species, populations and ecological communities and their habitats and concludes that, subject to the implementation of appropriate mitigation measures, the Project is not expected to have significant impacts in this regard.

Objects of the EP&A Act	Comment
(vii) ecologically sustainable development, and	**Chapter 24** of the EA provides a detailed consideration of the Project against the principles of ecologically sustainable development (ESD) and finds that the proposed continuation of operations at the site is generally consistent with the relevant principles.
(viii) the provision and maintenance of affordable housing, and	Not relevant to the Project.
(ix) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and	Not relevant to the Project.
(x) to provide increased opportunity for public involvement and participation in environmental planning and assessment.	The Project is subject to assessment under Part 3A of the EP&A Act and the public consultation and participation requirements set out therein. In addition to statutory requirements, the Proponent has undertaken community consultation as detailed in **Chapter 6** of this EA.

State and local EPIs are encompassed in the EP&A Act framework. A range of EPIs are created under the EP&A Act to provide further detailed guidance and regulation for development at a State, regional and local level.

Section 75R of the EP&A Act provides that:

> *(3) Environmental planning instruments (other than State environmental planning policies) do not apply to or in respect of an approved project.*

Section 75J (3) provides that the Minister may (but is not required to) take into account the provisions of any EPI, however, also states that the regulations may preclude approval for the carrying out of a class of project (other than a critical infrastructure project) that such an instrument would otherwise prohibit.

Clause 8O of the EP&A Regulation states:

> *(1) For the purposes of section 75J (3) of the Act, approval for the carrying out of a project may not be given under Part 3A of the Act for any project, or part of a project, that:*
>
> > *(a) is not the subject of an authorisation or requirement under section 75M of the Act to apply for approval of a concept plan, and*
> >
> > *(b) is prohibited by an environmental planning instrument that would not (because of section 75R of the Act) apply to the project if approved.*

In order to clarify the permissibility of the brick making facility component of the Project, the Proponent is seeking Concept Plan approval for the proposal. Subject to Section 75M of the EP&A Act the proponent may apply for Concept Plan approval, which allows the Minister for Planning to issue Concept Approval for certain major projects. Concept Plan approval requires the scope of the Project to be outlined alongside any development options, without providing a detailed description of the Project.

As part of this approval process the Minister has the discretion to consider the compliance of the Project with EPI's, including proposals that would otherwise be prohibited by an EPI. However, the Minister may not approve a Concept if the EP&A Regulation precludes approval of Concepts that are otherwise prohibited by an EPI.

AECOM is not aware of any provision in the EP&A Regulation that precludes approval of a Concept that would otherwise be prohibited by an EPI. Section 75O, sub clause (3) enables the Minister to provide Concept Approval for a proposal that would otherwise be prohibited by an EPI. Sub clause 3 states that:

> *"In deciding whether or not to give approval for the concept plan for a project, the Minister may (but is not required to) take into account the provisions of any environmental planning instrument that would not (because of section 75R) apply to the project if approved. However, the regulations may preclude approval for a concept plan for the carrying out of a class of project (other than a critical infrastructure project) that such an instrument would otherwise prohibit*".

Consequently, the proposed quarry and brick making facility will be assessed under Part 3A of the EP&A Act. The Proponent is seeking Concept Plan and concurrent Project approval for the proposed continuation of quarrying and brick making operations at the site. The Minister for Planning is the approval authority for the Project.

5.2.2 State Environmental Planning Policies

The following SEPPs are of relevance to the project:

- *SEPP (Major Development) 2005;*
- *SEPP (Mining, Petroleum Production and Extractive Industries) 2007;*
- *SEPP (Sydney Region Growth Centres) 2006;*
- *SEPP 33 Hazardous and Offensive Industries;*
- *SEPP 44 Koala Habitat Protection;*
- *SEPP 55 Remediation of Land.*

The Project is considered against the provisions of relevant SEPPs in the following sections of this EA.

State Environmental Planning Policy (Major Development) 2005

The primary aim of SEPP 2005 is:

> *'to identify development of economic, social or environmental significance to the State or regions of the State so as to provide a consistent and comprehensive assessment and decision making process for that development'.*

SEPP Major Projects 2005 identifies classes of development which are defined as 'major development' under Part 3A of the EP&A Act. The Director General of the DoP, as delegate of the Minister for Planning, has declared the proposal to be a major development, pursuant to the provisions of Clause 6 of SEPP 2005. The definition of the proposed works falls within Group 2, Schedule 1 of SEPP 2005:

Clause 7 (Extractive Industries) states:

> *(1) Development for the purpose of extractive industry that:*
>
> *(a) Extracts more than 200,000 tonnes of extractive materials per year, or*
>
> *(b) Extracts from a total resource (the subject of the development application (or other relevant application under the Act)) of more than 5 million tonnes*

The proposed works constitute development for the purpose of extractive industry, extracting up to 420,000 tpa. The Project is therefore eligible for declaration and has been declared as a 'major development' to which Part 3A of the EP&A Act applies.

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

The Mining SEPP was gazetted on 16 February 2007.

The aims of this Policy are:

- To provide for the proper management and development of mineral, petroleum and extractive material sources for the purpose of promoting the social and economic welfare of the State, and
- To facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and
- To establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources.

Clause 7(3) of this SEPP identifies development which can be carried out only with consent and includes the following of relevance to the Project:

> *'Extractive industry development for any of the following purposes:*
>
> *a. Extractive industry on land on which development for the purposes of agriculture or industry may be carried out (with or without development consent),*
>
> *b. Extractive industry 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 quarry component of the Project is therefore deemed to be permissible with consent pursuant to Clause 7(3) of the Mining SEPP.

Clause 7(4) of this SEPP addresses the co-location of industry in relation to extractive industry and provides that:

> *If extractive industry is being carried out with development consent on any land, development for any of the following purposes may also be carried out with development consent on that land:*
>
> *(a) the processing of extractive material,*
>
> *(b) the processing of construction and demolition waste or of other material that is to be used as a substitute for extractive material,*
>
> *(c) facilities for the processing or transport of extractive material,*
>
> *(d) concrete works that produce only pre-mixed concrete or bitumen pre-mix or hot-mix.*

The brick making facility component of the project could potentially fit within the definition of 'processing of extractive material'. 'Processing' is not defined explicitly under the Mining SEPP, however, processing as defined under LLEP 2008 involves *recycling, washing, crushing, sawing or separating* none of which accurately describe the brick making process. It is therefore considered unlikely that the brick making facility could accurately be described as processing.

Clause 12 of the Mining SEPP sets out matters for consideration in relation to proposals for extractive industry proposals. **Table 10** examines each of these matters in relation to the proposed Project.

Table 10: Matters for Consideration - Clause 12 of Mining SEPP

Matter for Consideration	Comment
(a) consider: i) the existing uses and approved uses of land in the vicinity of the development, and	The subject site is surrounded by a mix of rural industrial and agricultural land uses. The land to the north east of the site is occupied by ANL, which produces and stockpiles bulk landscape supplies. To the south is Inghams Chickens, which consists of a number of large sheds containing battery farmed chickens. Directly to the west of the site is Badgerys Creek and its tributaries, which form the western boundary of the site. The land further to the west and to the east is comprised of agricultural fields. To the north of the site are a number of market gardens, hobby farms and rural residential properties. The Project, subject to mitigation measures to control environmental impacts within acceptable levels would not impact significantly upon surrounding land uses in the vicinity of the Project Site.

Matter for Consideration	Comment
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, and	Subject to LLEP 2008 the land is zoned RU1 Primary Production. The objectives of the zone are to encourage primary production, minimise conflict between land uses, ensure that the development does not hinder the use of an airport in the vicinity and preserve bushland and wildlife corridors (refer to **Section 5.1.1** for more details). The proposal entails the continuance of the existing quarry and brick making facility use on-the site and would not hinder primary production in the vicinity. The proposal would not generate emissions that are likely to impact on a potential airport in the area and in turn is not sensitive to noise generated by the airport. Furthermore, the proposal includes the rehabilitation of certain land in the vicinity of Badgerys Creek, which would improve the riparian corridor along Badgerys Creek and adjacent bushland.
(iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and	The proposal is generally compatible with existing rural and rural industrial land uses surrounding the site and based on the desired future character as articulated by the zone objective, the proposal is considered to be compatible with planned future land use.
(b) evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and	The proposal would continue to supply an essential resource to the Sydney Metropolitan Region. The proximity of the Project Site to the SWGC ensures that the building materials produced on-site are in proximity to the market, thereby reducing transport times, emissions and associated congestion. The project would not create a significant impact on surrounding or desired future land uses in the vicinity of the site, while providing an essential raw material for the Sydney market.
(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	The site is compatible with surrounding land uses.

Clause 13 of the Mining SEPP relates to the compatibility of the proposal with mining, petroleum production or extractive industries. Clause 13 requires consideration of whether the development is likely to have "*a significant impact on current or future extraction or recovery of minerals, petroleum or extractive materials (including by limiting access to, or impeding assessment of, those resources)*", and whether the proposal is "*compatible with existing or approved uses or that current or future extraction or recovery*".

The project would extend the operation of the quarry and brick works for a further 20 years, thus, permitting the continued use of the site for the purposes of extractive industry and associated brick production. The use of the site for quarrying and brick making is not a sensitive use and should not therefore interfere with the potential extraction of minerals, petroleum or extractive materials in proximity to the site. Furthermore, it is proposed to maintain a number of voids on the Project Site to preserve the potential for the future extraction of deeper mineral deposits should this become a viable option in the future.

Clause 14 of the Mining SEPP relates to natural resource and environmental management and aims to ensure that development *"is undertaken in an environmentally responsible manner, including conditions to ensure the following:*

> *(a) that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,*
>
> *(b) that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,*
>
> *(c) that greenhouse gas emissions are minimised to the greatest extent practicable".*

Specialist studies have been undertaken as part the EA to examine the impacts of the project on ground and surface water and ecology. The investigations have found that, subject to the implementation of recommended mitigation measures, the proposal would not result in significant impacts.

The on-site processing of the quarried raw material into bricks limits transport movements and subsequent greenhouse gas emissions. Furthermore, the proximity of the Project Site to the SWGC means that a major market is in close proximity to the site and haul distances for brick products are subsequently reduced in comparison with more remote sites.

Clause 15 of the Mining SEPP requires the consent authority to consider the efficiency of the resource recovery operation and provides for conditions to be placed on operations to improve efficiency. The quarrying activity and brick works have been successfully operating on the site for 30 years. Operations have been refined over this time to develop an economically viable and efficient process. To ensure that the site operations remain viable the plant management has varied the extraction rates of different materials dependent upon market conditions.

Clause 16 of the Mining SEPP relates to the transport of the extracted material. The consent authority must consider whether conditions should require partial movement of the material by alternate methods to public roads and "*limit or preclude truck movements, in connection with the development, that occur on roads in residential areas or on roads near to schools"*. Additionally, it requires that a referral to the roads authority for the road and the Roads and Traffic Authority (RTA), if they are not the relevant roads authority be made.

The co-location of the quarry and brick works in itself reduces transport requirements, as does the proximity of the site to a major area of growth and therefore market demand in the SWGC. The bricks would be moved solely by truck, however due to recent upgrades to the brick plant, along with proposed extensions to the hours within which deliveries and dispatch can take place, truck movements would not increase as a result of the project and movements within peak times would, in fact, be reduced in frequency. The site has been operating for the past 30 years without giving rise to vehicle conflict on surrounding roads and it is not anticipated that continued operations on the site would result in significant impacts in relation to truck movements and transport generally. A more detailed discussion of the potential traffic and transport impacts of the Project is provided in **Chapter 13** and **Appendix G.**

Clause 17 of the Mining SEPP requires the consent authority to consider whether or not rehabilitation of the land should be undertaken. Rehabilitation may include:

- The preparation of a plan to guide the site's future topography
- Site remediation of contaminated land in accordance with relevant guidelines (including guidelines under section 145C of the Act and the *Contaminated Land Management Act 1997)*
- Remediation of the land to ensure that public safety is not jeopardized.

Boral has undertaken rehabilitation of certain land on-site that is no longer used including the Western Stockpile located in the site's south west corner. This area has been comprehensively revegetated. A RP has been developed for the site (refer to **Section 4.3** for details) and rehabilitation works over the life of the project would be carried out in accordance with this plan. During the 30 years of ongoing operation, the site has not created any public nuisance that has lead to the jeopardizing of public safety.

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

SEPP (Sydney Region Growth Centres) 2006 (SEPP (Growth Centres) 2006) was gazetted on 28 July 2006 and provides the initial planning instrument component of the Metropolitan Strategy. SEPP (Growth Centres) 2006 provides for the coordinated release of land for residential, employment and other urban development in the North West and South West Growth Centres of the Sydney Region.

As the Project Site is located in the SWGC, the provisions of SEPP (Growth Centres) 2006 apply.

The aims of SEPP (Growth Centres) 2006 are (in conjunction with amendments to the regulations under the EP&A Act relating to precinct planning) as follows:

- *"to co-ordinate the release of land for residential, employment and other urban development in the North West and South West growth centres of the Sydney Region;*
- *to enable the Minister from time to time to designate land in those growth centres as ready for release for development;*
- *to provide for comprehensive planning for those growth centres;*
- *to enable the establishment of vibrant, sustainable and liveable neighbourhoods that provide for community well-being and high quality local amenity;*
- *to provide controls for the sustainability of land in those growth centres that has conservation value;*
- *to provide for the orderly and economic provision of infrastructure in and to those growth centres;*
- *to provide development controls in order to protect the health of the waterways in those growth centres;*
- *to protect and enhance land with natural and cultural heritage value; and*
- *to provide land use and development controls that will contribute to the conservation of biodiversity."*

Clause 16, Part 4 of SEPP (Growth Centres) 2006 details the development controls that apply to land that is not subject to a precinct plan and is not on land referred to in Clause 7A of SEPP (Growth Centres) 2006. **Table 11** addresses the development controls in Clause 16.

Table 11: Matters for Consideration – Clause 16 of SEPP (Growth Centres) 2006

Matter for Consideration	Comment
(a) whether the proposed development will preclude the future urban and employment development land uses identified in the relevant growth centre structure plan,	The site is within a future industrial development area. The proposed industrial use is in accordance with the designated future use of the land under the *South West Subregional Strategy*.
(b) whether the extent of the investment in, and the operational and economic life of, the proposed development will result in the effective alienation of the land from those future land uses,	The proposed use of the site is in accordance with the designated future use. The project includes a RP, which would allow the site to be used for a range of industrial and primary production facilities upon completion of the proposed continued quarry and brick making facility use.
(c) whether the proposed development will result in further fragmentation of land holdings,	The project would not result in the fragmentation of land holdings.
(d) whether the proposed development is incompatible with desired land uses in any draft environmental planning instrument that proposes to specify provisions in a Precinct Plan or in clause 7A,	The LLEP 2008 zones the land RU1 Primary Production, which is in accordance with the proposed use and provides a current indication of the Council's desired land uses for the area.
(e) whether the proposed development is consistent with the precinct planning strategies and principles set out in any publicly exhibited document that is relevant to the development,	A precinct plan does not apply to the site.

Matter for Consideration	Comment
(f) whether the proposed development will hinder the orderly and co-ordinated provision of infrastructure that is planned for the growth centre,	Boral has been operating on the site for 30 years, using the existing infrastructure. The existing road infrastructure would continue to be used for transport purposes. A traffic study has been undertaken as part of the EA, which concludes that the proposed operation would not result in significant traffic impacts, but that upgrades would be required to certain intersections in the local area as a result of the development of the SWGC. The proposal would not therefore impact upon the provision of infrastructure in the growth centre.

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

SEPP 33 – Hazardous and Offensive Development (SEPP 33) aims to ensure that due consideration is given to the potential off-site risks of proposals for potentially hazardous or offensive industries in terms of the surrounding environment, amenity and health.

Applying SEPP 33-Hazardous and Offensive Development Application Guidelines, developed by the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR, 1994) (now NSW DoP) provides advice to consent authorities, industry, consultants and other government agencies on whether SEPP 33 applies to a proposal. The Guidelines recommend a 'risk screening' method for determining whether a proposal is hazardous and provides guidance on assessing potentially offensive development proposals. The screening process considers the class and volume of waste materials to be stored on the site and the distance of the storage area to the nearest site boundary.

The guidelines state that the first consideration is whether the proposed use falls within the definition of 'industry' adopted by the planning instrument which applies to the application.

Under the LLEP, the definition of 'industry' specifically excludes extractive industries. As noted above, the brick making component is ambiguous in terms of its definition. Notwithstanding, it is not believed that the Project represents a hazardous industry nor an offensive industry as defined under SEPP 33.

Section 20.1 of this EA concludes that major hazards identified as having the potential to pose a risk to the human, built and natural environments associated with quarrying and brick making operations at the site are generally associated with fuel storage, refuelling of vehicles and plant and chemicals associated with quarrying and brick production, stockpile areas and contaminated surface runoff.

The hazards identified are not considered to pose a significant constraint on the proposal provided appropriate mitigation measures are implemented.

State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 – Koala Habitat Protection (SEPP 44) applies to the LGAs listed in Schedule 1 of the SEPP. The Liverpool LGA is listed on this schedule.

The policy applies to land which is the subject of a development application and has an area greater than one hectare. Whilst the proposed Project would be assessed under Part 3A of the EP&A Act and is not therefore the subject of a development assessment under Part 4 of the EP&A Act, it is assumed that the policy is intended to apply to Part 3A Projects and the provisions of SEPP 44 have therefore been considered in relation to the proposal at **Chapter 17** of the EA.

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and to assist in reversing the current trend of koala population decline: The aims and objectives of the SEPP are met by:

- *"Requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat,*
- *Encouraging the identification of areas of core koala habitat, and*
- *Encouraging the inclusion of areas of core koala habitat in environment protection zones."*

An ecological assessment has been undertaken on the Project Site. The assessment identified a number of Forest Red Gums in proximity to Badgerys Creek and South Creek as well as small patches in proximity to the eastern boundary. The assessment did not record any evidence of recent koala activity and the site is not therefore classed as core koala habitat (refer to **Chapter 17** for further discussion). As the site is not considered core koala habitat the consent authority is not prevented from granting consent for the proposal.

State Environmental Planning Policy No. 55 – Remediation of Land

SEPP 55 – Remediation of Land (SEPP 55) aims to provide a state wide approach to the remediation of contaminated land.

In particular, SEPP 55 contains a number of objectives that aim to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health and the environment:

> *(a) By specifying when consent is required, and when it is not required, for a remediation work, and*
>
> *(b) By specifying certain considerations that are relevant in rezoning land and in determining development applications in general and development applications for consent to carry out a remediation work in particular, and*
>
> *(c) By requiring that a remediation work meet certain standards and notification requirements.*

Subject to Clause 7 of SEPP 55 a consent authority must not consent to the carrying out of development on land unless it has considered whether the land is contaminated. The Project does not involve a change of use of the land but a continuation of the existing operations at the site. An investigation of the DECCW Contaminated Land records was undertaken for the site and showed no record of contamination or remediation undertaken on the site. The subject land is considered to be suitable for continuation of quarrying and brick making operations and it is not anticipated that remediation of the land would be required in order for operations to continue at the site.

5.2.3 Other Relevant Acts

Mining Act 1992 (NSW)

The *Mining Act 1992* (NSW) (Mining Act) is the principle piece of legislation for the regulation of mining activities in the State. The underlying object of the Act is to encourage and facilitate the discovery and development of mineral resources in NSW having regard to the need to encourage ESD. The Act applies to commodities listed under the *Mining Regulation 2003* including structural clay such as that extracted at the Project Site.

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

Part 5 of the 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.

Should approval be granted for the Project, an application would be made for a mining lease in accordance with the relevant provisions of the Mining Act. Clause 75V of the EP&A Act provides that subject to the issue of Project Approval, a mining lease for the Project cannot be refused and must be substantially consistent with the terms of Project Approval.

Contaminated Land Management Act 1997 (NSW)

The primary purpose of the *Contaminated Land Management Act 1997* (NSW) (CLM Act) is to establish a process for investigating and (where appropriate) remediating land areas where contamination presents a significant risk of harm to human health or some other aspect of the environment. The Act sets out criteria for determining whether such a risk exists and gives the DECCW the power to:

- *"declare an investigation site and order an investigation*
- *declare a remediation site and order remediation to take place*
- *agree to a voluntary proposal to investigate or remediate a site."*

The site consists of, and is in the vicinity of, areas of agricultural and industrial lands that may have involved activities with the potential to result in contaminated materials. Contamination investigations have been undertaken, the results of which are detailed in **Chapter 14** of this report. The investigation included a search of the DECCW Contaminated Land records for the Liverpool LGA. The search concluded that the site does not traverse any of the identified contaminated lands. Therefore, the remaining provisions of the CLM Act do not apply.

Fisheries Management Act (NSW)

The NSW *Fisheries Management Act 1994* (as amended) (FM Act) aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations and applies in relation to all waters that are within the limits of the State. The FM Act provides for the protection of certain aquatic habitats and species, the preparation of recovery plans and threat abatement plans and the regulation of certain activities that have the potential to impact aquatic habitats. Under the FM Act, approval is required for certain activities involving dredging and reclamation, blockage of fish passages and development of certain waterfront land. However, Section 75U of the EP&A Act provides that a permit under section 201, 205 or 219 is not required for Part 3A projects.

Chapter 17 of this report addresses the potential impacts of the project on aquatic habitats and species as listed under the FM Act. The habitat value of the sedimentation ponds on the Project Site is limited, as significant vegetation does not occur within the water or in its immediate vicinity. The sediment ponds do not provide habitat for threatened species, populations or ecological communities listed under the FM Act, nor do the works involve a key threatening process, as listed under Schedule 6 of the FM Act.

Native Vegetation Act 2003 (NSW)

The *Native Vegetation Act 2003 (NSW)* (NV Act) provides for the protection from clearing of native vegetation, primarily within regional areas of NSW. Terrestrial native vegetation would not be affected by the proposed development which is discussed in detail in **Chapter 17** of this report. The proposed works would affect areas that have been primarily cleared. However, the works would involve the clearing of some isolated mature native trees and the stand of regrowth Forest Red Gum that occurs within the proposed location of Pit 4.

The proposed development has been sited to minimise the amount of native vegetation to be cleared. Consequently, impacts on the ecological values of the site would be minimal. Additionally, the ecological investigation recommends mitigation measures including the planting of five native seedling trees adjacent to the riparian vegetation alongside Badgerys and South Creek's, for each mature native tree removed.

Section 75U of the EP&A Act provides that authorisation under Section 12 of the NV Act is not required for Part 3A projects.

Threatened Species Conservation Act 1995 (NSW)

The objectives of the *Threatened Species Conservation Act 1995* (TSC Act) are to prevent the extinction and promote the recovery of threatened species, populations, ecological communities and critical habitat in NSW. It also aims to eliminate or manage key threatening processes. Schedule 1, 1A and 2 of the TSC Act provide lists of species, populations and ecological communities that are endangered, vulnerable or extinct.

Chapter 17 of this report addresses the potential impacts of the Project on threatened species, populations and ecological communities as listed under the TSC Act. The investigations found a total of 14 flora species and 22 fauna species known or potentially occurring within 10 km of the site (10 endangered and 4 vulnerable flora species and 7 endangered and 15 vulnerable fauna species). None of the threatened species were recorded at the site and none are considered to have potential habitat within the proposed development area.

National Parks and Wildlife Act (NSW)

The *National Parks and Wildlife Act 1974* (NPW Act), in part, provides for the conservation of objects, places or features of cultural value within the landscape, including places, objects and features of significance to Aboriginal people as well as places of historic significance.

Searches of the appropriate registers, including DECCW's Aboriginal Heritage Information Management System (AHIMS) as well as Aboriginal consultation conducted under the *Interim Community Consultation Requirements* (DECCW, 2004) have been undertaken and are discussed in detail in **Chapter 6** of this EA. The heritage investigation found that the Aboriginal heritage values of the study area pertain to low density artefact scatters or 'background scatter' occurring throughout the study area, with areas of highest Aboriginal archaeological sensitivity occurring adjacent to Badgerys Creek and South Creek. The proposed quarry plans do not encroach on these higher sensitivity areas and the remainder of the site is considered to be of low archaeological significance. Consequently, the proposal is not considered to impact the heritage values of the study area and ongoing monitoring or mitigation is not required.

Section 75U of the EP&A Act provides that a section 87 permit and a Section 90 consent under the NPW Act are not required for Part 3A projects.

Noxious Weeds Act 1993 (NSW)

The *Noxious Weeds Act 1993* (NW Act) establishes a system for the identification and control of noxious weeds in NSW. Under the NW Act, the Minister for Primary Industries (which incorporates agriculture) may declare a plant to be a noxious weed.

Responsibility for the control of noxious weeds lies with the owner and/or occupier of private land and Crown land, as well as local councils and other public authorities on land they occupy. The obligation can be enforced by the issue of weed control notices by the Minister and local control authorities.

The Ecology Investigation located at **Chapter 17** of this report found two species of noxious weed located in the riparian vegetation along South Creek and Badgerys Creek. Ongoing control of noxious weeds would be required during the operation of the proposed quarry and brick works. The ongoing management of noxious weeds would be detailed in the Environmental Management Plan (EMP) for the project.

Protection of the Environment Operations Act 1997 (NSW)

Under the POEO Act 1997 it is an offence, for which there are penalties, to cause water, air or noise pollution without authorisation for such under an EPL. Additionally, schedule 1 of the POEO Act identifies "scheduled activities" which are required to be licensed by the DECCW.

The Project Site is subject to an existing EPL which would need to be reviewed and updated based upon the proposed continued operations. An application would be made for a variation to the existing EPL to reflect the proposed future operations at the site. Clause 75V of the EP&A Act provides that, subsequent to the granting of Project Approval, an EPL cannot be refused and must be substantially consistent with the terms of Project Approval.

Water Management Act 2000 (NSW)

The *Water Management Act 2000* (WM Act) provides for the protection, conservation and ecologically sustainable development of the water resources of the State, and for other purposes. Chapter 3, Part 1 identifies basic landholder rights including harvestable water rights and when access licences are required. The harvestable water right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). Any capacity of the total of all dams on the property greater than the MHRDC may require a licence.

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

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

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

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

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

5.3 Sydney Metropolitan Strategy

The *Sydney Metropolitan Strategy* was developed by the DoP and was released in 2005. The Metropolitan Strategy is a strategic vision for Sydney's future, enabling it to accommodate an expected population growth of 1.1 million people by 2031. The Metropolitan Strategy aims to streamline the process of rezoning within the metropolitan region to allow continued and timely development of both urban and industrial land matched with appropriate infrastructure.

The Metropolitan Strategy includes directions and strategies on how growth and change would be managed in Sydney into the future and identifies two 'growth centres' in the South West and the North West where new

Greenfield development would be directed. Land use planning for the strategy is still in the early stages and Draft Structure Plans are being prepared for these areas.

The subject site is part of the SWGC, which includes the Campbelltown, Camden, Liverpool and Wollondilly LGAs. The Growth Centres are expected to accommodate 30 to 40 per cent of Sydney's new housing by 2031.

The objective of the Metropolitan Strategy is to support continuing economic growth while balancing social and environmental impacts. It is based on anticipated population, economic and demographic trends, and has been developed with five aims: enhance liveability, strengthen economic competitiveness, ensure fairness, protect the environment, and improve governance.

The South West is a large, diverse subregion with an area of 3,378 km². Urban land uses are concentrated in the north and east of the subregion, focusing on the centres of Liverpool and Campbelltown. Resource based land uses are spread across the western and southern parts of the subregion. They include agriculture, coal seam methane gas production, coal mining, and clay, sand, loam and gravel extraction. The protection of these resource lands is considered to be important to Australia's export markets, the NSW economy and energy supply and Sydney's fresh produce markets. Locally, the construction industry and secondary industries such as steelworks and brick, tile and cement manufacturing rely on these resources.

The SWGC is within the South West Subregion, which covers approximately 17,000 ha consisting of 18 precincts. The eastern portion of the SWGC consists of residential development and smaller rural lots (approximately 2 ha) and the western portion is primarily rural. The SWGC is largely within the South Creek Catchment and contains the villages of Rossmore, Austral, Catherine Fields, part of Kemps Creek, Leppington, Bringelly and Badgerys Creek.

5.3.1 South West Growth Centres Subregional Strategy

The *SWGC Subregional Strategy* includes plans for the development of centres, infrastructure and services, the retaining and protecting of strategic employment lands to help provide jobs close to home, the strengthening of Liverpool as one of Sydney's main city centres and promoting Campbelltown as a Major Centre, the improving of transport access via the South West Rail Link, rail clearways and bus networks, and the protection of resource based industries within this subregion. The Project Site is within a precinct earmarked for "future industrial" development (DoP, 2007).

The Environment, Heritage and Resources Actions for the South West Subregion aims to maintain resource lands through a consistent approach to future land use development, which is to be achieved through consultation between Councils and the NSW Department of Primary Industries (DPI) now Industry and Investment NSW (I&I NSW) to identify and protect significant rural and resource lands from inappropriate and incompatible uses through the provisions of LEPs.

The project would provide economic inputs in the local Badgerys Creek area through job retention and creation, in addition to supplying the raw materials for construction to allow continued economic growth in the SWGC. The project includes mitigation measures to ensure that significant environmental impacts are not created as a result of the proposal including water quality monitoring and management, noise attenuation and site rehabilitation (refer to **Chapter 22**). The project is therefore in accordance with the objectives of the Metropolitan Strategy.

The aims of the Metropolitan Strategy include enhanced liveability, economic competitiveness and environmental protection. The proposal is producing raw materials that are essential to improving liveability within the SWGC, through the provision of additional dwellings to cater for the predicated population growth. Furthermore, the proposal is contributing to the NSW economy in a resource efficient manner, without significant environmental impact.

The ongoing use of the site for resource extraction and processing meets the objectives of the *Subregional Strategy* through the maintenance of employment lands centrally in a precinct that is designated for future industrial development. The ongoing operation of the site would not impact on the potential for industrial development in the area in the future.

5.4 Commonwealth Matters

5.4.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) came into effect in July 2000 and requires the approval of the Commonwealth Minister for 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.

Approval under the EPBC Act is triggered by a proposal which has the potential to have a significant impact on a matter of NES or by a proposal which has the potential to have a significant impact on the environment of Commonwealth land. The EPBC Act lists eight matters of NES which must be addressed when assessing the impact of a proposal.

A search of the Department of Environment, Water, Heritage and the Arts (DEWHA, now Department of Sustainability, Environment, Water, Population and Communities) protected matters database was undertaken in August 2009, based on a 10km buffer around the Project Site. The following provides a preliminary assessment of the proposal and its potential impacts on matters of NES.

- **World Heritage properties:** There are no world heritage properties proximate to the proposed project, or that would potentially be affected by the proposal.
- **National Heritage Places:** There are no Commonwealth or National Heritage Places identified within the search area, however a total of seven places listed on the Register of the National Estate (RNE) were identified within the search area. Sites on the RNE do not constitute a matter of NES but are protected under s.391A of the Act. This section means that the Minister must enact the precautionary principle and consider RNE listed sites as part of a referred project.
- **Wetlands of National Importance:** The search identified the proposed Project would be located within the same catchment as a Ramsar site, Towra Point Nature Reserve, which is located approximately 16 km south of the Sydney CBD. However, given the nature of the Project and the distance of the site from the Towra Point Nature Reserve, it is not anticipated that there would be a significant impact on the Ramsar Wetland.
- **Commonwealth-listed Threatened species:** 25 Commonwealth listed threatened species (15 fauna and 10 flora) were identified within the search area. An examination of the potential for the project to impact upon these species is provided in **Chapter 17** of the EA. The assessment concludes that, given that the project does not involve the clearing of significant vegetation, the project would not have a significant adverse impact upon threatened species. **Chapter 17** summarises the mitigation measures proposed as part of the project to ensure that impacts upon threatened species are minimised.
- **Commonwealth-listed Migratory Species:** 14 migratory species were identified within the search area. **Chapter 17** considers the potential impacts of the project on migratory species and concludes that, significant impacts are not anticipated.
- **Nuclear Action:** The proposed project would not involve a nuclear action as defined under the EPBC Act 1999.
- **Commonwealth Marine Area:** There are no Commonwealth Marine Areas proximate to the proposed project, or that would potentially be affected by the proposal.
- **Commonwealth Land:** Three Commonwealth Land sites were identified within the search area. Defence land (the Orchard Hills Defence Site) is located on the opposite side of Badgerys Creek. The project involves the continuation of existing operations at the Project Site which have existed adjacent to the Defence land for the past 30 years with no significant conflict. Management of the Project Site would remain as under existing operations, including the management of stormwater to achieve nil discharge off-site. The proposed project is not anticipated to have a significant impact upon the adjacent Commonwealth Land. Due to the distance of the Project Site from the other two Commonwealth land sites, no adverse impacts are anticipated as a result of the project.

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6.0 Consultation

This chapter summarises the consultation undertaken in respect of the project and includes consideration of the requirements of the Director-General with regard to the EA, the comments of relevant government agencies and issues raised by the local community.

6.1 NSW Formal Procedures

This EA has been prepared in accordance with Part 3A of the EP&A Act and its Regulation. Part 3A of the EP&A Act ensures that the potential environmental effects of the proposal are properly assessed and considered in the decision making process.

In preparing this EA, 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 EA are outlined in **Table 12** below, together with the relevant section of the EA which addresses that matter. A full copy of the DGRs for the project is provided in **Appendix B**.

Table 12: Director-General's Requirements

DGRs	Reference in EA
General Requirements	
A description of the existing and approved operations and infrastructure, including all statutory approvals.	Planning history – **Section 1.1.2** (approvals to date) Existing Works and Infrastructure – **Chapter 4** (current site operations and infrastructure)
The existing environmental management and monitoring regime.	Project Description – **Chapter 4** (Current operation; RP and measures undertaken to date; existing water, air and rehabilitation management controls)
Project description including project need, alternatives considered and project timeframe.	Assessment of Alternatives – **Chapter 3** (need, alternatives and consequence of not proceeding) The Project – **Section 4.2** (detailed project description)
Risk assessment to identify key issues for further assessment.	Issues prioritisation – **Chapter 7** (matrix to address the significance of environmental issues)
Assessment of the existing environment; Cumulative impacts; Policies, guidelines and statutory requirements, strategic planning and potential land use conflicts; and mitigation measures.	Environmental assessment – **Chapters 8 - 21** Cumulative impacts – **Chapter 21** Statutory Planning –**Chapter 5** (consideration of planning legislation, policies and guidelines)
Statement of commitments outlining environmental management and monitoring issues.	Statement of commitments – **Section 22.3** (environmental management and monitoring measures)
Justification on economic, social and environmental grounds that considers the objects of the EP&A Act.	Need for the Project –**Section 3.1** (project justification) *Environmental Planning and Assessment Act 1979* – (consideration of EP&A Act objectives) – **Chapter 5**
Consultation with relevant local, State or Commonwealth Government authorities, service providers, community groups or affected landowners. Particularly: Department of Environment, Climate Change & Water Department of Industry and Investment Roads and Traffic Authority Liverpool City Council	Consultation and issues identification –**Chapter 6**

DGRs	Reference in EA
Key Issues	
Noise – Construction, operational and off site road.	Noise – **Chapter 9** and **Appendix F**
Transport – Predicted road traffic impacts on road network and potential measures to upgrade/maintain road networks.	Traffic and Transport – **Chapter 13** and **Appendix G**
Air Quality– Quantitative assessment of Greenhouse gas emissions and minimisation measures.	Air quality – **Chapter 8** and **Appendix E**
Greenhouse Gas Emissions	**Section 8.5** and **Appendix E**
Soil and Water – Site water balance and water management systems. Modelling of potential surface and ground water impacts, particularly in relation to Badgerys creek and its riparian zone. Flood impacts and mitigation measures.	Geology, soils and contamination – **Chapter 14** Water quality and management – **Chapter 10** and **Appendix C** Groundwater – **Chapter 11**
Visual – Measures to minimise visual impact.	Visual impacts – **Chapter 16**
Biodiversity – Potential impacts on terrestrial and aquatic threatened species, populations, ecological communities, habitats or ground water dependent ecosystems. Measures to maintain or improve biodiversity.	Ecology – **Chapter 17**
Heritage – Aboriginal and non – aboriginal.	Heritage – **Chapter 16** and **Appendix K**
Waste	Waste – **Chapter 19**
Quarry closure and Rehabilitation – including: measures taken upon quarry closure and a detailed rehabilitation strategy that considers the strategic planning of the site and surroundings. Measures to ensure that finance is in place to carryout rehabilitation.	Rehabilitation –**Section 4.3** and **Appendix D**
Social and economic – Assessment of the projects socio-economic impacts and demand on infrastructure.	Socio economic impacts – **Chapter 18**

6.2 Consultation with Stakeholders and Relevant Authorities

6.2.1 Statutory and Other Relevant Authorities

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 AECOM has referred to include:

- The DoP;
- The DECCW;
- The NSW Office of Water (NOW);
- The DII;
- The RTA; and
- LCC.

The purpose of this consultation has been to provide an overview of the project and to seek input into matters that stakeholders would like to see addressed in the EA.

In this regard, comments were sought from relevant statutory agencies identified in the DGRs to assist with the preparation of this EA. Copies of agency responses received are included in **Appendix B**. **Table 13** below summarises the outcomes of the consultation together with the relevant section of the EA that addresses the matter.

Table 13: Summary of Agency Responses

Agency	Issue	Reference in EA
NSW Office of Water	• Availability of a sustainable water supply; • The protection and rehabilitation of waterways and riparian land consistent with the Riparian Corridor Management Study stream categorisation of waterways; and • Groundwater and groundwater dependent ecosystems.	Existing environment – **Chapter 10** (water supply), **Appendix C** Wetlands –**Chapter 17** (ecological impacts) Groundwater – **Chapter 11** (potential impacts)
NSW RTA	• Transport objectives of the Metropolitan Strategy for the South West Growth Centre; • Daily and peak traffic movements. • Traffic analysis of the intersection of Elizabeth drive and Martin Road; and • Assessment of the potential increase in toxicity levels of loads transported on arterial and local roads to/from the site and consequently, the preparation of an incident management strategy for crashes involving such loads, if relevant.	The *Sydney Metropolitan Strategy* – Intersection performance – **Section 13.2.4** Potential impacts – **Section 13.4** and **Appendix G**

Agency	Issue	Reference in EA
NSW DECCW	• Consideration of the changing land uses with regard to the S*ydney Metropolitan Strategy;* • Noise and air impacts from both the quarrying and brick making operations; • Greenhouse gas emissions; • Aboriginal Cultural Heritage; • Water and Groundwater management • Appropriate management of stockpiles and wastes; and • Appropriate rehabilitation of the site.	*Sydney Metropolitan Strategy* – **Chapter 5** Air quality – **Chapter 8** and **Appendix E** Noise –**Chapter 9** and **Appendix F** Greenhouse gas – **Section 8.5** Climate Change – **Chapter 24** Heritage – **Chapter 16** and **Appendix K** Water quality and management – **Chapters 10** and **11** and **Appendix C** Groundwater – **Chapter 11** Waste – **Chapter 19** Rehabilitation – **Section 4.3** and **Appendix D**
NSW DII	• Assess the size and quality of the resource; • Address the aquatic habitat protection requirements; • Maintenance of a buffer zone between the operation and both Badgerys Creek and South Creek to ensure water connectivity does not occur; • Ensure site remains zero discharge for stormwater; and • Develop a comprehensive RPincluding designs for surface water management systems for use after pits and ensure that stockpiles are rehabilitated.	The project – **Chapter 4** Soil and water management – **Chapter 10** and **Appendix C** Water quality and management – **Chapter 10** and **Appendix C** Soil and water management – **Chapter 10** and **Appendix C**; and Rehabilitation – **Section 4.3 and Appendix D** On-site drainage – **Chapter 10** and **Appendix C**

6.2.2 Community Consultation

The Proponent regularly engages with adjoining landowners and has in the past received few complaints in relation to the existing site operations.

As part of the EA process, a program of targeted land owner consultation involving face to face meetings and discussions with potentially impacted landholders who reside within 250 m of the site boundary has been undertaken. The consultation process endeavoured to inform and discuss with local landowners, planned quarrying activities including the continued extraction of raw materials from Pit 3 and the progression of quarrying activities into proposed Pit 4 and Pit 5 in the eastern and northern areas of the site. Feedback from the consultation process has been taken into consideration and the issues raised by the community were:

- Noise from reversing beepers on the site - this issue is addressed in **Chapter 9** and **Appendix F** of the EA.
- Dust – this issue is addressed in **Chapter 8** and **Appendix E** of the EA.

Most landowners within a 250 m distance of the site boundary raised no issues with regard to the Proponent's quarrying and brick making activities at Badgerys Creek.

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

6.2.3 Aboriginal Community Consultation

The Aboriginal Heritage Assessment undertaken as part of this EA included Aboriginal consultation conducted in accordance with the NPW Act*: Part 6 Approvals – Interim Community Consultation Requirements for Applicants* (ICCRs). The following Aboriginal stakeholder groups were consulted following their response to an invitation to participate in the consultation process:

- Gandangara Local Aboriginal Land Council (GLALC);
- Darug Custodian Aboriginal Corporation (DCAC);
- Darug Tribal Aboriginal Corporation (DTAC);
- Darug Aboriginal Cultural Heritage Assessments (DACHA);
- Darug Land Observations (DLO); and
- Yarrawalk (YA).

Results of this consultation are summarised in the Heritage Assessment discussed in **Chapter 16** of this EA and included as **Appendix K**.

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7.0 Issues Prioritisation

7.1 Issues Identification

The issues associated with the Project include:

- Air quality;
- Noise;
- Surface water and ground water;
- Transport and traffic;
- Land use;
- Visual impact;
- Ecology;
- Heritage;
- Rehabilitation;
- Hazard and risk; and
- Social and economic.

7.2 Prioritisation of Issues

7.2.1 Approach

The prioritisation of issues for the proposed continued operations is based on the need to recognise that the higher the potential severity of adverse environmental effects and the greater the consequence of those unmanaged effects, the higher the degree of environmental assessment required.

Where a high potential effect was identified, the attribute or issue was allocated a higher priority for assessment.

Table 14 provides the Issues Prioritisation Matrix upon which the ranking of environmental issues has been based. This method assesses priority on the basis of the potential severity of environmental effects and the likely consequences of those potential effects if unmanaged. The potential severity and consequence of the environmental effect are each given a numerical value between 1 and 3. The numbers are added together to provide a result which is then ranked and shaded in the matrix by the level of priority being High, Medium or Low.

Table 14: Issues Prioritisation Matrix

Severity Of Effects	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)

7.2.2 Assessment

The prioritisation of environmental issues related to the Project is shown in **Table 15**. This assessment aims to allow the prioritisation of issues for assessment and does not consider the application of mitigation measures to manage environmental effects. In all cases, appropriate and proven mitigation measures, chosen based upon the experience of regulators and other similar projects would be used to minimise potential impacts. These measures would be described in detail in the EA prepared for the proposed extension of operations.

The allocation of risk is based upon the following considerations:

Severity of Risk

Low: localised implications; imperceptible or short term cumulative impacts.

Medium: regional implications; modest or medium term accumulation of impacts.

High: inter-regional implications: serious or long term accumulation of impacts.

Consequences of Unmanaged Effects

Low: minor environmental change; offsets readily available.

Medium: moderate adverse environmental change; offsets available.

High: important adverse environmental change, offsets not readily available.

Table 15: Prioritisation Analysis

Issue	Severity	Consequence	Priority
Aspect: Air Quality			
Quarry related impacts on air quality such as dust generation and vehicle emissions	2	2	**4 (Medium)**
Dust generation and vehicle emissions during brick making and handling activities	1	2	**3 (Low)**
Community concern regarding degradation of air quality.	1	2	**3 (Low)**
Regional and inter-regional impacts upon air quality.	1	2	**3 (Low)**
Aspect: Water			
Degradation of surface water quality in the local area during quarrying activities.	1	2	**3 (Low)**
Degradation of surface water quality in the local area during operation of brick making facility	1	2	**3 (Low)**
Release of waters into the surface drainage, including the potential for saline waters or sediment laden waters	2	2	**4 (Medium)**

Issue	Severity	Consequence	Priority
Release of surface water runoff into Badgerys Creek or South Creek	1	2	**3 (Low)**
Dewatering and disruption to groundwater aquifers due to activities	1	2	**3 (Low)**
Aspect: Noise			
Noise nuisance to local residents during quarrying activities	1	2	**3 (Low)**
Noise nuisance to local residents during brick making and handling	1	2	**3 (Low)**
Noise nuisance to local residents as an effect of traffic and transport movements	2	2	**4 (Medium)**
Aspect: Geology and Soils			
Erosion and sedimentation during quarrying activities	1	2	**3 (Low)**
Erosion and sedimentation during brick making and handling activities	1	1	**2 (Low)**
Potential geotechnical impacts as a result of quarrying activities	1	2	**3 (Low)**
Contamination and sterilisation of land for future uses	1	2	**3 (Low)**
Aspect: Hazard and Risk			
Exposure of surrounding land uses to risks and hazards during quarrying	1	1	**2 (Low)**
Exposure of surrounding land uses to risks and hazards during brick making and handling	1	1	**2 (Low)**
Exposure of employees to risks and hazards	1	2	**3 (Low)**

Issue	Severity	Consequence	Priority
Aspect: Ecological			
Loss of habitat due to clearing and quarrying	1	1	**2 (Low)**
Reduction in biodiversity due to loss of habitat for native species	1	1	**2 (Low)**
Spread of weeds and feral animals	1	1	**2 (Low)**
Impact upon threatened species	1	1	**2 (Low)**
Impact upon aquatic ecology of Badgerys Creek and South Creek	1	2	**3 (Low)**
Aspect: Socio-Economic			
Demand upon community, natural or transport resources	1	1	**2 (Low)**
Impacts upon amenity of surrounding properties such as noise, visual, etc	1	2	**3 (Low)**
Job creation during construction	1	1	**2 (Low)**
Job creation during operation	1	1	**2 (Low)**
Aspect: Traffic and Transportation			
Impact on traffic on local road network due to continued operations	2	2	**4 (Medium)**
Impact on regional road network	1	1	**2 (Low)**
Aspect: Cultural Heritage			
Impacts on Non-Indigenous heritage	1	1	**2 (Low)**
Impacts on Indigenous heritage.	1	1	**2 (Low)**
Visual Impacts			
Visual impacts during quarrying activities	1	2	**3 (Low)**
Visual impacts during brick making and handling activities	1	1	**2 (Low)**

Issue	Severity	Consequence	Priority
Aspect: Land Use			
Inappropriate use of land	1	1	**2 (Low)**
Incompatibility of land use with surrounding environment	1	2	**3 (Low)**
Incompatibility of land use with new land uses proposed for area	2	2	**4 (Medium)**
Aspect: Rehabilitation			
Impacts on soils and water quality as a result of rehabilitation works	1	2	**3 (Low)**
Impacts on air quality (dust) as a result of rehabilitation work	2	1	**3 (Low)**
Compatibility of final land use with future environment	2	2	**4 (Medium)**

Table 16 identifies that the prioritisation of environmental issues, and therefore the focus of assessment for the proposed project should be as follows:

Table 16: Prioritisation of Issues

Low	Medium	High
Hazard and Risk	Air quality	None
Ecology	Water	
Socio-Economic	Noise and Vibration	
Cultural Heritage	Traffic and Transportation	
Visual	Land Use	
Geology and Soils (Soil erosion impacts)	Rehabilitation	

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8.0 Air Quality

*This chapter provides a summary of all matters relating to the Air Quality Impact Assessment (AQIA). The full AQIA report is provided in **Appendix E**. This assessment has been undertaken in consultation with DECCW and with reference to the DGRs and takes into consideration pollutants of concern associated with quarrying and brick making operations at the site.*

8.1 Existing Environment

8.1.1 Existing Air Quality and Meteorological Environment

The existing air quality environment in the vicinity of the Project Site has been characterised using monitoring data from the DECCW air quality monitoring station located at Bringelly for the period 1 September 2006 to 31 August 2007. These data have been used in this assessment to estimate background pollutant concentrations. The DECCW air quality monitoring station is approximately 2 km south east of the Site.

The air pollutants relevant to the AQIA from the DECCW air quality monitoring station include:

- Fine particles (particulate matter less than 10µm in diameter (PM_{10}));
- Total suspended particulates (TSP);
- Sulfur Dioxide (SO_2); and
- Oxides of Nitrogen (NO, NO_2 & NO_x).

The background concentrations for each of these air pollutants are provided in **Table 17** below. The relevant impact assessment criteria specified in **Table 17** is the DECCW *Approved Methods (Department of Environment and Conservation (DEC), 2005)* for the AQIA pollutants of concern.

Table 17: Background Concentrations at the Bringelly DECCW Monitoring Station

Air Emission	Averaging Period	Background Concentration (µg/m^3)	Assessment Criteria (µg/m^3)
PM_{10}	24 hours	38.5	50
	Annual	20.4	30
TSP [1]	Annual	45.5	90
Sulfur Dioxide (SO_2)	1 hour	48.6	570
	24 hours	7.9	228
	Annual	1.1	60
Nitrogen Dioxide (NO_2) for assessment of Nitrogen Oxides (NOx) [2]	1 hour	82	246
	Annual	11.6	62

[1] – TSP calculated by applying TSP to PM_{10} ratio to PM_{10} results as previously stated

[2] – NO_2 background data used to predict background concentrations using the ozone limiting method (OLM) method

The DECCW monitoring station results show relatively high background levels of PM_{10} when compared to the assessment criteria. TSP background levels are also elevated, although are approximately half of the DECCW criterion of 90 µg/m^3. All other measured pollutant background levels are considered to be low when compared to the assessment criteria.

Dust deposition has been monitored at four locations within the Site using dust deposition gauges from October 2007 to October 2008. Samples have been collected monthly and analysed for insoluble solids and ash residue. The average measured dust deposition results for each of the four locations were compared to the predicted dust deposition results in Section 7.0 of the *Air Quality Impact Assessment* located at **Appendix E**.

A review of meteorological data from the DECCW air quality monitoring station is provided in the AQIA (**Appendix E**). Wind patterns are generally dominated by winds from a south south-westerly direction, with minor winds in most other directions. Summer and spring showed the highest average wind speeds (more dispersion and hence higher dilution of pollutants) with winter having the most calm periods (wind speeds less than 0.5 m/s). These wind parameters suggest that impacts from the Project Site are likely to be highest to the north north-east of the Project Site (receptors 5, 6 and 7 as shown in **Figure 6**), with impacts potentially peaking in winter periods.

8.1.2 Sensitive Receptors

The DECCW considers sensitive receptors to be areas where people are likely to either live or work, or engage in recreational activities (DEC, 2005). Sensitive receptors have been identified at 11 locations surrounding the Project Site, which are considered to be representative of the local community for the purposes of the AQIA. The sensitive receptors are listed in **Table 18** below and are also shown on **Figure 6**.

Table 18: Sensitive Receptor Locations

Receptor Number	Sensitive Receptor Location	Distance from Nearest Site Boundary	Type
1	Badgerys Creek Rd	Approximately 670 m SW of site boundary	Industrial
2	Corner of Badgerys Creek Rd and Jagelman Rd	Approximately 480 m W of site boundary	Residential
3	Badgerys Creek Rd	Approximately 290m W of site boundary	Residential
4	Longleys Rd	Approximately 200m N of site boundary	Residential
5	Lawson Rd	Approximately 28m N of site boundary	Residential
6	Martin Rd	Approximately 15m N of site boundary	Residential
7	Braikfield Ave	Approximately 500m NE of site boundary	Residential
8	Western Rd,	Approximately 450m E of site boundary	Industrial
9	Victor Ave	Approximately 130m E of site boundary	Residential
10	Victor Ave	Approximately 215m E of site boundary	Residential
11	Ramsey Rd	Approximately 600m SE of site boundary	Residential

8.2 Assessment Methodology and Dispersion Modelling

In order to assess the potential air quality impacts of the project, an AQIA was undertaken which included the following scope of works:

- Identification of pollutants of concern and development of an emissions inventory containing air quality emissions information from current operations at the site;
- Preparation of an AUSPLUME atmospheric dispersion model in accordance with DECCW guidelines, using emissions from surface infrastructure and facilities and mine ventilation shafts; and
- Assessment of predicted air quality emissions against assessment criteria using the DECCW Approved Methods (DEC, 2005).

AECOM

SENSITIVE RECEPTORS - AIR QUALITY

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 6

8.2.1 Pollutants of Concern

A number of pollutants of concern have been identified and are currently monitored at the site. These include:

- **Gaseous pollutants:**
  - Hydrogen Fluoride (HF) - Clays used in brick making naturally contains fluoride in the form of hydrated micas, such as muscovite and illite. The production of bricks requires that clay be fired in a kiln to drive off water. At these elevated temperatures gaseous HF is evolved and released.
  - Sulfur Dioxide (SO_2) - SO_2 is a colourless gas with a sharp, irritating odour. It is formed in combustion processes through burning fossil fuel containing sulfur, in petroleum refining and smelting mineral ores. During the brick making process clay is fired in a kiln to drive off water. Pyrite within the clay is oxidised, thereby removing sulfur-containing compounds such as sulfur dioxide from the clay. The simultaneous presence of airborne particulate matter can compound these effects.
  - Sulfuric Acid Mist - During the clay firing process sulfur dioxide is released which can oxidize in the atmosphere to form sulfuric acid (H_2SO_4). Sulfuric acid enters the air during production, use and transport. In the air it would react with other chemicals present (ammonia, magnesium, calcium) to form salts, which neutralise the acid. The acid particles dissolve in clouds, fog, rain, or snow, resulting in very dilute acid solutions. This may impact the environment as wet acid deposition ('acid rain').
  - Gaseous Chlorine (Cl) - Gaseous Cl is a yellowish-green gaseous element of the halogen group. It has a strong, distinctive odour that is irritating to the respiratory tract and is poisonous if ingested or inhaled.
  - Nitrogen Oxides ($NO_{x)}$ - NO_x is a generic term for mono-nitrogen oxides (NO and NO_2). These oxides are produced during combustion, especially combustion at high temperatures. At ambient temperatures, the oxygen and nitrogen gases in air would not react with each other. In an internal combustion engine or industrial heating applications e.g. boilers, combustion of a mixture of air and fuel produces combustion temperatures high enough to drive endothermic reactions between atmospheric nitrogen and oxygen in the flame, yielding various oxides of nitrogen.
  - Odour - Odour is a sensory response to the inhalation of one or more chemicals in the air we breathe. A person's perception of an odour can vary significantly depending on the sensitivity of the person, the acuteness of the person's sense of smell and the connotations that the odour bestows on that person. Odour primarily affects a person's quality of life and can have a large range of adverse effects including stress and other physical symptoms.
- **Dust emissions:**
  - Particulate Matter (TSP and PM_{10}) and dust deposition - Particulate matter refers to solid or liquid particles found in the air. Some particulate matter is visible to the naked eye including smoke, however fine particulate matter is generally not. Particulates are generally produced by the break-up of larger solid particles. Coarse particulate matter can include dust from roads, agricultural processes, exposed soil in mining operations and non-combustible materials released from burning fossil fuels.

8.2.2 Pollutant Sources

Two potential sources of gaseous air pollutants from the brick production facility are present at the site; the Kiln Stack and the Dryer Exhausts. In addition to these sources, the quarrying operation and exposed surfaces (including stockpiles) within the site are potential dust emission sources. Emissions inventories have been prepared for both gaseous pollutants and dust emissions which identify the source and characteristics of each of the pollutants of concern.

A full description of the pollutant source characteristics utilised in the AQIA for the brick production facility (kiln stack and dryer exhaust) and quarrying operations are detailed in the AQIA (**Appendix E**).

8.2.3 Assessment Criteria

The relevant impact assessment criteria specified by the DECCW *Approved Methods (Department of Environment and Conservation, 2005)* for the AQIA pollutants of concern are presented in **Table 19**. The relevant averaging period for each pollutant is provided.

Table 19: Relevant Air Quality Impact Assessment Criteria

Air Emission	Averaging Period	Assessment Criteria (µg/m^3)
PM_{10}	24 hours	50
	Annual	30
TSP	Annual	90
Deposited Dust (maximum allowable increase)	Annual	2 g/m^2 month
Deposited Dust (maximum measured levels)	Annual	4 g/m^2 month
Hydrogen Fluoride	90 days	0.5
	7 days	1.7
	24 hours	2.9
Sulfur Dioxide (SO_2)	10 minutes	712
	1 hour	570
	24 hours	228
	Annual	60
Sulfuric Acid Mist (H_2SO_4 as So_3)	1 hour	18
Chlorine (Gaseous) (Cl)	1 hour	50
Nitrogen Dioxide (NO_2) for assessment of Nitrogen Oxides (NOx)	1 hour	246
	Annual	62
Odour	Peak Concentration	4 OU

Deposited dust criteria are provided in the Approved Methods for two parameters; maximum measured levels and maximum allowable increase. Modelled ground level impacts from operations are compared against the maximum allowable increase in dust of 2 g/m^2 per month (annual average).

The land use around the Site does not include any HF sensitive vegetation such as grape vines and stone fruits. Accordingly, the Approved Methods (DEC, 2005) HF assessment criteria for general land uses has been applied in the AQIA. It should also be noted that AUSPLUME cannot estimate ground level concentrations (GLCs) for the time period of 30 days. As such this assessment time period has not been considered in the AQIA.

The assessment criterion for NO_2 has been used for the assessment of NO_x in the AQIA.

It has been estimated that the local population potentially impacted by emissions from the Site is greater than 125 but less than 500 people. Based on this assumption the odour GLC impact assessment criterion to be applied in the assessment is 4 OU at the 100th percentile in accordance with the Approved Methods (DEC, 2005).

8.2.4 Dispersion Modelling

Dispersion modelling for the project was divided into different scenarios for gaseous pollutants, and dust emissions, as described below.

Gaseous Pollutant Emission Modelling

The following pollutants have been modelled from the brick making facility (kiln stack and dryer exhausts) assuming maximum emission rates gained from previous stack tests. As such the scenario is considered to represent worst case typical operating conditions for the following parameters:

- HF;
- SO_2;
- H_2SO_4 as SO_3;
- Gaseous Cl;
- NO_x as NO_2; and
- Odour.

The pollutant modelling scenario outlined above assumed that the brick making facility was operating continuously all year (24 hours per day, 365 days per year). The facility is unlikely to operate at this level due to operational restrictions and as such the scenario is considered to be a conservative estimate of likely impacts.

Dust Emission Modelling

Dust modelling for TSP, PM_{10} and dust deposition was performed for three scenarios to represent the three proposed quarry locations:

- Scenario 1 – Phase 3 Pit (current):
  - 1A – Quarrying activities modelled;
  - 1B – No quarrying activities modelled;
- Scenario 2 - Phase 4 Pit (future); and
- Scenario 3 - Phase 5 Pit (future).

As discussed previously, quarrying activities are undertaken for only 3 consecutive months each year. In order to gain realistic worst case predictions, the seasonal impact has been examined in the AQIA. A preliminary modelling run applying the quarry activities to all days in the year, showed that the worst case impacts were predominantly present in autumn and winter. As such quarrying activities were modelled for autumn and winter only for Scenario 1 (with normal operations during the rest of the year). Results indicated that dust impacts were worst during winter, and therefore quarrying activities were modelled during winter only (with normal operation during the rest of the year) for Scenarios 2 and 3. The brick making facility was modelled as a constant source for all model runs.

The dust impacts from areas of the Project Site not being quarried have also been predicted in the AQIA, designated as Scenario 1B. The scenario only examines the impacts from wind generated dust and the impacts from the typical operation of the brick making facility.

8.3 Potential Impacts

8.3.1 Gaseous Pollutants

The pollutant modelling results indicate that odour, HF, SO_2, H_2SO_4 as SO_3 and Gaseous Cl each meet the relevant assessment criteria at the representative sensitive receptors for both isolated and cumulative predicted GLCs. Detailed results of gaseous pollutant modelling are provided in section 7.2 of the AQIA included as **Appendix E** to this EA.

8.3.2 Dust Emissions

Total Suspended Particulates

The dust modelling results show that predicted TSP GLCs and dust deposition met the assessment criteria for all modelled scenarios (refer to section 7.1 of the AQIA located at **Appendix E**).

Particulate Matter (PM_{10})

The predicted 24 hour average PM_{10} GLCs in isolation from the background concentration, met the criteria for scenario 1B (no quarrying activities) only, with all other scenarios exceeding the criteria. Although the cumulative 24 hour average PM_{10} GLCs exceeded the criteria for all scenarios, the isolated results only exceeded at receptor 6 which is 15m north of the Project Site boundary, 650m north east of the brick making facility and located in the predominant downwind direction from the Project Site.

Scenario 1B represents the typical operating conditions for at least 75% of the year (9 to 10 months of the year), indicating that for the majority of the year dust impacts at most receptors would be acceptable.

The PM_{10} 24 hour GLC results for Scenario 1B met the criteria when in isolation from background concentrations but exceeded for cumulative GLCs. This suggests that the assumed mitigation measures applied to the Project Site may not be adequate to reduce the off-site dust impacts to below the assessment criteria during normal quarrying operations. Recommendations for achieving this goal during both normal operation and quarrying campaigns are discussed below.

The predicted annual average PM_{10} GLCs in isolation from the background concentration met the assessment criteria for all modelled scenarios. The cumulative annual average PM_{10} modelling results met the assessment criteria for scenario 1B (no quarrying activities) only, with all other scenarios exceeding the criteria at a small number of close receptors located to the north of the Project Site.

The modelling results showed that the worst case PM_{10} GLCs were at Receptor 5 (400m north of the brick making facility) and Receptor 6 (650m north east of the brick making facility). Both are the closest receptors to the boundary of the Project Site. The meteorological data shows that the predominant wind direction was from the south west (blowing to the north east) which puts these two receptors generally downwind of the Project Site. Mitigation measures would therefore have to focus particularly on dust impacts in this direction.

As the Project Site was operational during the background data measurement program, it is expected that the Project Site would have had a contribution to the regional air shed and the measured background dust concentrations. This impact is particularly true for near field impacts. Applying the measured background concentrations to the predicted dust emissions for the Project Site may result in a degree of double counting of dust emissions from the Project Site. This is likely to result in an overestimation of predicted impacts.

Dust Deposition

The dust deposition results predicted from the modelling were below the average measured from the Project Site from October 2007 to October 2008. The predicted results were those related to Boral operations and do not incorporate other sources of dust from the local area including other anthropogenic activities such as other quarries, activities at ANL, wheel generated dust, or natural sources of dust such as bush fires. It is therefore expected that the predicted dust deposition results would be lower than the measured results (which would include impacts from off-Project Site dust sources as previously stated), which supports the modelling methodology and results.

8.4 Mitigation Measures

The following mitigation measures would be implemented as part of the Project to manage potential air quality impacts:

- Dust control measures would be employed on the Project Site as follows:
  - Haul roads to be watered at a rate equal to or greater than 2 L/m^2/hr;
  - Dust generated during the unloading of trucks containing raw or unusable extracted material to be controlled using water sprays;
  - Dust from raw material stockpiles to be controlled using water sprays;
  - Dust from existing stockpiles of unusable material and open pits to be controlled using water sprays with chemical additives (surfactants); and
  - Completed pits to be revegetated as soon as practicable after completion of quarrying activities.
- Preparation of an AQMP for the Project Site. The AQMP would include measures to control dust and emissions from the Project Site. Specifically, the AQMP would include details of a dust mitigation program for the Project Site including:
  - Instantaneous dust monitoring at the most affected Project Site boundary through the installation of an instantaneous dust monitor (such as a Tapered Element Oscillating Microbalance (TEOM)) to alert Project Site personnel when elevated dust levels occur such that operations can be modified to reduce dust impacts;
  - Revegetation of disturbed soil surfaces on the Project Site in accordance with the RP (**Appendix D**); and
  - Review of operational practices to ensure 'best practice' techniques are being employed and that operational equipment is working efficiently.

8.5 Greenhouse Gas Assessment

8.5.1 Methodology

GHG emissions were estimated using the National Greenhouse Accounts (NGA) Factors (June 2009) published by the Department of Climate Change (DCC) which include three assessment categories:

- **Scope 1**, which covers direct emissions from sources within the boundary of an organisation, such as fuel combustion and manufacturing processes;
- **Scope 2**, which covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation; and
- **Scope 3**, which includes all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation, such as product transport emissions and emissions from the generation of purchased electricity.

This assessment estimated emissions relating to:

- Fuel Combustion – Stationary Plant (Scope 1)
- Fuel Combustion – On-site Transport (Scope 1)
- Electricity Use (Scopes 2 and 3)
- Product Transport (Scope 3).

8.5.2 Estimates

Estimates of GHG emissions associated with the relevant activities on site are shown below.

Fuel Combustion – Stationary Plant (Scope 1)

The brick manufacturing process involves firing of bricks in a gas-fired kiln. Emission factors associated with combustion of natural gas are provided in **Table 20**.

As shown in **Table 21** and **Table 22**, emissions of GHG associated with brick making at the site at current production levels from the combustion of natural gas and solid fuels would increase by approximately 10,081,522 kg CO2-e (0.01 Mt CO2-e) per year while the proposed level of brick production occurs (approximately 250,000 tpa).

Table 20: Emission Factors – Combustion of Gaseous Fuels

Fuel Combusted	GHG Emission Factors (kg CO_2-e/GJ)		
	CO_2	CH_4	N_2O
Natural gas distributed in a pipeline	51.2	0.1	0.03

Source: Table 1, NGA Factors, June 2009

Table 21: Emission Estimates – Combustion of Gaseous Fuels

Scenario	Average Annual Amount (GJ)	GHG Emissions (kg CO_2-e)			
		CO_2	CH_4	N_2O	Total
Existing	230,734	11,813,564	23,073	6,922	11,843,559
Proposed	358,077	18,329,964	35,801	10,740	18,376,504
Difference	127,273	6,516,400	12,728	3,818	6,532,945
GJ = gigajoules					

Table 22: Emission Estimates - Combustion of Solid Fossil Fuels (excluding coal or coke)

Scenario	Average Annual Usage (t)	GHG Emissions (kg CO_2-e)			
		CO_2	CH_4	N_2O	Total
Existing	3,108	6,408,478	4,121	20,606	6,433,206
Proposed	4,822	9,943,416	6,394	31,972	9,981,783
Difference	1,714	3,534,938	2,273	11,366	3,548,577

Fuel Combustion – On-site Transport (Scope 1)

On-site transport emissions relate to the combustion of fuel on site by vehicles and mobile plant. Emission factors for emissions of GHGs associated with on-site transport activities are shown in **Table 23**. On-site transport emissions would generate approximately 16 t CO2-e which is shown in **Table 24**, an additional 5,849 kg CO_2-e (0.000006 Mt CO_2-e) per year above existing production levels based upon maximum proposed brick production.

Table 23: Emission Factors – Combustion During On-site Transport

Vehicle Type	Fuel Type	GHG Emission Factors (kg CO_2-e/kL)		
		CO_2	CH_4	N_2O
General transport	Diesel oil	69.2	0.2	0.5

Source: Table 4, NGA Factors, June 2009

Table 24: Emission Estimates - Combustion During On-site Transport

Scenario	Average Annual Amount (kL)	GHG Emissions (kg CO_2-e)			
		CO_2	CH_4	N_2O	Total
Existing	152	10,498	30	76	10,604
Proposed	235	16,288	47	118	16,453
Difference	83	5,790	17	42	5,849

Electricity Use (Scopes 2 and 3)

Scope 2 emissions associated with electricity use relate to the burning of fuels at a power station to produce the electricity consumed at the Project Site. The Scope 3 emissions relate to the distribution and transmission of that electricity. The relevant emission factors are provided in **Table 25**, while **Table 26** provides the emissions estimates calculated for the Project Site. As shown, approximately 12,261 t CO2-e would be generated from electricity use at the Project Site per year under proposed maximum production rates, an increase of 4,358,881 kg CO2-e (0.0043 Mt CO2-e) per year over existing production levels.

Table 25: Emission Factors – Electricity Use

State, Territory or Grid	GHG Emission Factors (kg CO_2-e/kWh)	
	Scope 2	Scope 3
New South Wales and Australian Capital Territory	0.89	0.18

Source: Table 39, NGA Factors, June 2009

Table 26: Emission Estimates – Electricity Use

Scenario	Average Annual Amount (kWh)	GHG Emissions (kg CO2-e)		
		Scope 2	Scope 3	Full Fuel Cycle
Existing	7,385,236	6,572,860	1,329,343	7,902,203
Proposed	11,458,956	10,198,471	2,062,612	12,261,083
Difference	4,073,720	3,625,611	733,269	4,358,880

Product Transport (Scope 3)

GHG emissions associated with transport of the product produced at the Project Site were estimated based on the approximate fuel usage associated with this activity. The NGA Factors provide Scope 3 emission factors for liquid fuels. Factors relating to diesel fuel are shown in **Table 27**.

Table 27: Scope 3 Emission Factors - Diesel Fuel

Liquid fuel combusted	GHG Emission Factors (kg CO_2-e/kL)
Diesel oil	69.2

Source: Table 38, NGA Factors, June 2009

Products produced at the Project Site are distributed throughout Sydney. In order to estimate product transport emissions, the average trip distance was assumed to be half the width of the city (i.e. 30 km). Data used for the estimates are shown in **Table 28**.

Table 28: Product Transport Data

Parameter	Value
Number of trips per year	32,448
Fuel consumption rate of trucks (L/km)*	0.547
Average distance per trip (km)	30
Total annual distance travelled (km)	973,440
Total fuel consumed (kL)	532
Density of diesel fuel (kg/L)**	0.836
Energy content of diesel fuel (GJ/t)***	45.6
Diesel use (t)	0.45
Diesel use (GJ)	20,299
***** ABS Data (2007); http://www.abs.gov.au ** Table 61, NPI Emission Estimation Technique Manual for Combustion Engines, v3.0, June 2008 *** http://www.ior.com.au/ecflist.html	

Using the data in **Table 27** and **Table 28**, the GHG emissions associated with product transport were estimated to be approximately 107,583 kg CO_2-e (0.0001 Mt CO_2-e) per year.

8.5.3 Emissions Summary

Emissions estimates from the sources outlined above are summarised in **Table 29**. As shown, the greatest source of emissions from the facility (approximately 60 % of total emissions) are those associated with the combustion of natural gas in the production process, followed by electricity use.

Table 29: Greenhouse Gas Emissions Summary

Activity		Estimated Annual Average Emissions (t CO2-e)		
		Existing	**Proposed**	**Difference**
Scope 1	Fuel combustion – stationary plant*	18,277	28,358	10,082
	Fuel combustion – on-site transport	11	16	6
	Total Scope 1	*18,288*	*28,374*	*10,088*
Scope 2	Electricity use	6,573	10,198	3,626
	Total Scope 2	*6,573*	*10,198*	*3,626*
Scope 3	Electricity use	1,329	2,063	733
	Product transport	108	108	0
	Total Scope 3	*1,437*	*2,170*	*733*
Total		**26,298**	**40,743**	**14,447**
***** Natural gas and solid fuel				

Total emissions from the Project Site were estimated to increase by a total of 14,447 t CO_2-e, or 0.01 Mt CO_2-e per year based upon the maximum proposed level of production. As such, the proposed development would not result in significant increased GHG emissions or cause significant additional environmental impacts. Total potential emissions associated with the proposed project (0.041 Mt CO_2-e) represent approximately 0.4 % of the total emissions from the mining non-energy sector in Australia (9.2 Mt CO_2-e), and 0.007 % of total Australian emissions (597.2 Mt CO_2-e). As such, the contribution of the proposal to GHG emissions overall is not considered to be significant.

8.6 Conclusion

An AQIA was undertaken in accordance with the DECCW's Approved Methods (DEC, 2005). Maximum predicted pollutant GLCs on a gridded modelling domain and at identified sensitive receptors were compared against relevant guideline values. The modelling results show that odour, HF, gaseous Cl, SO_2 and H_2SO_4 mist all met the stated assessment criteria at the discrete sensitive receptors for both isolated and cumulative predicted GLCs.

The dust modelling results indicated that TSP GLCs and dust deposition met the assessment criteria for all modelled scenarios. In relation to PM_{10} the modelling indicated the following:

- The predicted 24 hour PM_{10} GLCs, in isolation from background concentrations and cumulatively, showed exceedances of assessment criteria for all scenarios (except scenario 1B (no quarrying activities) in isolation from background concentrations); and
- The predicted annual PM_{10} GLCs in isolation from background concentrations met the assessment criteria for all scenarios. The cumulative annual PM_{10} GLCs showed exceedances of assessment criteria for all scenarios (except scenario 1B).

Due to exceedances of PM_{10} GLC assessment criteria, mitigation measures would be included in the AQMP for the proposal to reduce dust impacts from the Project Site. Provided the mitigation measures outlined in **Section 8.4** are implemented as part of an AQMP to meet relevant assessment criteria, impacts in relation to dust are not expected to be significant.

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9.0 Noise

A Noise Assessment was undertaken to inform the EA. The assessment established the existing noise sources within the study area and identified potential sensitive receptors. Predicted environmental noise impacts of the proposed Project were established and assessed in relation to criteria determined in accordance with the DECCW's Industrial Noise Policy (INP).

9.1 Existing Environment

9.1.1 Noise Sensitive Receptors

Residences surrounding the Project Site and the receptor locations where noise predictions were carried out (i.e. noise sensitive receptors) are highlighted in **Figure 7** and listed below.

- R1 - Fuller Street (Lot 1 DP 838361)
- R2 - 255 Longleys Road
- R3 - 255 Lawson Road
- R4 - 217 Martin Road
- R5 - 225 Martin Road
- R6 - 82 Victor Avenue
- R7 - 80 Victor Avenue
- R8 - 70 Victor Avenue
- R9 - 50 Victor Avenue
- R10 - 32 Victor Avenue

It is noted that the residence at 225 Martin Road (R5) is owned by Boral. Consequently, Boral would have the option to unoccupy this residence and noise levels at this location do not strictly need to comply with the environmental noise criteria.

9.1.2 Existing Noise Environment

Environmental noise measurements were performed to quantify the existing noise environment at receptors in the area of the Project Site, and to allow determination of the applicable environmental noise criteria in accordance with the NSW INP.

Measurements were performed at 10 Victor Avenue and 210 Lawson Road, shown on **Figure 7** as these sites were considered representative of the typical noise environments present at the receptors potentially most-affected by noise from the proposed operations. Noise levels measured at 10 Victor Avenue are representative of the typical background noise levels at the Victor Avenue residences included in the assessment. The noise levels measured at 210 Lawson Road are considered to be generally representative of the background noise levels at the receptors to the north and west of the Project Site.

Rating Background Levels (RBLs) (L_{A90}) measured at these locations is shown in **Table 30**.

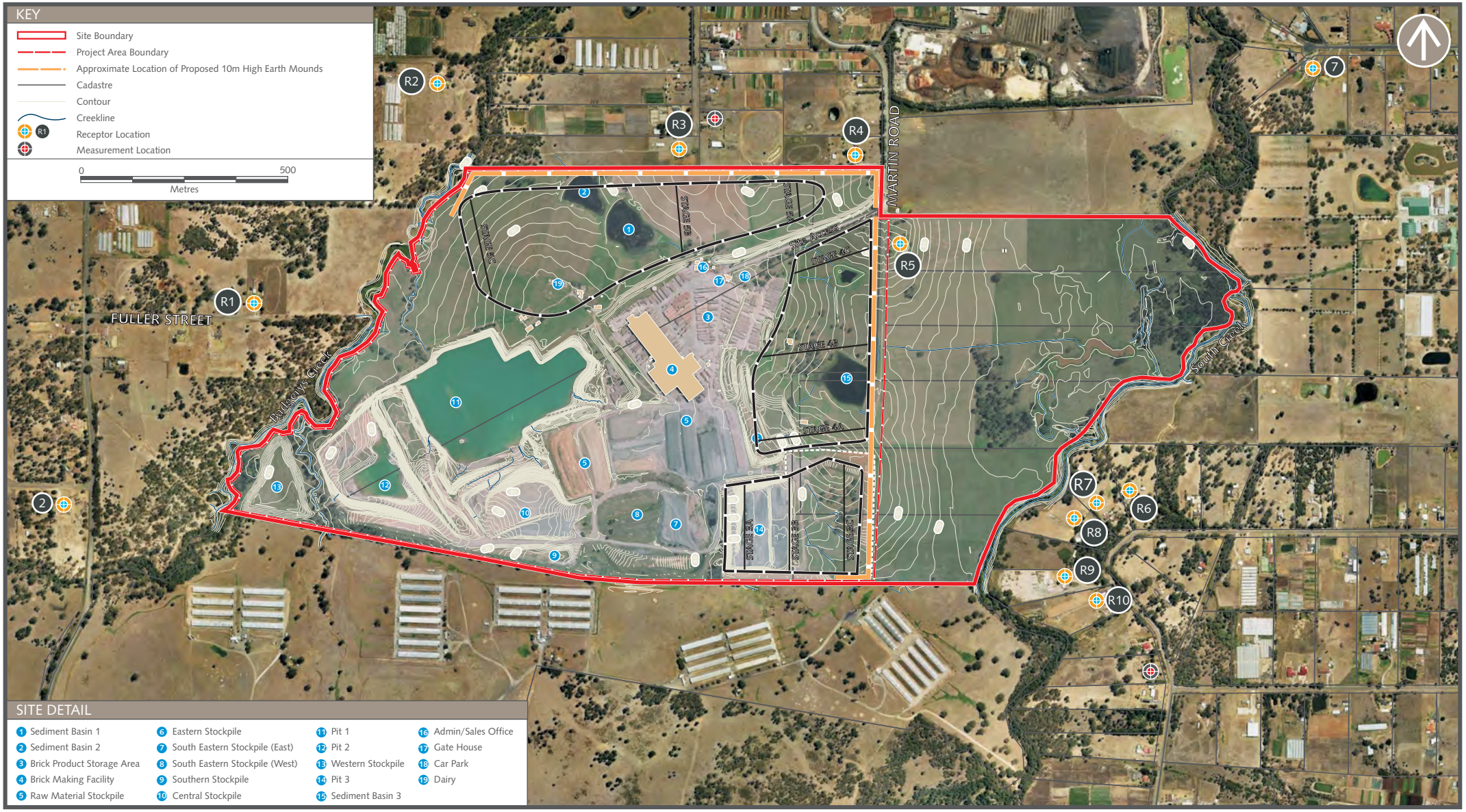
Table 30: Rating background Levels

Location	Rating Background Level (Tenth Percentile L_{A90})		
	Day	Evening	Night
10 Victor Avenue	35	33	30
210 Lawson Road	38	35	34

Notes:

The time periods presented in the tables above are as per the definitions provided in the INP:

- Day period is defined as 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays
- Evening period is defined as 6pm to 10pm on any day
- Night period is defined as 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.



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NOISE RECEPTORS, PROPOSED MITIGATION AND STAGING

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 7

The ambient noise environment at both measurement locations is typical of a rural residential setting, with noise from wildlife, vegetation, occasional traffic, and other rural residential activities, dominating the noise environment.

9.1.3 Environmental Noise Criteria

Operational Noise

The INP provides the relevant guidance in relation to acceptable noise limits for the proposed operations. Noise criteria determined in accordance with the procedures presented in the INP have therefore been used as the basis of the operational noise assessment. The assessment procedure used in the INP is comprised of two components, which are controlling intrusive noise impacts in the short term for residences and maintaining noise level amenity for residences and other land uses

Based on the measured background noise levels (RBL) at the sample locations as discussed previously and on the INP Intrusiveness and Amenity Criteria, operational noise criteria are presented in **Table 31** and **Table 32**. The criteria are formulated to satisfy the lower of the amenity and intrusiveness criteria for each time period.

Table 31 presents the operational criteria applied for the receptors located on Victor Avenue to the south east of the quarry, based on the background noise levels measured at 10 Victor Avenue. **Table 32** presents the operational noise criteria applied for all of the other receptors included in the assessment, based on the background noise levels measured at 210 Lawson Road.

Table 31: Operational Noise Criteria for Victor Avenue Receptors

Period	RBL (Tenth Percentile L_{A90})	Intrusiveness Criterion (RBL + 5 dB)	Ambient Noise Level (dB L_{Aeq})	Amenity Criterion (Ambient–10 dB)	Environmental Noise Criterion (dB L_{Aeq})*
Day	35	40	52	42	**40**
Evening	33	38	52	42	**38**
Night	30	35	51	41	**35**
Shoulder	37	42	60	50	**38****

* Represents the lower of the amenity and intrusiveness criterion for the time period.

** Mid-point between Daytime and Night-time criteria

Table 32: Operational Noise Criteria for all Other Receptors

Period	RBL (Tenth Percentile L_{A90})	Intrusiveness Criterion (RBL + 5 dB)	Ambient Noise Level (dB L_{Aeq})	Amenity Criterion (Ambient–10 dB)	Environmental Noise Criterion (dB L_{Aeq})*
Day	38	43	54	44	**43**
Evening	35	40	58	48	**40**
Night	34	39	46	36	**36**
Shoulder	40	45	51	41	**39****

* Represents the lower of the amenity and intrusiveness criterion for the time period.

** Mid-point between Daytime and Night-time criteria

In addition to the criteria presented for the time periods that normally apply under the INP (i.e. Daytime, Evening, and Night-time), morning “Shoulder” period criteria have been determined for the period between 6am and 7am. It is considered that this is justified in accordance with Section 3.3 of the INP, because the typical background noise levels measured between 6am and 7am are either at a similar level to the daytime background noise levels, or rising rapidly towards the daytime levels.

Operational noise criteria for the day time period is 40 (dB(A) L_{Aeq}) at Victor Avenue and 43 (dB(A) L_{Aeq}) at all other receptors, and 38 (dB(A) L_{Aeq}) at Victor Avenue and 39 (dB(A) L_{Aeq}) at all other receptors during the Shoulder period. The higher background noise levels during the shoulder period mean that it is unnecessarily stringent to apply the Night-time period noise criteria for operations between 6am and 7am. The rise in

background noise levels during and prior to this period is shown by the graphed noise measurement results presented in the Noise Assessment Report in **Appendix F** to the EA.

The "Shoulder" period criteria have been determined as the mid-point between Daytime and Night-time criteria, as suggested by Section 3.3 of the INP. The "Shoulder" period criteria resulting from this approach are less than the criteria that would be calculated for the period if the normal method for determining criteria under the INP (as used for the other periods) is applied. On this basis it is considered that the approach of taking the mid-point between Daytime and Night-time criteria is slightly conservative but appropriate.

Construction Noise

Under the definitions provided in the INP, it is considered that temporary noise associated with the construction of noise mitigation measures that may be required to control noise from the proposed activities (e.g. earth mounds), would be classified as a construction activity and would therefore not be covered by the INP. Noise from these types of activities would therefore be assessed in relation to the guidelines presented in the *NSW Interim Construction Noise Guideline* (ICNG), as maintained by the DECCW. The ICNG are structured towards managing the impact of construction noise as far as is feasible and reasonable, rather than specifying strict construction noise limits.

For residential receptors and work within "standard" construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday), the ICNG sets the Management Level equal to the RBL (as determined in accordance with the INP) plus 10 dB. Outside of "standard" construction hours, the Management Level for residential receptors is equal to the RBL plus 5 dB.

Based on the established RBLs for the area, the Management Levels for the receptors in the vicinity of the quarry are as follows:

Table 33: Construction Noise Management Levels

Location	Management Level, dB $L_{Aeq,15min}$	
	Standard Construction Hours (7am-6pm Mon-Fri, 8am-1pm Sat)	Outside Standard Construction Hours
Victor Avenue Receptors	45	40 (1pm to 6pm Saturday) 38 (6pm to 10pm Monday to Saturday) 35 (All other times)
All Other Receptors	48	43 (1pm to 6pm Saturday) 40 (6pm to 10pm Monday to Saturday) 39 (All other times)

Where the construction noise levels are predicted to exceed the Management Level at any given receptor, the receptor would be considered to be "noise-affected" and the noise management procedures outlined in the INCG should be implemented.

Where construction noise levels are predicted to be in excess of 75 dB $L_{Aeq,15min}$ at any given receptor, the receptor would be considered to be "highly noise-affected". In this case, the ICNG allows for the relevant authority (consent, determining or regulatory) to require respite periods by restricting the hours when very noisy activities can occur.

Traffic Noise

The changes in traffic noise levels along public roads, as a consequence of changes in traffic movements generated by the proposed continuation of operations, has been assessed using the DECCW's document *Environmental Criteria for Road Traffic Noise* (ECRTN).

Traffic noise was assessed on Martin Road only as it was considered that traffic generated by the Project would be insignificant in comparison to the existing traffic volume on arterial roads such as Elizabeth Drive and would give rise to negligible changes to the noise levels.

Table 34 sets out the DECCW's road traffic noise criteria for land use developments with potential to create additional traffic on existing roads. The external criteria are applied at 1 metre from the affected residential building façades.

Table 34: Land use developments with the potential to create additional traffic on existing roads traffic noise criteria

Road Classification	Period	Parameter	Criterion, dB(A)
Local	Day (7:00 am to 10:00 pm)	$L_{Aeq(1hr)}$	55
	Night (10:00 pm to 7:00 am)	$L_{Aeq(1hr)}$	50

Notes:

In cases where noise from an existing road already exceeds the above criteria:

(1) The DECCW recommends that "where feasible, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments."

(2) In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB(A).

9.2 Methodology

The noise model considers noise from the Project Site and the worst case scenario for noise generated from the Project Site has been adopted for the purposes of the assessment. The modelling has included a review of historical meteorological data to establish and factor the predominant conditions into the modelling.

9.2.1 Quarry

The noise impact from the quarry would vary as the quarrying location progresses over the life of the proposed operation. To allow assessment of the changing noise levels as the quarry progresses, noise from the quarry was modelled for nine separate stages during the life of the proposed operation. These stages are noted in the bullet points below and shown in **Figure 7**:

- Stage 3A – Pit 3, early life.
- Stage 3B – Pit 3, mid life.
- Stage 3C – Pit 3, late life.
- Stage 4A – Pit 4, early life.
- Stage 4B – Pit 4, mid life.
- Stage 4C – Pit 4, late life.
- Stage 5A – Pit 5, early life.
- Stage 5B – Pit 5, mid life.
- Stage 5C – Pit 5, late life.

For each stage, the processes of overburden removal and clay / raw material extraction were modelled in separate scenarios. The modelling adapted a worst case noise scenario that included locating equipment working in tandem within the pits towards the sensitive receptors and operating at existing ground level for the process of overburden removal. Using this approach, the predicted noise levels from the quarry pits can be considered to represent the maximum levels that would typically be expected for each stage of the quarry. Generally, noise levels from the quarry pits could be expected to be marginally less than those predicted by the model.

It was also assured that equipment would only operate in the quarry during the Day assessment period (7am to 6pm Monday to Saturday).

9.2.2 Brick Making Facility and Storage Yard

The brick making facility would operate 24 hours per day, seven days per week (as per current operations), and the storage yard from 6am to 10pm Monday to Friday, and 6am to 6pm on a Saturday.

For the purpose of the noise modelling, the maximum number of plant items likely to operate on a typical basis in any given assessment period (Day, Evening or Night as defined by the INP) was considered.

The modelling included both vehicles and fixed plant associated with the brick making facility based on site observations and noise measurements performed by AECOM during a site visit in November 2009.

No account has been made in the modelling for the potential shielding effects of stacked bricks in the storage yard. It is anticipated that the heights and location of the bricks in the storage yard could vary considerably over

the life of the quarry, and therefore acoustic shielding from the bricks cannot be relied upon as a noise control measure. However, it is expected that some acoustic shielding would generally result from the stacked bricks in the storage yard, and therefore the model may slightly over-predict the noise levels due to the brick making facility and storage yard.

9.2.3 Site Access Road

AECOM's Traffic Impact Assessment Report indicates that the number of vehicles using the access road would be highest on weekdays. The Traffic Impact Assessment Report prepared as part of this EA states that 60 trucks per weekday would travel along the site access road to the storage yard and brick making facility, and 76 employee vehicles per weekday would travel along the site access road to the employee car park.

Noise from the site access road has been modelled as a line source. In the model, the line source extends the full length of the access road from Martin Road to the storage yard, and includes a loop around the storage yard, to simulate the path that trucks would typically take on their way to / from being loaded (employee vehicle noise has not been included in this loop since the employee car park is located before the storage yard on the access road).

The sound power level of the line source has been calculated using the methodology presented in Equation D.6 of the British Standard 5228-1:1997 (Refer to **Appendix F**).

In order to make the model representative of the maximum noise impact that would typically occur due to vehicles on the site access road, the calculation of the line source sound power level has been based on the expected peak vehicle flow rates along the access road for each assessment period. Based on the data presented AECOM's Traffic Impact Assessment Report, the peak vehicle movements on the access road were modelled as follows:

Table 35: Peak Vehicle Movements Modelled for Each Assessment Period

	Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 6am)	Night-time (6am to 7am)
Truck Movements Per Peak Hour	12	12	0	12
Employee Vehicle Movements Per Peak Hour	6	6	6	6

Typical vehicle speed on the access road has been modelled as 30 km/h.

9.3 Potential Impacts

9.3.1 Noise Modelling Results

Details of the Predicted Operational Noise Levels without mitigation are provided in Section 6.0 of the *Noise Assessment Report* in **Appendix F**, and discussed as follows.

Quarry

Noise levels at the Victor Avenue receptors are predicted to exceed the criterion during quarrying in Pits 3 and 4. The highest noise levels at Victor Avenue are predicted to occur when quarrying is being performed near to the end of the life of Pit 3 (Stage 3C). At that time, noise levels at the Victor Avenue receptors are predicted to be up to 7 dB in excess of the noise criterion.

Noise levels at the other receptors considered in the assessment are also predicted to exceed the noise criterion at certain stages during the life of the proposal. Most notably, the noise levels at 217 Martin Road, 225 Martin Road, and 255 Lawson Road are predicted to be up to 30 dB in excess of the criterion during the late stages of Pit 4 through the mid stages of Pit 5. There are also a number of other residences around these locations, which are not included in the model, but would be similarly affected by noise from the quarry. Noise reduction measures would therefore be required in order to comply with the noise criterion at these locations.

Noise levels at the receptor at Fuller Street are predicted to be slightly in excess of the noise criterion for most of the life of the proposed expansion. This would primarily be due to noise from the bulldozer and other mobile plant working on the overburden dump and western stockpile.

Noise impacts may also result from warning beepers on vehicles and equipment at the Project Site, which would be audible at some or all of the most-affected locations at certain times. Particularly affected residencies are likely to be 217 Martin Road (and the other residences near to this location), 225 Martin Road, and 255 Lawson Road (and the other residences near to this location). An additional +5 dB noise adjustment is therefore required at these residencies under the INP.

Brick Making Facility

Noise levels due to Evening period operations (6pm – 10 pm) at the brick making facility and brick product storage yard are predicted to exceed the noise criteria at 225 Martin Road and 255 Lawson Road without mitigation under neutral meteorological conditions, due primarily to trucks using the access road. However, it is predicted that noise from forklift operations in the area of the brick making facility and storage yard would also contribute to noise levels. Noise from the brick making facility between the hours of 10pm and 6am is predicted to comply with the Night period noise criteria under neutral meteorological conditions for all locations except 255 Lawson Road, which would be only marginally in excess of the criterion. However, between 6am and 7am, the noise levels at 217 Martin Road, 225 Martin Road, and 255 Lawson Road (40, 49 and 44 dB(A) L_{Aeq} respectively) would exceed the Night period noise criterion of 36 dB L_{Aeq}. Background noise levels are rapidly increasing towards normal daytime levels during this period and can be therefore be considered a “shoulder” period by the INP and as such it is considered that it may be unduly stringent to apply the Night period criterion.

An appropriate criterion considered for this project would be the mid value between the Day and Night period criteria i.e. 39 dB L_{Aeq} for the receptors concerned. It is noted that even if a shoulder period criterion of 39 dB L_{Aeq} is applied, the predicted noise levels at 217 Martin Road, 225 Martin Road, and 255 Lawson Road (40, 49 and 44 dB L_{Aeq} respectively) would still not comply with the criterion without taking measures to reduce the noise levels at the affected receptors.

Traffic Noise

The Traffic Impact Assessment Report (AECOM, January 2010) predicted that the number of daily traffic movements generated by the Project would not increase compared with the existing operations owing to the installation of a Dehacker at the brick making facility. The Dehacker improves the efficiency of brick transport by packing bricks more efficiently enabling a greater quantity of bricks to be transported by truck. The forecast changes in traffic movements due to the project are predicted to result in a slight reduction in the maximum $L_{Aeq(1hr)}$ traffic noise levels on Martin Road. As such, traffic noise from public roads generated by vehicle movements associated with the proposed operation would be no greater than the existing case, and would comply with the traffic noise criteria.

Due to the different hours of operation, the peak hour traffic volumes are predicted to change. Under the ECRTN, traffic noise generated by the project is to be assessed in terms of the $L_{Aeq(1hr)}$ noise levels. The highest $L_{Aeq(1hr)}$ traffic noise levels would occur during the peak hour traffic flow, and therefore it is appropriate to assess the traffic noise impact of the Project in relation to the peak hour traffic flows.

Based on the peak hour traffic volumes predicted in the Traffic Impact Assessment Report, the changes in the traffic noise level from Martin Road have been predicted. **Table 36** presents the changes in peak hour traffic movements on Martin Road as discussed in the Traffic Noise Assessment Report, along with the predicted changes in traffic noise level.

Table 36 Predicted Changes in Noise Level from Martin Road

Peak Hour Vehicle Movements due to Existing Operation, (veh/hr)	Total Existing (2009) Peak Hour Traffic on Martin Road Including Existing Operations, (veh/hr)	Peak Hour Vehicle Movements due to Proposed Continuation of Operations, (veh/hr)	Total Peak Hour Traffic on Martin Road Including Proposed Operations, (veh/hr)	Percentage Change in Traffic Volume on Martin Road due to Proposed Continuation of Operations	Predicted Change in Traffic Noise Level
28(1)	43(2)	24(3)	39(4)	-10%	-0.4 dB(A)

Notes:

(1) 16 truck movements plus 12 employee vehicle movements per peak hour (Source: AECOM Traffic Noise Assessment Report, January 2010.
(2) From AECOM Traffic Noise Assessment Report, January 2010
(3) 12 truck movements plus 12 employee vehicle movements per peak hour (Source: AECOM Traffic Noise Assessment Report, January 2010.
(4) Calculated as the existing 2009 peak hour traffic on Martin Road plus difference between the peak hour vehicle movements due to the existing and proposed operations.

Traffic noise resulting from project-generated traffic movements must not exceed the specified $L_{Aeq(1hr)}$ criteria, or, where the existing noise levels exceed the criteria, project-related traffic must not increase the existing noise levels by more than 2 dB(A).

The forecast changes in traffic movements due to the project are predicted to result in a slight reduction in the maximum $L_{Aeq(1hr)}$ traffic noise levels on Martin Road. As such, traffic noise from public roads generated by vehicle movements associated with the proposed operation would be no greater than the existing case, and would therefore comply with the traffic noise criteria.

9.4 Mitigation Measures

The following noise mitigation measures would be implemented to ensure that noise levels resulting from the proposed operations comply with relevant noise criteria.

9.4.1 Earth mounds

Two 10 m high earth mounds would be constructed along the northern and eastern Project Site boundary, wrapping around to the western boundary for a length of 150 m and extending along the southern boundary for 100 m, as illustrated in **Figure 7** and Figure 10 of the Noise Assessment Report in **Appendix F**. The earth mound is to be constructed in stages as specified in **Figure 7** of the EA and Figure 12 of the *Noise Assessment Report.*

Construction of the 10m high earth mounds, in combination with one or more of the noise control methods discussed below, is considered to be the most suitable approach to achieve satisfactory noise levels at the Victor Avenue receptors.

Noise levels during the construction of the earth mounds would, at certain times exceed the Management Levels recommended in the ICNG, however these works would be temporary and transient in nature.

9.4.2 Construction Work Hours

Construction works associated with the earth mound within 300 m of any residences, shall be limited to 7am to 6pm Monday to Friday and 8am to 1pm on Saturdays.

9.4.3 Mobile Plant Noise Reduction

Noise from mobile plant in the quarry is predicted to be the main contributor to daytime quarry noise levels at receptors. Noise reduction could be achieved by acoustically treating mobile plant by:

- Enclosure of the engine within an acoustic enclosure and/or sealing of gaps around the engine bay;
- Use of acoustic louvres / treatments on engine air intakes and cooling air exhausts;
- Installation of high attenuation engine exhaust mufflers; and/or

- Lining of the trays/bodies of dump trucks with high impact rubber to reduce loading noise, or using specially designed suspended dump bodies (e.g. Duratray).

Implementation of some of the above treatments in combination with the use of the 10m high earth mound would satisfy the noise criteria at all locations except 255 Lawson Road, during all stages of the quarry life. At 255 Lawson Road, the noise levels during quarrying of the middle stages of Pit 5 may still be marginally (2 dB) over the noise criterion for that location. This exceedence is considered to be insignificant and would occur for a limited time period.

9.4.4 Use of Alternative Vehicle Movement and Warning Alarms

Alternative vehicle movement and warning alarms could be utilised at the Project Site such as broadband movement and warning alarms on mobile plant rather than beepers, proximity sensing alarms that operate at low level (or not at all) until a person or object is sensed in the immediate proximity of the vehicle and/or vibrating safety vests activated by proximity to moving plant. These measures would reduce the +5 dB tonality adjustment required by the INP, which may apply at 217 Martin Road (and the other residences near to this location), at 225 Martin Road, and at 255 Lawson Road (and the other residences near to this location), if conventional vehicle movement and warning beepers were to be used.

9.5 Conclusion

The Noise Assessment undertaken for the subject site found that a number of residences to the north, west, 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 fully implemented, it is predicted that noise from the Project Site would generally comply with the INP noise criteria.

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10.0 Surface Water

This Chapter describes the existing water environment on the Project Site in the context of surrounding catchments and sub catchments. The Chapter looks at the effectiveness of the existing water management system on the Project Site for managing water flows and water quality both on and off site and assesses the potential impacts of the continuation of quarrying and brick making operations in terms of water quality and surface water management. Mitigation measures are identified to minimise the impact of the Project on the surrounding water quality where appropriate.

10.1 Existing Environment

10.1.1 Catchments

The Project Site is situated within the Hawkesbury Nepean Catchment, with a total area of approximately 22 000 km² (2.2 million hectares) and which covers the majority of the western half of the Liverpool LGA extending west to the Hawkesbury Nepean River (the Liverpool LGA boundary). It includes two sub catchments, the South Creek catchment and Upper Nepean catchment.

The Project Site is located within the South Creek sub catchment which is part of the greater Hawkesbury Nepean catchment area. The South Creek sub catchment covers an area of 620 km² and is mostly made up of small rural farms and residential houses. The portion of South Creek sub catchment in the Liverpool LGA includes three major creeks -Kemps Creek, South Creek and Badgerys Creek. The main issues affecting the South Creek sub catchment include loss of vegetation, poor water quality and high soil salinity.

The main channel of South Creek is in a predominantly unmodified state as are its main tributaries, including Ropes Creek, Kemps Creek and Eastern Creek (RTA, 2002).

The Project Site rises within the central (65 m AHD) and southern (80 m AHD) site portions, and falls towards South Creek to the east (45 m AHD) and towards Badgerys Creek (50 m AHD) to the west.

10.1.2 South Creek

South Creek flows into the Hawkesbury River east of Windsor. It enters Liverpool LGA from the south and flows north for some 11 km before entering Fairfield LGA. South Creek forms the eastern property boundary of the Project Site and has a small tributary in the eastern portion of the Project Site.

South Creek is an intermittent creek of average health whose topsoil consists of brown, silty sand and clay. The creek has a very gentle slope and contains stagnant water with floating vegetation. There is frequent erosion along the river edge and banks contain weeds. The creek is used to water cattle which graze on the eastern portion of the Project Site.

The tributary of South Creek in the eastern portion of the Project Site is also of average health and has isolated connectivity. The topsoil of the area comprises mottled brown clayey silts with no erosion evident. Weeds are dominant and the tributary is used to water stock.

10.1.3 Badgerys Creek

Badgerys Creek is also located within the South Creek sub catchment and 7 km of Badgerys Creek is within the Liverpool LGA. The western property boundary of the Project Site adjoins Badgerys Creek and a small tributary of Badgerys Creek is located in the south-western portion of the Project Site, between the western stockpile and Pit 2 (see **Figure 4**) (Liverpool City Council, 2009).

Badgerys Creek is a permanent creek of average health whose topsoil consists of fine grained, orange-brown sandy silt. There is scattered erosion in this area, frequent weeds and a few dead trees.

The Badgerys Creek tributary is a seasonal or intermittent creek of poor health with eroded banks and large areas of weeds. Topsoil comprises grey, silty, sandy clay soils.

10.1.4 Flood Prone Areas

Current quarrying operations on the Project Site are located outside of the flood prone areas identified on LCC flood maps and the SWGC Flood Zone Map. However, a portion of the Project Site that is east of Martin Road is located within the South Creek floodplain and the western site boundary along Badgerys Creek is located within the Badgerys Creek floodplain (see **Figure 8**). The Western stockpile located in the south west corner of the Project Site is within the Badgerys Creek floodplain has been in its current location since 2002 and has been rehabilitated to provide a stabilised final landform. The dimensions of the Western stockpile would not change as a result of the proposal.

10.1.5 On Site Drainage

Existing surface water flow on the Project Site is shown on **Figure 8**. Within the disturbed area, there are seven sub catchments including:

- **Sediment Basins 1 and 2**

  The catchment of Sediment Basin 1 includes the area around the brick making facility, gate house, pallet storage area and a small overland flow component. Sediment Basin 1 has a total catchment area of 17.3 ha.

  Capacity exists for runoff from Pit1 to be pumped into Sediment Basin 1 on an as required basis in order to maintain the volume of Pit 1.

  Sediment Basin 1 overflows into Sediment Basin 2. Sediment Basins 1, 2 and 3 are used for stock watering and irrigation of pasture as part of the dairy operation.

  There are also additional minor sediment basins at the bases of several of the stockpiles on the Project Site. These sediment basins aid sediment removal from site runoff and reduce the volume of run-off entering the Project Site water management system. In larger rainfall events, these additional sediment basins are submerged and run-off flows via roads and open grassed channels to Pit 1.

- **Pit 1**

  Pit 1 has the largest catchment on site, comprising 37.2 ha. Pit 1 contains a basin and a floating off-take pump. Runoff from the unusable material and overburden stockpiles to the south of Pit 1 drain to the Pit 1 Basin. During minor rainfall events runoff ponds in localised areas or smaller sediment basins, however during larger rainfall events the minor sediment basins are submerged and run off flows to Pit 1 via roads and open grassed drains. Surface water detained in Pit 1 is either transferred to Sediment Basin 1 via the off-take pump, remains stored within the pit or is used for dust suppression across the Project Site.

- **Pit 2**

  Pit 2 is currently being rehabilitated. It contains a sediment basin and pump out facilities. Runoff flowing to Pit 2 is pumped into Pit 1.

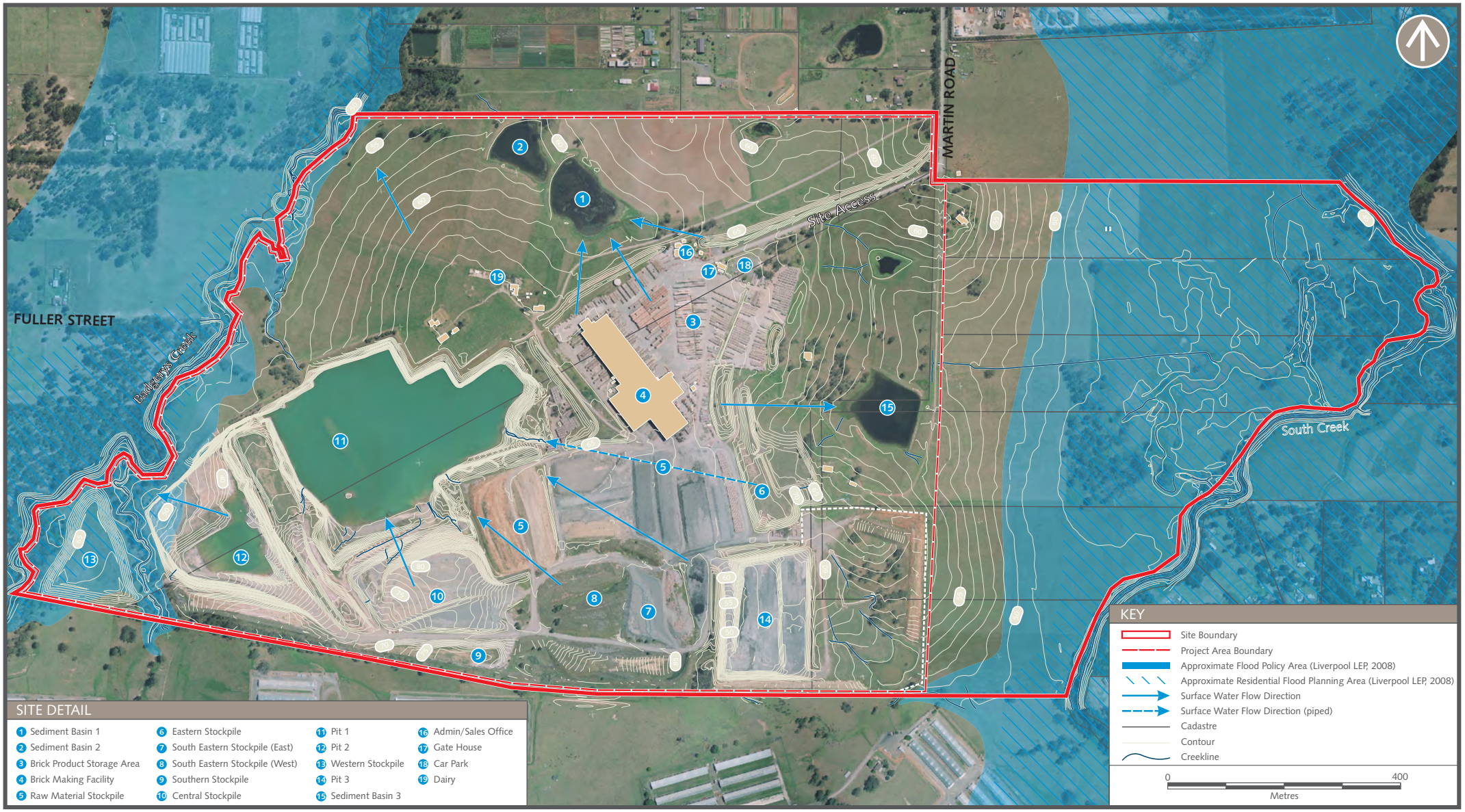
- **Pit 3**

  Pit 3 is the active pit where quarrying is currently occurring. Water collected in this pit is pumped to Pit 1.

- **Brick making facility**

  Roof drainage from the brick making facility flows via the gutter, downpipe, external perimeter open drain, pipe, then grass swale to Sediment Basin 3. Sediment Basin 3 is used as a stock watering point by the on-site dairy farming operation. Sediment Basin 3 also has an overland flow catchment.

  Areas surrounding the brick making facility drain separately, with the northern side draining to Sediment Basin 1 via a slotted agricultural pipe, and the southern part draining via an access road and a culvert into Pit 1.



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EXISTING SURFACE WATER MANAGEMENT

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 8

- **Western Stockpile**

  The Western stockpile drains to both Badgerys Creek and a Badgerys Creek tributary and is at a lower elevation than the surrounding site.

  Rehabilitation of this stockpile was undertaken in March 2006 to prevent runoff and sediment from entering Badgerys Creek and the Badgerys Creek Tributary. This rehabilitation involved sediment fencing, earthworks (including slope reshaping, crest bunding and contour deep ripping), waste amelioration (including the use of gypsum, the use of chicken manure as a topsoil alternative, final ripping/scarification) and revegetation (including pasture establishment and native woodland establishment).

- **South East Drain**

  A section of the southern end of the raw material stockpiling area, a section of road and an unusable material stockpile drain to the south via a grassed open drain and culvert. During minor rainfall events localised ponding may occur and during larger events discharge is controlled through bunding.

- **East Drain**

  Runoff from the eastern stockpile and the raw material stockpiles runs through dish drains and is piped into Pit 1. The Eastern stockpile is vegetated to control erosion. The raw material stockpiles are generally used within a 12 month period and show no signs of significant erosion.

The majority of run-off from the Project Site flows to Pit 1 or Sediment Basin 1. Runoff collected within Pit 1 is reused for dust suppression during quarry campaigns on Project Site and Sediment Basins 1, 2 and 3 are used for stock watering and irrigation of pasture as part of the dairy operation. There is no stormwater discharge offsite.

10.1.6 Sewage Disposal

Sewage is discharged from the plant, gate house office and Project Site office to three septic tanks. The site office and plant septic tanks are connected to absorption trenches located west of the brick making facility. Retained solid effluent from the gate house and site office septic tanks is pumped out on a monthly basis by a licensed contractor and biannually from the Plant as required.

10.1.7 Truck Washing Facility

The truck wash facility located in the central north portion of the Project Site, north east of Pit 1, captures dirty water in an oil and water separator. Clean water from this area is piped back to the brick making facility.

10.2 Potential Impacts

Operation of the quarry and brick making facility would involve activities largely the same as those currently carried out on the Project Site, however the proposed works would result in the loss of some existing water storage and the creation of additional voids (expanded Pit 3, Pit 4 and Pit 5).

The establishment of Pits 4 and 5 would result in the loss of Sediment Basins 1, 2 and 3 and the continued rehabilitation of Pit 2 would ultimately result in a change to the landform in the western portion of the Project Site, such that the existing void would be filled to just above ground level. This would also result in potential impacts to stormwater runoff.

10.2.1 Stormwater Runoff

In order to manage stormwater runoff and achieve nil discharge from the Project Site as under existing operations, runoff currently draining to Sediment Basins 1, 2 and 3 would be diverted to Pit 1 for storage and use for dust suppression.

The proposed project would ultimately result in the following changes to site drainage although these would occur in stages over the life of the project:

- Diversion of drainage of brick making facility and surrounding sealed area;
- Total site operating area to increase from 64 hectares to approximately 114 hectares;
- Pit 3, Pit 4 and Pit 5 to have surface areas of approximately 8.9, 14.2 and 19.5 hectares respectively;
- Pit 3 and Pit 4 to be used as water storage pits post quarrying;

- Pit 5 to be pumped to Pit 4 for storage during active quarrying;
- Either infrastructure to be installed to enable Pit 1 to spill to Pit 4 and Pit 4 to spill to Pit 3, or catchment plan to be reconfigured to reduce Pit 1 catchment area and increase Pit 3 and Pit 4 catchment area; and
- Water captured in Pit 1 to be used for increased dust suppression as per AQMP. Boral to actively investigate and pursue opportunities for the reuse of this water for other beneficial purposes.

Figure 9 illustrates proposed surface water management on the Project Site.

Water Balance Modelling

As part of the EA, water balance modelling was undertaken based upon a single 'worst case scenario' represented by the full development of Pits 4 and 5. The objective of the modelling exercise was to assess the ability of the Project Site to provide on-site water retention with no offsite discharge. The model comprised two components:

- Estimating the storage capacity required to contain runoff from the individual design rainfall event (90th percentile, 5 day) as required by the EPL; and
- Water balance modelling to develop strategies for achieving no offsite discharge over a 10 year rainfall period.

Modelling Approach

The modelling approach is described in detail in the *Addendum to Badgerys Creek Brick Works Soil and Water Management Plan* (AECOM, 2010), included as **Appendix C** to this EA. Modelling was undertaken in accordance with *Managing Urban Stormwater: Soils and Construction – Mines and Quarries* (DECC, 2008) which 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 37**.

Table 37: 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	Controlled extraction of water for dust suppression or to manage storage levels

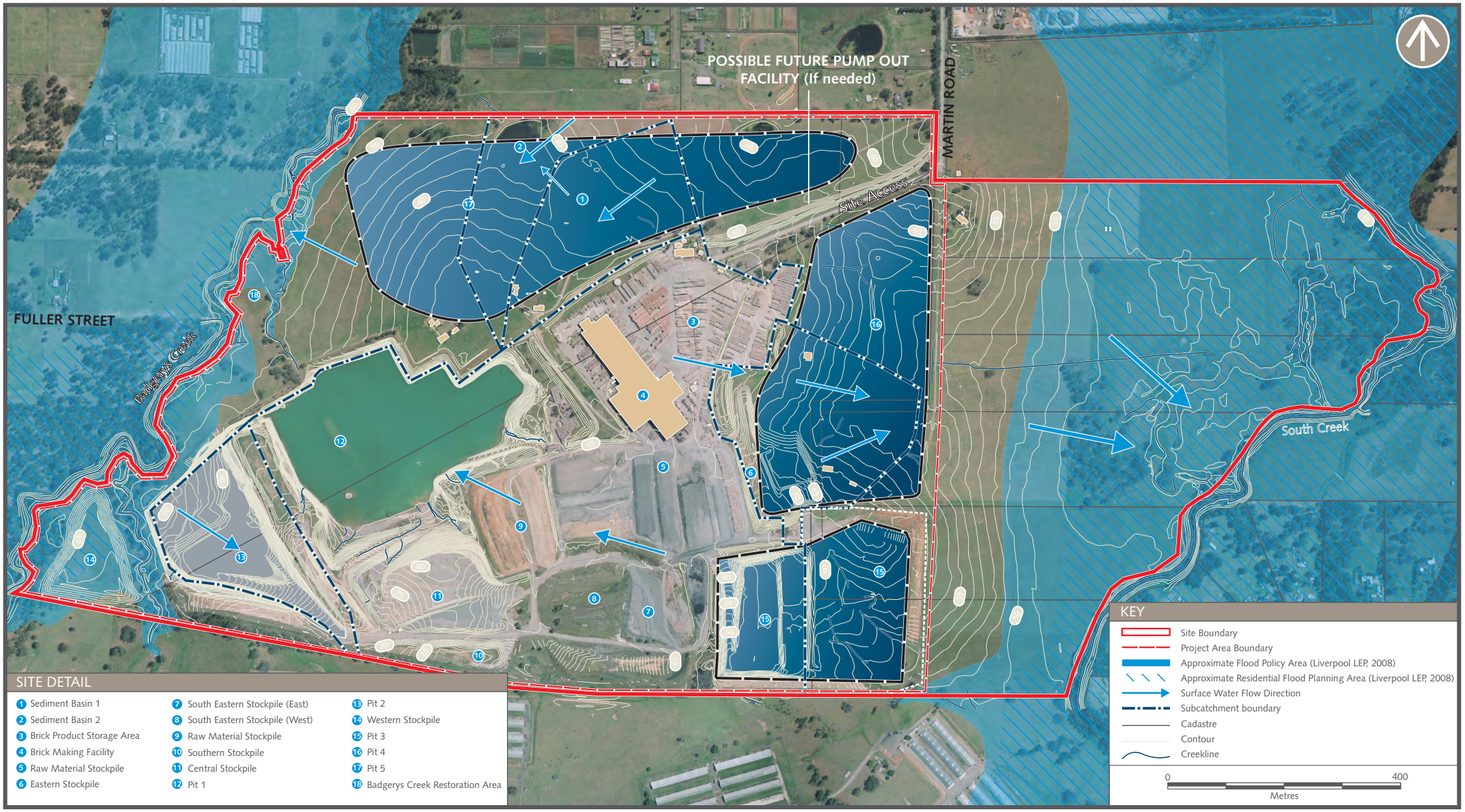
Modelling Results

The results of modelling in relation to the available storage capacity to accommodate an individual rainfall event as required by the EPL for the Project Site are summarised in **Table 38**.

Table 38: Available site storage capacity required to comply with EPL requirement

Catchment	90th Percentile, 5 day Volume (m^3)
Pit 1	5368
Pit 3	3030
Pit 4	4377
Pit 5	7408
Impervious	2939
Other Pervious	18405
Total	**41528 (42ML)**

Allowing for sediment loading over 20 years for the 'worst case scenario', all pits have capacity to contain runoff of approximately 42 ML from a 90th percentile, five day rainfall event at the Project Site.



AECOM

PROPOSED SURFACE WATER MANAGEMENT

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 9

Detailed results of ten year water balance modelling for the Project Site are provided in **Appendix C**. The results indicate that the combined capacity of Pit 1, Pit 3 and Pit 4 is sufficient to contain site runoff without offsite discharge post development of Pit 4 and Pit 5, subject to a reconfiguration of the catchment plan or the installation of infrastructure to enable Pit 1 to spill to Pit 4 and Pit 4 to spill to Pit 3.

Based upon this arrangement, the level of on-site storage would be sufficient to contain runoff on the Project Site without discharge for ten years. Beyond ten years the combined storage level of these pits would eventually reach capacity, however, once operations at Pit 5 are complete, significant additional storage would be available in this void. In addition, the extraction regime applied on the Project Site could be adapted to assist with the management of storage levels and spill risk. Extraction regimes can reduce the risk of uncontrolled offsite discharge by stabilising storage levels. A daily extraction regime may include a future reuse project where stored runoff is frequently used in the brick making process or for reuse at other premises offsite. Currently 30 kL/day of water is extracted from Pit 1 for reuse onsite for dust suppression.

Due to the low level of reuse currently proposed for captured runoff, storage levels in pits are generally likely to rise over time, and a storage solution alone would likely exceed the capacity of Pits 1, 3 and 4 over a 10-15 year outlook for the 'worst case scenario'. It is important to note however that the conservative 'worst case' scenario represents the largest likely total catchment area post development of Pit 4 and Pit 5, and assumes infiltration from storage pits to be negligible. It is also important to note that the existing Pit 1 has contained onsite runoff for many years without spill.

Given the transition from the current catchment configuration to the potential 'worst case' scenario is likely to occur over the next 5-10 years and the quarrying of Pit 5 is expected to provide additional storage capacity in the next 10-15 years, the proposed storage is considered sufficient to contain runoff without site discharge for the next 20 years.

It is noted that the WM Act identifies basic landholder rights including harvestable water rights and when access licences are required. The harvestable water right has been defined in terms of an equivalent dam capacity, the Maximum Harvestable Right Dam Capacity (MHRDC). Schedule 1 of the *WM Regulation* 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. Consequently, as the on-site pits (dams) are used solely for the capture, containment and reticulation of drainage, consistent with best management practice to prevent the contamination of Badgerys Creek, the pits (dams) are exempt from the need to obtain a licence under the WM Act.

10.2.2 Water Quality

To date there have been no recorded discharges from the Project Site with the majority of run-off from the Project Site flowing to Pit 1 or Sediment Basin 1, where it is used for stock watering, irrigation, dust suppression or is simply stored.

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 on the Project Site 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, potentially resulting in increased turbidity and degradation of water quality; and
- Increased potential for contamination of soil and water resulting from accidental spillage of fuel from vehicles or machinery entering nearby waterways.

As the Project Site would remain a nil discharge site with surface water runoff fully contained on site, the proposal would not impact on the water quality of either Badgerys or South Creeks.

10.2.3 Flooding

Current quarrying operations on the Project Site and the proposed future quarry Pits 4 and 5 are outside of the flood prone areas identified on Council's flood maps and the SWGC Flood Zoning Map (refer to **Figure 8**).

As the location of future quarrying is not within the South Creek or Badgerys Creek floodplains, the proposal would not have a significant impact on the natural functioning of the floodplain and the quarry pits themselves would not be at significant risk from flooding.

The Western stockpile located in the south west corner of the Project Site is within the Badgerys Creek floodplain and has been in its current location since 2002. The dimensions of this stockpile would not change as a result of the proposal and therefore would not impact on existing flood storages.

10.3 Mitigation Measures

Soil and water management on the Project Site is well established and the existing operation is managed under a SWMP with nil discharge to the receiving environment. The SWMP investigated the existing stormwater catchment areas and identified management measures which have been implemented on the Project Site. These management measures include bunding, silt fences, an emergency spill kit and stormwater reporting sheets for monitoring purposes. As part of this EA, the SWMP has been updated via an addendum to reflect the proposed future operations over the next twenty years (**Appendix C**) and includes recommendations with regard to the management of stormwater runoff over the life of the project, including:

- Reconfiguration of the catchment to proportion runoff going to storage pits according to their storage capacity. This would maximise the timeframe before spills would occur in the proposed storage pits. For Pit 4, this could be achieved by regrading the area between Pit 4, Pit 5 and Pit 1 to flow to Pit 4, in addition to draining Pit 5 to Pit 4. For Pit 3, this could be achieved by regrading part of the eastern and south eastern stockpiles to drain to Pit 3.
- As an alternative to catchment reconfiguration, infrastructure could be installed to allow Pit 1 to spill to Pit 4 and Pit 4 to spill to Pit 3.
- Investigation of options for the reuse of water stored on-site for beneficial use in order to increase the extraction regime to improve on-site storage capacity. The potential for managing storage levels through adapting the extraction regime onsite is discussed in **Appendix C.**
- Monitoring of storage levels in Pits1, 3 and 4 such that spill risk is managed and the need for additional storage and/or extraction can be readily identified.

Additional mitigation measures to be implemented on the Project Site in relation to proposed operations include:

- The continued use of drains, silt fences and bunding to direct site runoff into appropriate sediment basins and to control erosion;
- Stabilisation of disused stockpiles to minimise the risk of erosion;
- Diversion of stormwater runoff from Sediment Basins 1, 2 and 3 to Pit 1 upon establishment of Pits 4 and 5;
- The use of flocculants in sedimentation basins to increase sediment removal rates if required;
- The removal of oil and grease within the sediment basin by volatilisation if required;
- The maintenance of a riparian corridor of 50 m in width along Badgerys Creek;
- Routine maintenance and inspections of drains, sediment basins and bunds; and
- The continued use of a combination of town water and recycled water for the brick making process.

10.4 Conclusion

The potential water quality and management impacts associated with the proposed project include an increase in the volume of on-site water storage required as a result of the project as the Project Site would continue to operate with nil offsite discharge.

The increased risk of sediment-laden runoff entering nearby waterways due to increased surface disturbance and increased duration of the existing quarrying activities at the Project Site would be significantly reduced by the containment of water onsite. The project is therefore not expected to have significant impacts on surface water on the Project Site or in the surrounding waterways subject to the maintenance and augmentation of water management measures.

11.0 Groundwater

Based on review of existing data, a conceptual model of the hydrogeological regime within the Project Site has been developed. This section discusses the conceptualisation and data used to develop the model as well as potential impacts, mitigation measures and proposed investigation works for continued quarrying activities at the Project Site.

11.1 Existing Environment

11.1.1 Regional Geology and Geomorphology

As indicated by the *1:100 000 Geological Series Sheet 9030 for Penrith*; NSW DMR 1991, the geology in the vicinity of the Project Site comprises the Wianamatta Group of Triassic age, which is made up of shale, carbonaceous claystone, laminate, fine to medium grained lithic sandstone, rare coal and tuff that is predominantly of marine origin. The Wianamatta Group comprises three main geological units, namely the Bringelly Shale, Minchinbury Sandstone and Ashfield Shale. The Bringelly Shale is mined within the Project Site.

The Wianamatta Group extends to a depth of up to 110 m within the southern Sydney Basin and is underlain by the Hawkesbury Sandstone which comprises a medium to coarse grained quartz rich sandstone with claystone, siltstone, minor shale and shale lenses and is known to contain significant amounts of groundwater in some parts of the Sydney Basin.

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

The regional geology is dominated by the north-south trending Lapstone Monocline and Nepean Fault west of the Site, the Luddenham Dyke System, and a series of anticlinal and synclinal structures. Block faulting has disrupted the strata in the vicinity of the Project Site and faults have been observed within existing excavations and interpreted from core data within the Project Site.

A summary of the local stratigraphic sequence is provided in **Table 39**. The maximum depth of quarrying activities associated with the development is approximately 35 metres, within the Bringelly Shale.

Table 39: Upper Stratigraphy of the Southern Sydney Basin

Period	Group	Stratigraphic Unit	Indicative Depth to Base of Formation	Lithology	Hydrogeology[1]
Triassic	Wianamatta Group	Bringelly Shale	60 m	Shale, carbonaceous claystone, claystone, laminate, fine to medium grained sandstone, rare coal and tuff.	Aquitard Total Dissolved Solids (TDS) > 3000 mg/L
		Minchinbury Sandstone	70 m	Fine to medium grained quartz lithic sandstone.	
		Ashfield Shale	110 m	Dark grey to black claystone, siltstone and fine, sandstone-siltstone laminate.	Aquitard TDS >3000 mg/L
	Mittagong Formation		120 m	Interbedded shale, laminate and medium grained quartz sandstone.	
	Hawkesbury Sandstone		300 m	Medium to coarse grained sandstone, minor laminated mudstone and siltstone lenses.	Aquifer TDS <500mg/L Yields: 0.2 to 2 L/sec Transmissivity = 3 m^2/day

11.1.2 Hydrogeological Setting

The hydrogeological regime of the Project Site is dictated by the structural and textural characteristics of the Bringelly Shale. Bringelly Shale is typically characterised by low permeability and groundwater velocities due to the fine grained and consolidated nature of the interbedded claystones and siltstones. Although technically the Bringelly Shale and Ashfield Shale units are considered aquitards not aquifers, they contain limited (and localised) quantities of saline groundwater, with groundwater flow restricted to occasional horizontal bedding planes or discontinuous carbonaceous lenses within the shales. Groundwater movement within the shale aquitard is minor and occurs within these horizontal zones of slightly higher permeability. Fracturing and faulting may impart a secondary permeability on the rock mass, however these fractured bedrock systems tend to be laterally and vertically discontinuous, resulting in poor hydraulic connection and low groundwater yields. Shallow or 'perched' groundwater is expected as a result of infiltrating rainwater accumulating at the interface between weathered and fresh shale.

Groundwater associated with the Wianamatta Group formations is characteristically saline due to its formation within a marine environment, and is generally unsuitable for extraction and use. Naturally elevated concentrations of metals are also commonly reported for groundwater within these units.

Alluvial deposits of unconsolidated clays and silts with minor sand are present associated with Badgerys Creek to the east and South Creek to the west of the Project Site. Due to the shallow nature of the alluvial deposits, groundwater is highly responsive to rainfall and stream flow. Groundwater flow within the alluvial sediments is expected to follow topography and flow towards the creeks and it is likely that the alluvial aquifer is hydraulically connected to the creeks.

The Hawkesbury Sandstone, underlying the Wianamatta and Mittagong formations is known to contain groundwater suitable for extraction and augmentation of Sydney's potable water supply within the Sydney Basin. However, as the maximum depth of excavation in the development is approximately 35 m, the Hawkesbury

[1] McKibbin and Smith (2000). Sandstone Hydrogeology of the Sydney Region.

Sandstone aquifer, which lies more than 100 m below the surface at the Project Site would not be intercepted or impacted by the development.

11.1.3 Project Site

The Project Site is underlain by the lower 51 metres of the Bringelly Shale. Shale exposed at the surface has weathered to form a clay horizon across the Site, averaging approximately six metres in depth. Groundwater is expected to collect (perch) at the interface between weathered and fresh shale, and/or in iron stone bands within the weathered zone, and reflects seepage from the surface which accumulates locally in joints within the weathered zone.

The quantity of perched groundwater on top of the fresh shale is invariably limited and when exposed during extraction, quickly evaporates on the side walls of the excavation. The presence of limited groundwater within this weathered zone is supported by Project Site exploration drilling, which did not identify groundwater within this zone.

Exploration drilling within the floodplain adjacent South Creek has identified alluvial sediments between three and ten metres in thickness. Groundwater within these alluvial sediments has been identified up to 200 metres from the current alignment of South Creek (Borehole RP18). Groundwater levels encountered within the alluvial sediments suggests connectivity between the alluvial aquifer and South Creek.

Alluvial deposits or groundwater associated with Badgerys Creek have not been encountered within the Project Site. The overbank deposits associated with Badgerys Creek predominantly lie to the west of the creek, with limited alluvial material deposited on the Project Site (east) side of the creek. Alluvial deposits were not reported in the closest boreholes to Badgerys Creek (RP10, RP25, located approximately 60 m from Badgerys Creek), and the topography of the Project Site indicates that alluvial sediments associated with Badgerys Creek would be limited on the Site. Slightly increased groundwater inflows into Pit 2 were reported when the excavation advanced to within 20 metres of Badgerys Creek. Excavation ceased and the area has since been rehabilitated.

Extraction within the Project Site to date has resulted in negligible groundwater inflow into the pits.

11.2 Groundwater Usage

A database search of registered groundwater bores in the vicinity of the Project Site identified 14 bores within a five kilometre radius of the development. The locations of the registered bores are provided on **Figure 10**.

The registered uses of the bores were described as being for:

- Monitoring;
- Domestic stock; and
- Industrial.

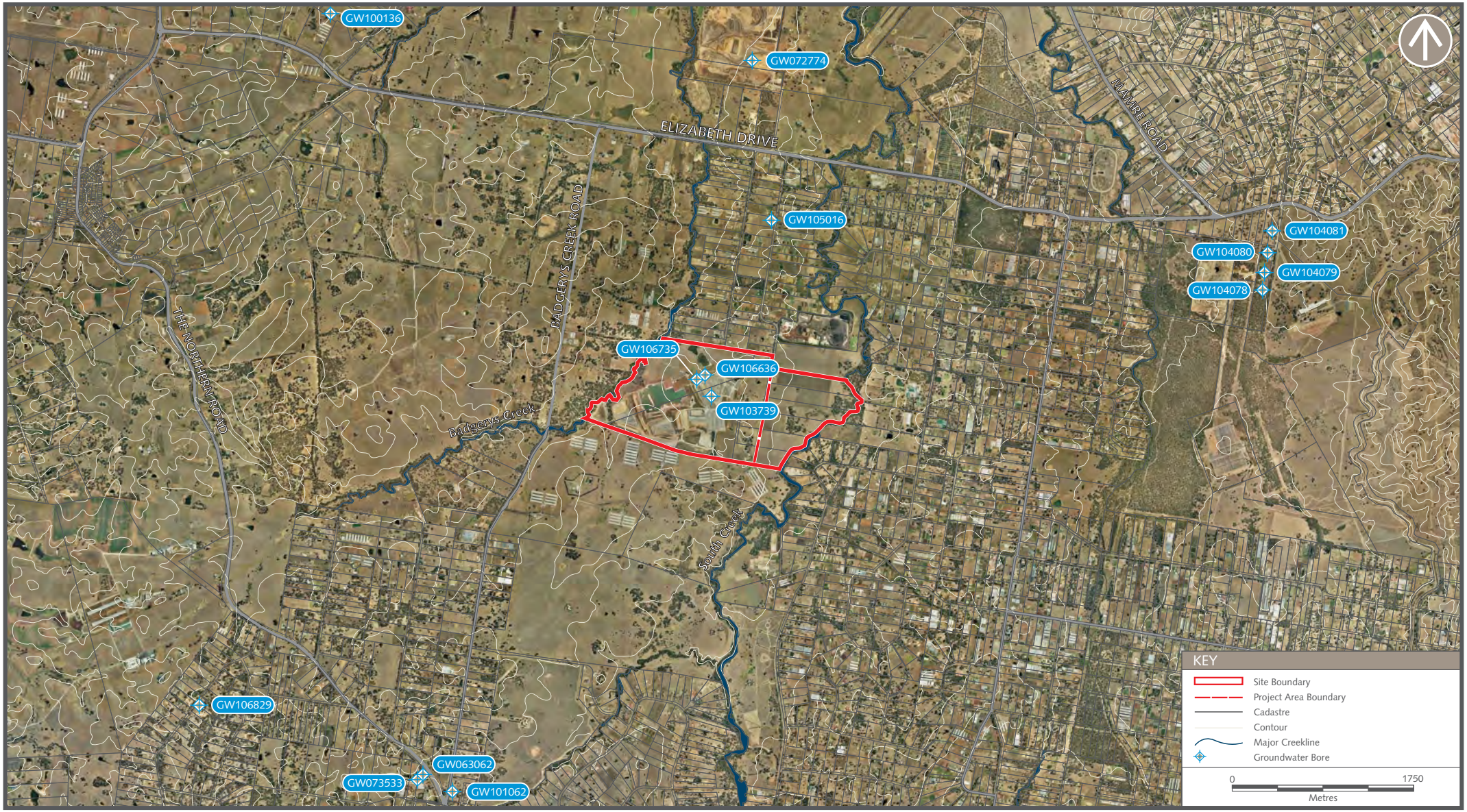
While it is recognised that not all existing bores are likely to be registered, the database gives an indication of groundwater usage in the area. The search reported that bores registered for groundwater abstraction purposes (e.g. domestic stock watering or industrial purposes), extract groundwater from the Hawkesbury Sandstone formation at depths greater than 220 m. Groundwater within the alluvial sediments or Wianamatta Group is not extracted for use in the vicinity of the Project Site.

Overall, it is concluded that the importance of, and reliance on, groundwater by local landowners and residents is limited in the vicinity of the Project Site. The contribution and importance of the groundwater system to stream flows and groundwater dependant ecosystems is discussed further in the following sections.

11.3 Methodology

Based on the review of existing data, a conceptual model of the hydrogeological regime for the Project Site has been developed. A numerical groundwater model was not developed for this assessment for the following reasons:

- The maximum depth of excavation is 35 m into very low permeability rock. No significant groundwater would be encountered, as has been confirmed by previous experience at the site. The storage of water in pits and lack of seepage during mining confirms the low permeability of the rock. Groundwater within the top 35 metres is considered a fractured bedrock aquifer (associated with fractures rather that within the rock itself) and very difficult to model (with any accuracy);
- There is no threat to the Hawkesbury Sandstone aquifer (which lies more than 100 metres below);



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EXISTING GROUNDWATER BORE LOCATIONS

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 10

- Groundwater is not extracted for use in the vicinity of the Project Area; and
- The groundwater and surface water regimes in the subject area have already been disturbed by mining activities. The natural state of the groundwater regime prior to mining is unknown.

It is considered that intrusive investigation of the alluvial sediments associated with South Creek and Badgerys Creek and the implementation of a groundwater monitoring program would provide beneficial (and real) data than a model would be able to achieve as there is currently very little data available to prepare a numerical model and as such, it the accuracy of the model would be questionable. A conceptual model was therefore developed and would be refined following the alluvial investigation and implementation of a groundwater monitoring schedule.

11.4 Existing Impacts on Groundwater Regime

The presence of the existing open pits within the Project Site would have influenced the local groundwater regime, although the influence would be limited as a result of the relatively impermeable geology. Groundwater present within the weathered zone and upper Bringelly Shale would have slowly drained (dewatered) into the open pits, although as discussed previously, negligible groundwater has been observed.

Pit 1 has been flooded and collects rainfall and surface water runoff from across the Project Site. This water may be providing a source of recharge to surrounding and underlying strata, although the impermeable nature of the shale units suggests that recharge would be minimal.

The presence of the flooded pit (Pit 1) immediately adjacent to open, empty pits within the Project Site, with no observable or measurable impact to groundwater inflows, further confirms the impermeable nature of the geology within the Project Site.

11.5 Potential Impacts

Potential impacts to the groundwater regime as a result of the proposed development may include:

- Aquifer dewatering;
- Contamination by leaking or spilt hydrocarbons; and
- Impact to base flow and groundwater dependant ecosystems, if present.

These potential impacts are discussed in more detail below.

11.5.1 Aquifer Dewatering

Previous operations within the Project Site are likely to have resulted in localised dewatering of the formations exposed within the pits. Although significant groundwater resources are not associated with the Bringelly Shale unit, the limited quantity of groundwater present is likely to have been depleted in the immediate area surrounding the pits.

The presence of groundwater within the weathered zone, particularly following rainfall events, is likely to persist throughout the life of the project with the voids created by ongoing extraction causing the small quantity of groundwater present to flow/seep towards and into the voids. In reality, and based on observations in the existing extraction areas, little if any groundwater would flow/seep into the void, as it would simply evaporate on the exposed side walls of the excavation void.

Cumulative impacts from the mining of additional pits within the Project Site are not expected to result in measurable changes to groundwater levels within the strata of the Wianamatta Group, and as groundwater within the Wianamatta Group is not utilised in the vicinity of the Project Site, adverse impacts as a result of dewatering are not anticipated.

Dependant on the extent of alluvial deposits associated with Badgerys Creek, there is potential for alluvial sediments and associated aquifers to be encountered by quarrying activities (Pit 5), and subsequent dewatering of the alluvial aquifer to occur, if present. Dewatering of alluvial aquifers has the potential to affect groundwater dependant ecosystems (if present) and base flow to the creek, if there is connection between surface water within the creek and shallow groundwater.

Drilling logs indicate that the alluvial sediments associated with South Creek, which extend some 200 metres west of the Creek, would not be intercepted by the development, with the closest proposed pit (Pit 4) located more than 400 metres west the Creek.

The extent of alluvial sediments associated with Badgerys Creek is expected to be limited within the Project Area and would be further investigated as part of the drilling and mapping program, described in **Section 11.6**. The

purpose of the alluvial investigation is to gain a better understanding of the alluvial sediments so that an adequate buffer distance can be established between the alluvial sediments and the proposed pits to ensure the alluvial sediments are not impacted by the development. The extent of the buffer zone would be determined based on the findings of the alluvial investigation and would take into account the geological properties, subsurface conditions encountered and extent of connectivity between the aquifers present.

In addition, groundwater wells would be installed within the alluvial material adjacent to both Badgerys Creek and South Creek and a monitoring schedule implemented to enable unanticipated impacts to the alluvial aquifers, if present, to be readily identified and managed accordingly. The proposed assessment and monitoring program is described in **Section 11.6** and would commence within 12 months of the project approval.

The low permeability of the shales targeted for extraction within the Project Site, combined with the limited and localised occurrence of groundwater within the shale units, would minimise dewatering impacts across the Project Site. Further investigation of the extent of alluvial sediments would be undertaken and an appropriate buffer between the excavated pits and the alluvial sediments established to ensure that the localised dewatering of the formations within the exposed pits would not impact adjacent alluvial sediments and associated groundwater ecosystems, if present.

11.5.2 Impacts to Water Quality

The accidental release of fuels, solvents or chemicals used during the operation of the facility has the potential to contaminate underlying groundwater resources. Impacts to groundwater that occur from spills and leaks are usually limited in extent and are not likely to impact off-site users. The relatively impermeable nature of the geology in the vicinity of the Project Site would further limit the migration of any accidental release and protect underlying aquifers.

The potential for spills and leaks to impact water quality would be minimised through the appropriate storage of fuels and hazardous chemicals, the implementation of appropriate work procedures and regular inspections and maintenance of equipment and plant in accordance with the EMP for the project. The implementation of a groundwater monitoring program (refer to **Section 11.6**) would enable impacts to groundwater quality to be identified and managed accordingly.

11.5.3 Impact to Base Flows and Groundwater Dependant Ecosystems

Dewatering of the alluvial sediments has the potential to result in impacts to base flows and groundwater dependant ecosystems (if present).

The extent of the alluvial aquifers in the vicinity of the Project Site, contribution to base flow within the creeks and presence of groundwater dependant ecosystems is not known, and would be investigated as part of the alluvial investigation and groundwater monitoring program (refer to **Section 11.6**). Based on the findings of the alluvial investigation, an appropriate buffer zone would be implemented between the proposed pits and the alluvial sediments so that the alluvial aquifers are not disturbed by the development and thus impacts to the alluvial aquifer are avoided. In addition, groundwater monitoring wells would be installed and a monitoring program initiated within 12 months of project approval, so that any unanticipated impacts to the alluvial aquifers, if present, are able to be identified and managed accordingly.

11.6 Mitigation Measures

The following mitigation measures would be implemented as part of the proposal.

- Appropriate storage of fuels and hazardous chemicals, implementation of appropriate work procedures as well as regular inspections and maintenance of equipment and plant to minimise potential for contamination due to spills;
- Undertaking of an alluvial investigation and groundwater monitoring program to negate the likelihood of impacts to the alluvial aquifer, base flow to the creeks and groundwater dependant ecosystems (if present). The proposed program is discussed below; and
- Based on the findings of the alluvial investigation, establishment of a buffer zone between the alluvial sediments and proposed pits to ensure the alluvial sediments are not disturbed by the development.

11.6.1 Alluvial Assessment and Groundwater Monitoring Program

Investigation of the alluvial sediments associated with Badgerys Creek and South Creek would be undertaken so that an appropriate buffer distance between the creeks and the proposed workings can be established to ensure the alluvial sediments and any groundwater they contain are not impacted by the proposal.

The alluvial aquifer assessment would include:

- Assess the lateral and vertical extent of the alluvial sediments associated with South Creek and Badgerys Creek;
- Assess the presence of groundwater within the alluvial sediments;
- Establish whether there is connectivity between surface water within the creeks, the alluvial aquifer and groundwater perched within the weathered zone.
- Assess the contribution of groundwater to the base flow of the creeks.
- Assess the presence of groundwater dependant ecosystems in the vicinity of the Project Site.
- Establish a monitoring well network to enable ongoing groundwater monitoring at the Site.

The investigation would comprise the following works:

Mapping of the Alluvial Sediments

A drilling and mapping program would be undertaken adjacent Badgerys Creek and across the flood plain associated with South Creek. Boreholes would be advanced and logged until bedrock is encountered so the lateral and vertical extent of alluvial sediments and presence and depth of groundwater can be assessed.

The indicative drilling program would comprise:

- Advancement of ten boreholes in the vicinity of South Creek and the associated flood plain; and
- Advancement of four boreholes in the vicinity of Badgerys Creek.

Indicative locations are provided on **Figure 11**. It is noted that the number and location of boreholes may alter dependant on access restrictions and the sub-surface conditions encountered during the drilling works.

The drilling program would enable the extent of the alluvial sediments and occurrence of groundwater in the vicinity of Badgerys Creek and South Creek to be established. Mapping of the alluvial sediments would commence within 12 months of project approval.

Groundwater Monitoring Well Installation

As part of the alluvial drilling and mapping program, groundwater monitoring wells would be installed into the alluvial sediments adjacent South Creek and Badgerys Creek. It is anticipated that six wells would be installed within the alluvial sediments, comprising four wells adjacent to South Creek and two wells adjacent to Badgerys Creek.

Two additional groundwater monitoring wells would be installed into the Bringelly Shale to a maximum depth of 35 metres, so that connectivity between aquifers can be assessed and the deeper groundwater can be monitored.

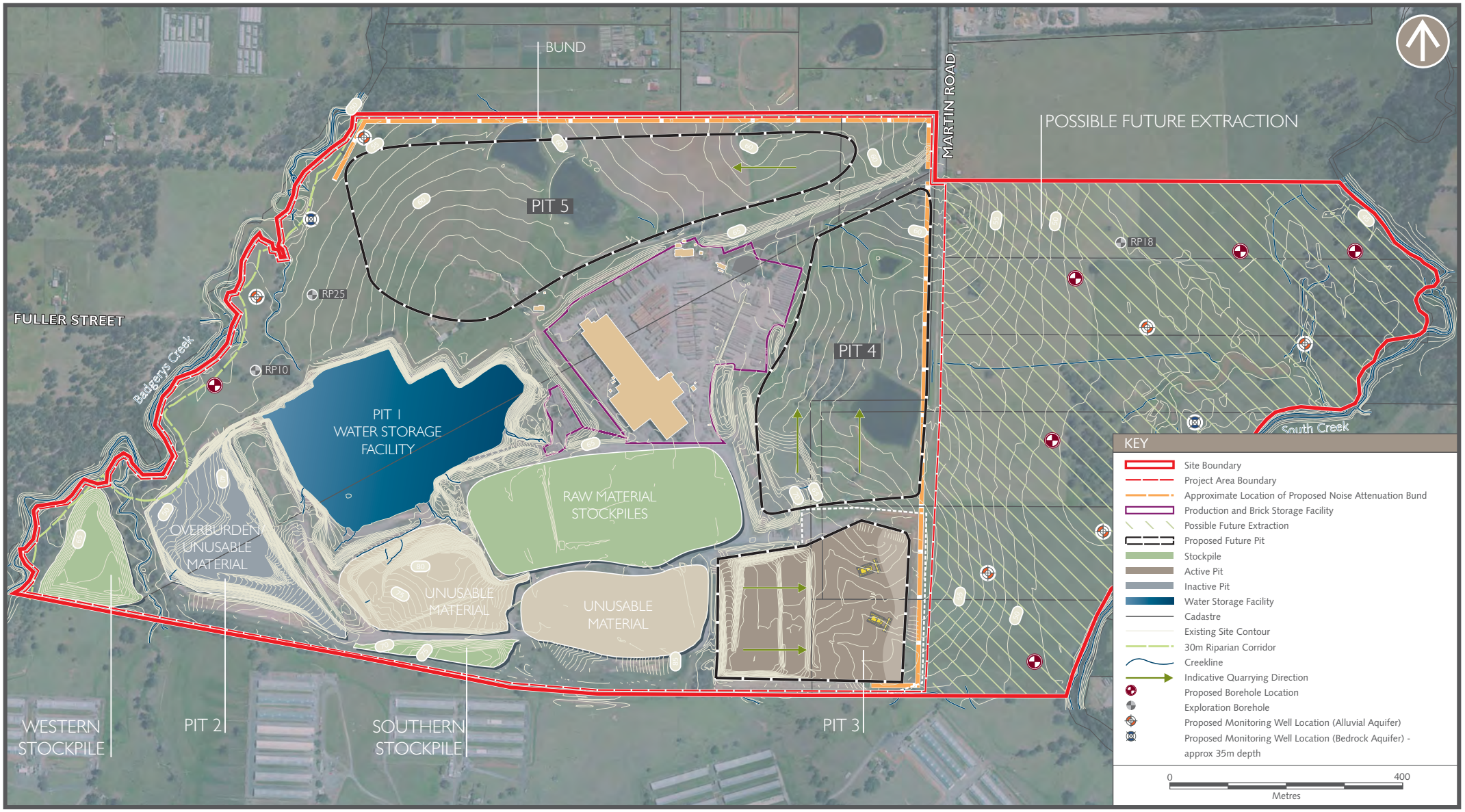
Indicative locations of the groundwater monitoring wells are provided on **Figure 11**, although it is noted that the final location of wells would be dependent on the outcomes of the drilling program.

Licences would be obtained from the NOW enabling the installation of groundwater monitoring wells, prior to the commencement of drilling.

Alluvial Assessment

Once the monitoring wells are installed, the wells and creeks would be surveyed and an assessment of water levels and water chemistry undertaken to determine flow direction, aquifer connectivity and contribution from the alluvial aquifers to the creeks. Permeability testing (slug tests) would be performed to establish the hydraulic conductivity and flow velocities of groundwater across the Site.

Measurement and permeability analysis of the sediments within both South Creek and Badgerys Creek would be undertaken so the base flow of the creeks can be assessed. Information regarding the presence of groundwater dependant ecosystems in the vicinity of the Project Site would be sourced and reviewed (if available).



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Indicative Drilling Locations for Alluvial Assessment

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 11

Based on the outcomes of the drilling program and alluvial assessment, a buffer zone would be implemented to ensure the alluvial aquifers are not disturbed by the development. The extent of the buffer zone would be established in consultation with the Director-General of the DoP and the NOW.

Groundwater Monitoring Program

Following installation of the groundwater monitoring wells, a groundwater monitoring program would be implemented so that unexpected impacts to the hydrogeological regime as a result of the development can be readily identified and managed accordingly. Groundwater monitoring would commence within 12 months of project approval so that adequate background data would be obtained prior to pits approaching the buffer zone associated with the alluvial sediments. The collection of a robust data set would enable natural variations in groundwater levels to be differentiated from unanticipated impacts associated with the development.

Groundwater monitoring, water level measurement, sample collection, storage and transportation would be undertaken in accordance with t NSW DECCW endorsed guidelines.

The proposed groundwater monitoring program is presented in **Table 40**, although it is noted that the monitoring schedule may change dependant on the outcomes of the alluvial investigation.

Table 40: Proposed Groundwater Monitoring Program

Location	No. of Wells	Parameters	Frequency
Badgerys Creek – Alluvial Sediments	2	Water level, EC, pH	Bi-monthly
South Creek - Alluvial Sediments	4	Comprehensive analysis*	Bi-annually
Bringelly Shale – Bedrock Aquifer	2		

*Comprehensive analysis is to be undertaken on an annual basis. The comprehensive sampling is to include the following: pH, Conductivity, TDS, Na, K, Ca, Mg, Cl, HCO_3, NO_3, SO_4 and hardness.

The groundwater monitoring program would be subject to an annual review and revised or updated as necessary. Results of the groundwater monitoring program would be reported to the Director-General of the DoP and the NOW on an annual basis.

11.7 Conclusion

The hydrogeology of the Project Site is strongly influenced by the geology which comprises low permeability shales and clays across a majority of the as well as Quaternary alluvial deposits flanking the creeks located to the east and west of the Project Site.

Exploratory resource drilling across the Site intercepted little groundwater associated with the shale units, and extraction within the Project Site to date, has reported negligible groundwater inflow from the shale and overlying weathered material into the open pits.

The alluvial deposits which flank South Creek to the east and Badgerys Creek to the west of the Project Site are likely to yield higher quantities of groundwater compared to the shale units. The extent and hydrogeological characteristics of the alluvial deposits would be investigated prior to excavation of additional pits, to provide a more comprehensive understanding of the alluvial aquifers and their importance to base flow within the creeks and groundwater dependant ecosystems.

Based on the outcomes of the alluvial investigation, a buffer zone would be implemented to ensure the alluvial aquifers and groundwater dependant ecosystems, if present, are not disturbed by the proposal. A groundwater monitoring program would also be employed so changes to the hydrogeological regime as a result of the proposal can be identified and managed accordingly.

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12.0 Land Use

This chapter addresses existing and proposed future land use within and in the vicinity of the Project Site and the relationship of the Project to these land uses. The chapter assesses the potential impacts of the continuation of quarrying and brick making operations on the existing and future surrounding land use, including development proposed as part of the SWGC.

12.1 Overview

The Project Site has been operated as a quarry and brick making facility for the past thirty years prior to which it was used for agricultural purposes. The site is zoned Rural RU1 (Primary Production) under LLEP 2008 which is consistent with the zoning of land directly to the north and south of the Project Site.

The existing and future land use context of the Project Site is shown in **Figure 3**. Land to the west of the Project Site (west of Badgerys Creek) is zoned Special Activities SP1 (Commonwealth activities) and land to the east of the Project Site, and east of South Creek is zoned Rural RU4 (Rural Small Holdings). Agricultural enterprises including chicken farming and market gardens and rural residential development are the predominant land uses surrounding the Project Site. ANL operates a bulk landscaping supplies handling facility north east of the Project Site.

As discussed in **Chapter 5** of the EA, the Project Site has been earmarked under the *Sydney Metropolitan Strategy* as 'future industrial' employment land. Surrounding areas have been designated for either 'future industrial' or 'residential' land use. The potential land use impacts of the Project are generally associated with the compatibility of the proposed works with existing and future planned land use in the surrounding area. In considering these potential impacts, the importance of retaining opportunities both for the full utilisation of the valuable natural resource existing on the Project Site and the redevelopment of the Project Site in the future consistent with the vision set out in the Metropolitan Strategy, is acknowledged.

12.2 Existing Land Use

The Project Site

As described previously in this EA, the Project Site is currently used for the purposes of extractive industry and brick production. Other land uses on the Project Site include agricultural and residential uses as described in the following sections.

Residential

The Project Site accommodates a single residence used by a dairy farmer who currently leases land from the Proponent for the agistment of stock. This residence is located in the north eastern section of the Project Site on Martin Road and adjacent to the northern boundary of the Project Site. Two other residential buildings are located on the Project Site, comprising a former site manager's residence in the central eastern portion of the Project Site and a small farm house in the central northern portion of the Project Site, however these are vacant.

Residential land use surrounding the Project Site is predominantly low density rural residential development. Many of the surrounding residences are small hobby farms and market gardens. Residential properties located adjacent to South Creek to the east and Badgerys Creek to the west are set back from the creeks, with property frontages to nearby streets.

Agricultural

Parts of the Project Site are utilised for agricultural land use being the grazing of stock in the northern and eastern portions of the Project Site and limited grazing and stock watering adjacent to South Creek. The lease between the Proponent and the dairy farmer is intended to remain until such time as quarrying activities extend into the eastern area, at which time the lease would be discontinued.

Agricultural land use surrounding the Project Site is variable and includes large-scale commercial chicken farming on properties immediately south (approximately 60 m) and north west (approximately 170 m) of the Project Site (Inghams), and market gardening at neighbouring properties. An agricultural pharmaceutical research company operates in the vicinity of the Project Site on the opposite side of South Creek and also agists sheep in the north eastern portion of the property, where they are maintained for research purposes.

Other

Other significant land uses in the surrounding area include ANL - a bulk landscape supply centre approximately 150 m north of the Project Site, on Martin Road and a landfill and advanced waste treatment facility north of the Project Site on Elizabeth Drive (SITA).

More broadly, within the region coal seam methane (CSM) gas is extracted from the underlying Bulli coal seam for energy production as part of the Camden Gas Project.

12.3 Future Land Use

The Project Site is located within the SWGC one of two key centres of growth in the broader Sydney region as identified under the *Sydney Metropolitan Strategy.* The *Metropolitan Strategy* has as one of its aims the creation of an additional 89 000 jobs by 2031. The SWGC comprises 18 Precincts covering approximately 17 000 ha and having a capacity to accommodate approximately 110, 000 new homes, along with employment land.

SEPP (Sydney Region Growth Centres) 2006 is the planning instrument which defines the future planning outcomes in the Growth Centres as part of the Metropolitan Strategy. However, at a local level, LLEP 2008 controls land use in the Liverpool LGA.

The Project Site has been earmarked for future industrial development under the *Metropolitan Strategy*, designated as Category 1 Employment Land. Category 1 employment lands include sites that presently function as industrial areas and provide a regional or national economic role. Designation of these lands as Category 1 Employment Land does not necessarily limit potential intensification or redevelopment of the sites to meet modern industrial land use, but simply that industrial operations at these sites should continue within the range generally allowed under current zoning. The proposed continuation of quarrying and brick making activities at the Project Site aligns with this vision as part of the *Sydney Metropolitan Strategy*, maintaining the output of the facility and the number of its employees. This designation also supports the retention of the brick making facility on the Project Site and the Concept Plan in so far as it seeks approval for the clarification of permissibility of this component of the project.

The current zoning of the Project Site (Rural RU1 Primary Production) is compatible with the designation as Category 1 Employment Land earmarked as ‘future industrial’ under the *Sydney Metropolitan Strategy*. Although the Project Site is located in a ‘future industrial’ precinct, many of the surrounding areas would support residential uses in the Kemps Creek, North Bringelly and North Rossmore precincts.

12.4 Potential Impacts

Potential impacts of the Project in terms of land use are focussed on the future use of the Project Site itself, along with the potential impacts of the Project on surrounding existing and future land use.

12.4.1 Future Use of the Project Site

The future use of the site is of integral importance to the Proponent, government agencies and the local community, especially given the location of the Project Site within an area designated for significant growth and land use change in the short to medium term.

Given the extent of the clay/shale resource on the Project Site, it is vitally important to the Proponent that future options for continued extraction both in other areas of the Project Site and deeper extraction within existing pits is preserved. The Proponent’s rehabilitation strategy for the Project Site is reflective of this key objective through the retention of certain voids to allow for future extraction within these pits should this option become viable in the longer term. It is important that rehabilitation and/or redevelopment on the Project Site does not sterilise these opportunities which would result in the loss of a potentially significant resource to the region and the State.

The vision of the NSW DoP and other relevant government and community stakeholders for the Badgerys Creek area and surrounds is also acknowledged and it is the Proponent’s intention that the Project Site is ultimately redeveloped in line with this vision and the relevant provisions of SEPP (Growth Centres) 2006. It is therefore likely that the long-term future land use on the Project Site would be some form of industrial development and that the final landform of the Project Site be designed to accommodate this future use. In this sense, the planned conceptual final landform would incorporate areas of level land and the retention of certain voids which could be used as pads for industrial development either with basement levels or utilising the void to absorb an industrial building/operation with minimal visual and acoustic impact.

At this stage future land use on the Project Site is intended to be continued quarrying and brick production as described in the EA. Given the substantial change in surrounding land use, landscape and development set to occur over the next ten to twenty years, a specific future land use beyond the twenty year proposed life of the quarry operations has not been identified. However, any future use would be in line with relevant planning strategies and controls applicable to the land.

12.4.2 Compatibility with Existing and Future Land Use

Potential land use impacts of the project include the compatibility of the project with existing and proposed future land use in the surrounding area, particularly given the location of the Project Site within the SWGC (refer to **Figure 12**). Land use impacts in this regard are generally associated with amenity, i.e. noise, traffic, air quality and visual impacts.

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 as described previously. A RP has been prepared as part of this EA (refer to **Section 4.3**) broadly describing the rehabilitation strategies to be progressively implemented in conjunction with continued quarrying activities over the next twenty years of quarry life. The intent of the RP is to continue rehabilitation of certain areas and components of the Project Site. In particular the RP focuses on the stabilisation and rehabilitation of stockpiles with the aim of creating a landform which is compatible with a future industrial land use, in line with the objectives of the *Sydney Metropolitan Strategy,* but which also retains opportunities for future extraction if viable.

Given that quarrying and brick making activities have been taking place on the Project Site for some 30 years without significant conflict, the potential impacts of the proposed continuation of operations upon existing surrounding land use are considered to be similar to those experienced under existing conditions. The movement of quarrying activities across the Project Site in the future would result in certain changes in impacts related to noise and visual amenity, however these have been assessed as part of the EA (**Chapters 9** and **15**) and potential impacts (with the implementation of recommended mitigation measures) are not considered to be significant. Further, an assessment of the air quality and traffic impacts of the proposed continued operations has been undertaken and concludes that impacts would be manageable through the implementation of appropriate mitigation strategies.

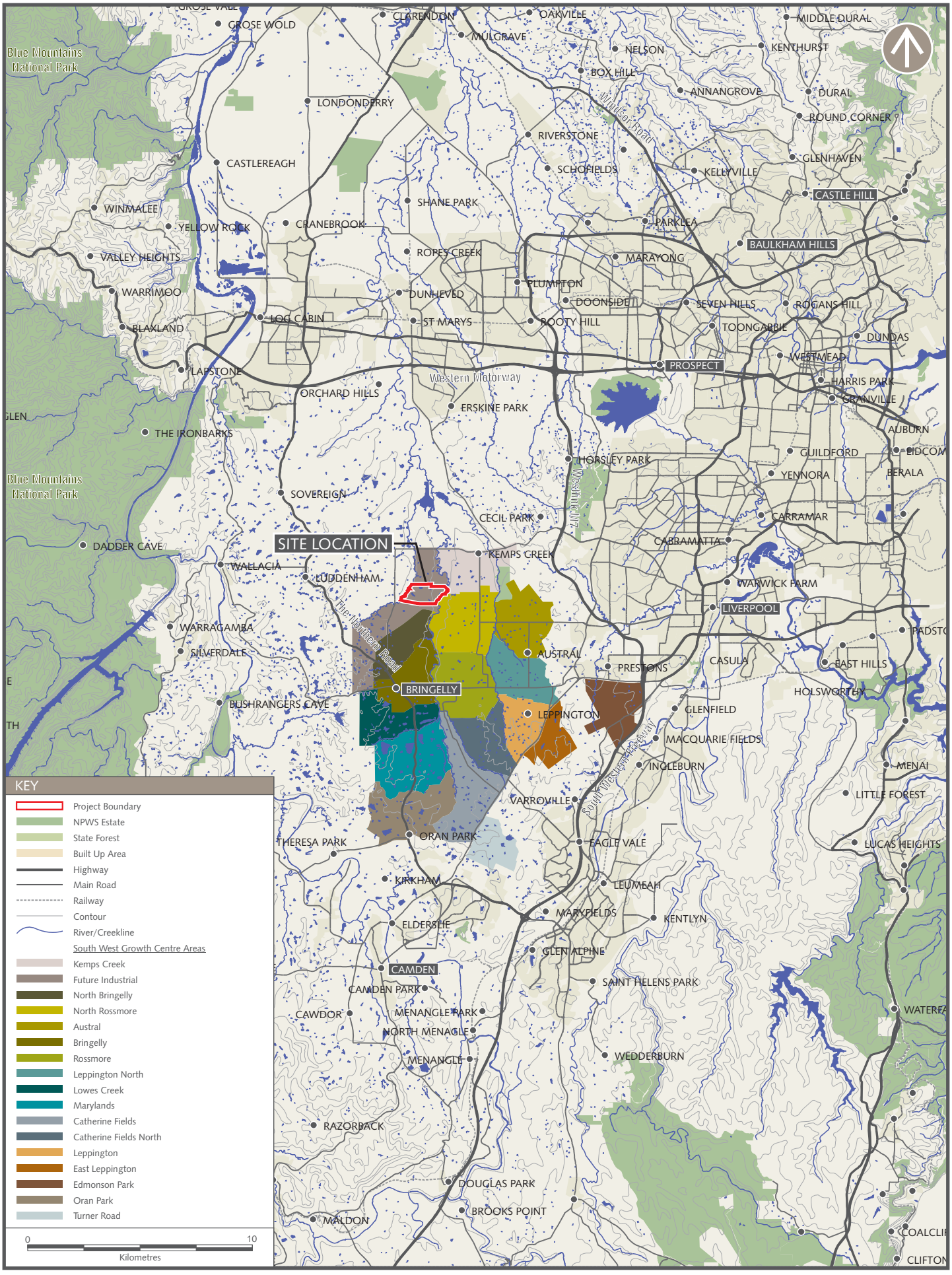
The continuation of operations at the Project Site would therefore mean the retention of industrial presence in the area. Into the future with the development of the SWGC, the proposed operations are considered to integrate well with the proposed future industrial/ employment use of the Project Site and surrounding area. Further, the existing rural landscape of the surrounding area would likely change significantly such that the Project Site would be viewed within an industrial context.

As stated previously, rehabilitation works would continue on the Project Site in accordance with the RP and would include improvements to the riparian corridor along Badgerys Creek. Existing Pit 2 would also be filled during the life of the proposed operations, creating a level platform in the western part of the Project Site where industrial or other development may take place in the future. Retained voids would also preserve an opportunity to be used as platforms for industrial development.

12.5 Mitigation Measures

Given that many of the land use impacts relate to amenity issues discussed elsewhere in this EA, the measures proposed in **Chapters 8** to **20** to manage air quality, noise, visual and traffic impacts in particular, would also assist in managing potential land use impacts. Specific safeguards to minimise the potential impacts of the project upon existing and future land use include:

- Ongoing consultation with the relevant authorities managing the release of land for industrial and urban development within the vicinity of the Project Site to ensure that project activities and management of infrastructure is effectively integrated with future development in the area. This would also ensure that Boral is promptly informed of changes to the existing road networks and the relevant matters as part of development within the area.
- Quarrying and rehabilitation activities at the Project Site to be undertaken in accordance with the RP prepared and attached as **Appendix D** to this EA.



AECOM

LAND USE CONTEXT (SOUTH WEST GROWTH CENTRES)

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 12

12.6 Conclusion

The impact of the proposed works on land use is not considered to be significant. Many of the potential land use impacts are related to amenity issues which can be effectively managed through the implementation of appropriate mitigation measures.

The Project Site and surrounding area is set to experience significant land use changes over the life of the project and as such, the project has been designed to adapt and integrate with that change. 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.

13.0 Traffic and Transportation

This chapter assesses the potential impacts of the proposed continuation of quarrying and brick making operations at Boral Badgerys Creek in terms of traffic impacts on the surrounding strategic and local road networks. In this regard, consideration is given to anticipated background traffic volumes independent of the continued operation of the quarry and brick making facility and proposed methods for the management of traffic should operations continue at the Project Site.

13.1 Strategic and Local Road Network

The Macarthur region is an important hub for south western Sydney's industrial and residential zones, connecting several important transport corridors from Sydney to the south coast of NSW and Victoria. The strategic road network servicing the Project Site includes the Westlink M7 and the Western Motorway (M4), as shown in **Figure 13**.

The Westlink M7 is a 40km motorway linking the M2, M4 and M5 motorways. It links the M5 at Prestons in the south, with the M4 at Eastern Creek and the M2 at West Baulkham Hills in the north. The Westlink M7 provides access to Liverpool, Fairfield, Blacktown and Baulkham Hills. The motorway has two lanes in each direction, separated by a wide median and speed limits of up to 100km/hr.

The M4 is an urban expressway of 40 km that connects Concord in Sydney's Inner West to Penrith in the west. The motorway connects with the Westlink M7 at Eastern Creek and has three lanes in each direction for the majority of its length. The speed limit along the Western Motorway varies, reaching 100km/hr at various points.

The local road network comprises Martin Road, Elizabeth Drive and The Northern Road. A description of the local roads is provided below:

- **Martin Road** - Martin Road is a two-way, undivided, sealed road that connects Elizabeth Drive to the Project Site. The road runs in a north-south direction and has a speed limit of 60km/h leading to and from the Project Site. NSW does not have specific standards or guidelines relating to lane widths and alignments for roads with heavy vehicle traffic.
- **Elizabeth Drive** - Elizabeth Drive is a two-way sealed road that runs in an east-west direction north of the Project Site. Elizabeth Drive connects to The Northern Road to the west and to the Westlink M7 to the east, via Wallgrove Road. Martin Road and Elizabeth Drive are connected with a priority controlled T-intersection. The speed limit along the section of the road that runs north of the Project Site on Elizabeth Drive is 80km/h.
- **The Northern Road** - The Northern Road is a two-way, undivided, sealed road that connects to Elizabeth Drive with a roundabout west of the Project Site. The road runs in a north-south direction and connects to the M4 to the north and Camden Valley Way to the south. The Northern Road has a speed limit of 80km/h where it connects to Elizabeth Drive.

13.2 Existing Traffic Volumes and Intersection Performance

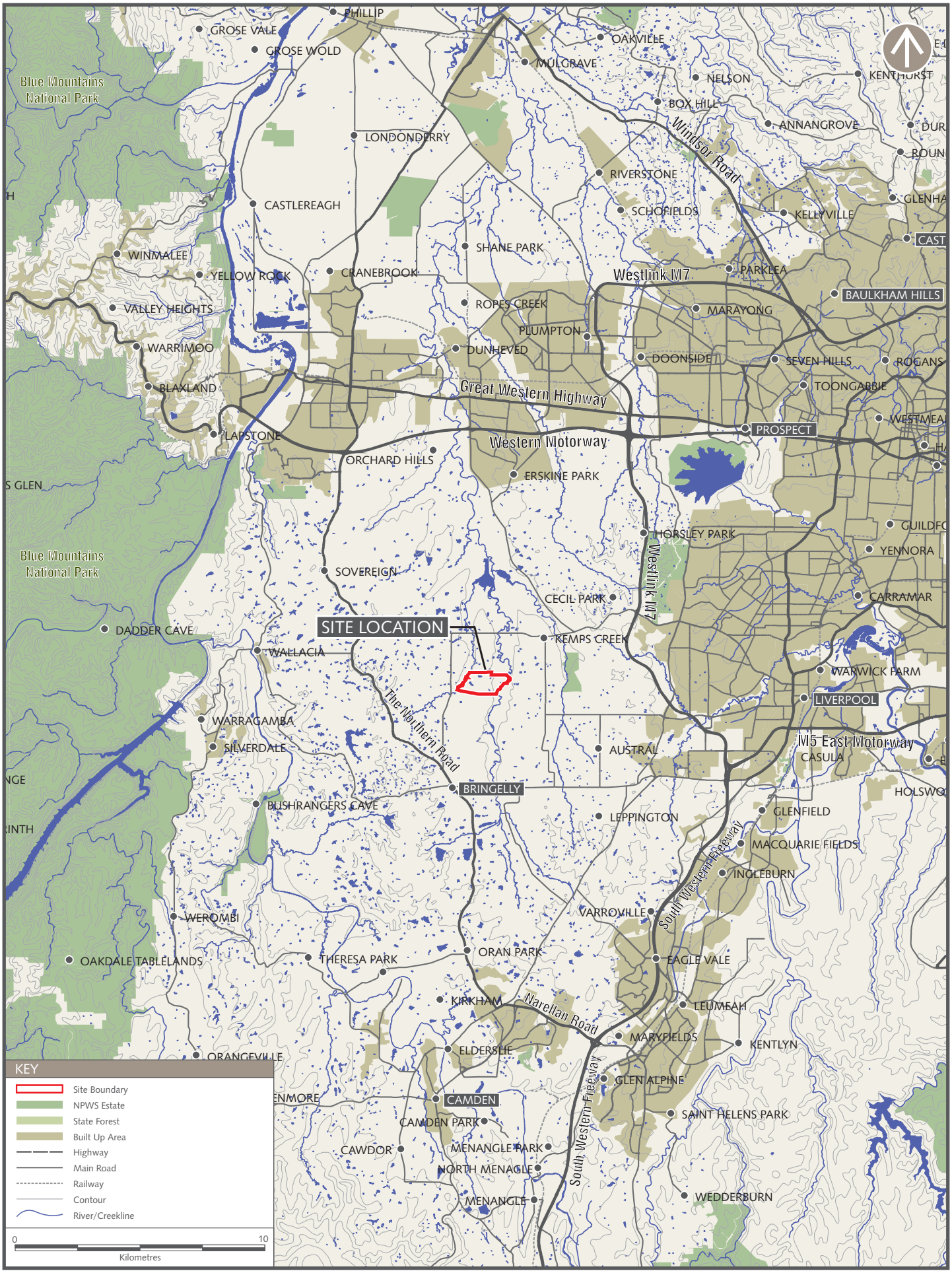
13.2.1 Traffic Volumes

Two permanent RTA traffic count stations are located on Elizabeth Drive in the vicinity of the Project Site. The first is positioned east of The Northern Road and the second, at South Creek Bridge. Average annual daily traffic (AADT) at both of these locations increased at an average rate of 1.2% pa from 1999 to 2005. Historical traffic volumes are shown in **Table 41**.

Table 41: Historical Traffic Volumes

Station Number	Location	AADT Volumes			Annual Growth Rate
		1999	2002	2005	1999-2005
64.032	Elizabeth Drive, E of The Northern Road	6,753	6,592	7,311	1.3%
64.037	Elizabeth Drive, at South Creek Bridge	9,117	9,098	9,757	1.1%

Source: RTA, 2005



AECOM

SURROUNDING ROAD NETWORK

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 13

13.2.2 Current Traffic Generation

At present, delivery and dispatch of packaged bricks off-site by truck originates from the storage yard. Currently, there are approximately 60 truck pickups/deliveries (120 truck movements) per day during the week and approximately 12 truck pickups/deliveries (24 truck movements) on a Saturday.

There are currently 56 people employed in the Brick Production Facility and 20 employees in the office generating in the order of 152 light vehicle movements (to and from the site) per day. The number of employees working at the Project Site is not proposed to change as part of the continued operations of quarrying and brick making activities at the Project Site.

13.2.3 Intersection Counts

Sky High Traffic Data conducted intersection counts at the Elizabeth Drive and Martin Road intersection on 10 November 2009, for the AM and PM peak periods.

The data indicated that the morning peak period occurred between 7 am to 8 am and the evening peak period from 4.30 to 5.30 pm. It was observed that traffic on Elizabeth Drive is of a 'tidal' nature, with heavier flows of both light and heavy vehicles eastbound on Elizabeth Drive (towards the city) in the morning peak period and westbound (away from the city) in the evening peak period.

13.2.4 Existing Intersection Performance

The Elizabeth Drive and Martin Road intersection performance in the AM and PM peak hour has been evaluated using *SIDRA Intersection 3.2*, a computer based modelling package designed for calculating isolated intersection performance.

The main performance indicators for SIDRA 3.2 include:

- Degree of Saturation (DoS) – a measure of the ratio between traffic volumes and capacity of the intersection used to measure the performance of isolated intersections. As DoS approaches 1.0, both queue length and delays increase rapidly. Satisfactory operations usually occur with a DoS range between 0.7-0.8 or below 0.7;
- Average Delay – duration, in seconds, of the average vehicle waiting at an intersection; and
- Level of Service (LoS) – a measure of the overall performance of the intersection, as described in **Table 42**.

Table 42: Performance Criteria for Intersections

Level of Service	Average Delay per Vehicle (seconds/vehicle)	Traffic Signals and Roundabout	Give Way and Stop Signs
A	Less than 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, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents would cause excessive delays	At capacity; requires other control mode
F	>70	Roundabouts require other control mode	At capacity; requires other control mode

Source: Guide to Traffic Generating Developments, Roads and Traffic Authority, 2002

Table 43 and **Table 44** summarise the performance of the Elizabeth Drive and Martin Road intersection, based on the 2009 traffic flows for the morning and evening peak hours respectively.

Table 43: 2009 AM Peak Intersection Performance

Location	Demand Flow (veh/h)	LoS	DoS (v/c)	Ave Delay (sec)	95% Back of Queue (m)
Martin Road	20	LoS C	0.133	34.7	6
Elizabeth Drive (E)	227	LoS A	0.111	1.7	N/A
Elizabeth Drive (W)	756	LoS A	0.401	0.1	0
All vehicles	**1,003**	**N/a**	**0.401**	**1.2**	**6**

Notes to table:

- **95% Back of Queue – the maximum extent of the queue relative to the stop line or give-way (yield) line during a signal cycle or gap-acceptance cycle.**
- **v/c – intersection vehicle volumes divided by the intersection capacity.**

Source: AECOM, November 2009

Table 44: 2009 PM Peak Intersection Performance

Location	Demand Flow (veh/h)	LoS	DoS (v/c)	Ave Delay (sec)	95% Back of Queue (m)
Martin Road	8	LoS B	0.027	25.9	1
Elizabeth Drive (E)	719	LoS A	0.375	0.3	N/A
Elizabeth Drive (W)	230	LoS A	0.125	0.6	1
All vehicles	**957**	**N/A**	**0.375**	**0.6**	**1**

Notes to table:

- **95% Back of Queue – the maximum extent of the queue relative to the stop line or give-way (yield) line during a signal cycle or gap-acceptance cycle.**
- **v/c – intersection vehicle volumes divided by the intersection capacity.**

Source: AECOM, November 2009

In the morning peak hour, the Elizabeth Drive and Martin Road intersection operates with approximately 60% spare capacity and with minimal average delays. Elizabeth Drive (east and west) performs at LoS A and Martin Road performs at LoS C, with slightly longer average delays, which demonstrates both are operating at an acceptable performance level.

In the evening peak hour, the Elizabeth Drive and Martin Road intersection operates with approximately 62% spare capacity with minimal average delays. Both Elizabeth Drive and Martin Road perform at acceptable LoS A and C respectively.

13.2.5 Traffic Safety

Accident data at the intersection of Martin Road / Elizabeth Drive for the period of January 2004 to December 2009 has been obtained from the RTA.

During this period, there were 2 crashes at the intersection, both occurring in 2004, one injury and one non-casualty. The injury crash was a rear end collision involving a car and a truck both proceeding to travel in the westbound direction on Elizabeth Drive. The non casualty crash involved two lorries, one of which was turning from Martin Road onto Elizabeth Drive and the other was travelling along Elizabeth Drive resulting in a 'cross traffic' accident.

Based on the low number of crashes, with none being recorded since 2004, there does not appear to be an issue with safety at the intersection of Martin Road / Elizabeth Drive.

13.3 Future Transport Conditions (without the Project)

An assessment was undertaken of the ability of the surrounding road network to cope with future traffic volumes as a result of background traffic growth, regardless of the continuation of Boral's operations at the Project Site or any traffic increases that may be associated with the project. The purpose was to identify the future performance and capacity of the Elizabeth Drive / Martin Road intersection without any Project traffic added, to provide a base case for the impact assessment.

The Project Site is located in an area that is expected to see significant future urban growth. Accordingly, for a robust assessment of the base case future year (without Project generated traffic), this future development was considered. The assessment considered traffic associated with committed development, including the SWGC, as well as future predicted traffic growth.

The assessment was undertaken for the future year of 2029, which is the proposed life of the Project, and provides the worst case scenario in terms of the base case. The assessment focuses on the morning and evening peak hours, when traffic movements on the surrounding network are highest and the greatest demand is placed on road infrastructure. It is noted that there are no firm residential or industrial development proposals being assessed or considered that AECOM are aware of in the surrounding area, which would contribute significantly to traffic growth at this time. As such the assessment below represents a worst case scenario.

The intersection of Martin Road and Elizabeth Drive was assessed with future year (2029) traffic flows, without any project traffic present on the road network. A growth rate of 3.8%[2] per annum was applied to the 2009 existing traffic counts to determine the future year traffic volumes on Elizabeth Drive and Martin Road.

Table 45 summarises the change in intersection performance from 2009 to 2029 base traffic flows for the morning and evening peak hours.

Table 45: Intersection Performance Summary Table (all vehicles)

Location		Demand Flow (veh/h)	DoS (v/c)	Average Delay (sec)	95% Back of Queue (m)
AM Peak	2009 Base Case	1,003	0.401	1.2	6
	2029 Base Case	2,114	1.000	20.6	104
PM Peak	2009 Base Case	957	0.375	0.6	1
	2029 Base Case	2,017	0.800	4.3	29

Notes to table:

- **95% Back of Queue – the maximum extent of the queue relative to the stop line or give-way (yield) line during a signal cycle or gap-acceptance cycle.**
- **v/c – intersection vehicle volumes divided by the intersection capacity.**

Source: AECOM, November 2009

The combined results indicate that the Martin Road and Elizabeth Drive intersection does not perform satisfactorily in the 2029 morning peak hour. In the evening peak hour, the intersection operates within capacity, but Martin Road performs at LoS F and with long average delays (refer to Traffic Impact Assessment, **Appendix G**).

[2] Refer to Section 3.2 of Traffic Impact Assessment (AECOM, 2010) for basis of the growth rate.

13.4 Traffic Generation and Potential Impacts

13.4.1 Proposed Production and Operations

Beyond September 2011, the hours of operation of the brick product storage yard (6 am to 6 pm) would increase to 6 am to 10 pm Monday to Friday, with no change to Saturday operating hours, as shown in **Table 46**.

Table 46: Current and Proposed Hours of Operation

Site Facility	Current Hours of Operation	Proposed Hours of Operation
Quarry	Monday to Saturday, 7 am to 6 pm for 2 to 3 months per year	Monday to Saturday, 7 am to 6 pm for 2 to 3 months per year
Brick Making Facility	24 hours a day, Monday to Sunday	24 hours a day, Monday to Sunday
Brick Product Storage Yard	Monday to Friday, 6am to 6pm. Saturday 6 am to 12 pm.	Monday to Friday, 6 am to 10 pm and Saturday 6 am to 12 pm.

Source: Boral Bricks Pty, 2009

The number of employees associated with the Project Site is not proposed to change.

13.4.2 Trip Generation

The existing loading practices and employee movements are used to estimate the likely traffic generation from the Project Site into the future. **Table 47** indicates the number of trucks per hour required to transport product bricks off-site under the existing and proposed operating hours of the brick product storage yard, Monday to Friday. Peak hour truck numbers are also presented and are assumed to be 50% higher than a normal hour. **Table 48** indicates the number of vehicles generated by employees of the brick making facility and office. Proposed transportation of product brick on week days is considered to have the greatest potential for impact on the road network, compared to proposed movements on Saturdays, as the number of truck movements would be higher during the week. This traffic assessment therefore focuses on the impact of the continuation of production on weekdays as the worst case scenario.

Table 47: Truck Trip Generation Table

Operating Hours	Trucks per day	Trucks per hour	Trucks per peak hour	Truck movements per peak hour
Existing – 6 am to 6 pm (12 hours)	60	5	8	16
Proposed – 6 am to 10 pm (16 hours)	60	4	6	**12**

Source: AECOM, November 2009

Table 48: Employee Trip Generation Table

Operating Hours	Vehicles per day	Vehicles per hour	Vehicles per peak hour	Vehicle movements per peak hour
Production Facility 24 hours	76	4	6	**12**

Source: AECOM, November 2009

The continuation of operations at the Project Site, including the extended operating hours of the brick product storage yard, would generate approximately 12 truck movements per peak hour (in and out). Under current operating hours, the brick product storage yard generates approximately 16 truck movements per peak hour (in and out).

The extended operating hours of the Brick Product Storage Yard would enable a broader distribution of truck movements throughout the day/evening and provide greater opportunity for trucks to avoid peak hour movements. This spreads the impact of the trucks over a longer period of time, reducing the impact to the intersection of Martin Road and Elizabeth Drive in the peak hours. Employee movements associated with the continuation of production would continue to be in the order of 12 vehicle movements per peak hour.

Table 47 shows the existing truck movements generation (8 trucks per peak hour) and the future truck movement generation (6 trucks per peak hour), as well as employee generated trips (6 vehicles per peak hour) as a proportion of the traffic volumes at the Martin Road / Elizabeth Drive intersection in 2009 and 2029 respectively.

Table 49: Proportion of Project Generated Traffic at Martin Road / Elizabeth Drive Intersection

Peak Hour	2009 Intersection count	% of existing traffic (current ops)	2029 Forecast Intersection count	% of future traffic (proposed ops)
AM	1,003	1.3%	2,670	0.4%
PM	957	1.3%	2,240	0.5%

Source: AECOM, November 2009

The table indicates that Project generated traffic accounts for 1.3% of the traffic volume at the Martin Road and Elizabeth Drive intersection in both peak hours at present, which is a negligible contribution to traffic volumes.

With the inclusion of the development of the SWGC, by the forecast year of 2029, Project generated traffic accounts for 0.4% of the traffic at the intersection in the morning peak hour and 0.5% of traffic in the evening peak hour. Accordingly, the Project generated traffic would have a negligible impact on the performance of the intersection in the future year of 2029.

The proposed Project is expected to generate less truck movements than currently generated due to recent capital investment in new packaging equipment that has resulted in significant efficiencies in brick packaging and dispatch. The new plant has resulted in the achievement of 400 bricks per pack rather than the 288 bricks per pack previously achieved, meaning that fewer trucks are required to move the same number of brick, directly reducing truck movements to and from the site. Modelling of the existing intersection (under existing conditions) with the proposed number of trucks, indicates improved results in terms of efficiency than under current conditions.

The analysis undertaken shows that the most significant impact on the intersection would be as a result of background growth, rather than project generated traffic. The traffic impact assessment highlights that the development of the SWGC is the primary contributor to future projected traffic volumes along Elizabeth Drive. The Traffic Impact Assessment indicates that the intersection fails in the future without Project generated traffic present. Consequently, the project is not the key contributor to this reduced level of performance.

13.4.3 Martin Road/Elizabeth Drive Intersection

The Traffic Impact Assessment report in **Appendix G** shows that the intersection of Martin Road and Elizabeth Drive currently performs satisfactorily and Martin Road performs at a LoS C in the worst case (the AM peak). During Project operations the number of trucks entering and exiting the site during the am and pm peak hours would decrease (due to the extended operating hours and investment in the Dehacker) which means fewer trucks would be turning right onto Elizabeth Drive per hour. There is therefore, no need for upgrade works to the Martin Road/Elizabeth Drive intersection to accommodate the proposed continued operation.

As discussed in **Section 13.3**, the Martin Road and Elizabeth Drive intersection would not perform satisfactorily in the forecast future year of 2029, should the future planning initiatives in the SWGC be realised. With the potential increase in traffic growth the intersection Martin Road and Elizabeth Drive would require an upgrade regardless of Project generated traffic. Based upon the results of the traffic impact assessment, there is no nexus to justify a contribution by Boral in relation to intersection upgrades to accommodate these future traffic volumes.

13.4.4 Suitability of Martin Road

Martin Road is a two-way, undivided, sealed road that connects Elizabeth Drive to the Project Site and is currently used by both Boral and ANL trucks. An assessment of the suitability of the alignment and pavement condition of Martin Road was undertaken which took into consideration the type and volume of transport vehicles currently using this road and those vehicles that are proposed to continue to use Martin Road for the proposed Project.

Road Alignment

A visual assessment of the alignment of Martin Road was undertaken to determine the road's suitability for heavy vehicles at a road speed limit of 60km/hr. The assessment took into consideration the basic elements of road / alignment design with reference to 'Austroads' Guide to Road Design Documents (GRD Part 3 & 4a).

Martin Road runs in a north-south direction, is approximately 2.1km in length, and is generally straight with graduated bends considered suitable for truck movements. The cross section profile of the road was assessed at a number of locations along the alignment of Martin Road. The overall width of the two lanes of Martin Road varied from approximately 7.0 – 7.5m, therefore meeting the standard lane width requirement of 3.5m for heavy vehicles.

There are no significant alignment issues identified that would suggest Martin Road is unsuitable for existing or ongoing operations associated with Boral Bricks Pty Ltd, however a number of improvements in relation to shoulder widths, and the alignment and sight distances within the vicinity of the horizontal reverse curves would be investigated and may include:

- Construction of shoulders at minimum standard widths where required;
- Clearing of existing roadside vegetation to improve sight lines within the vicinity of the reverse curves; and
- Provision of 'W1-4(L)' warning signposting in advance of the reverse curves to advise motorists of the upcoming curved alignment.

Road Pavement

Traffic volumes on Martin Road are low to moderate, although the proportion of commercial vehicles is high, with commercial vehicles constituting approximately 50% of total vehicle traffic. Boral's existing operation contributes to this commercial traffic volume, however the proposed Project would result in fewer heavy vehicle movements per hour than under existing operating conditions.

A visual assessment of the road pavement of Martin Road was undertaken which identified that the asphalt wearing course looks to be nearing the end of it service life, with significant areas of fatigue cracking noted. Signs of failure were evident in previous patching and pavement crack sealing work undertaken along the road.

Although the wearing surface of Martin Road is in need of replacement, deformation or rutting of the pavement were only found in limited areas, indicating a reasonable level of pavement structural integrity.

The existing truck loadings from the Boral operation are the largest contributor to the impact on the pavement of Martin Road to the south of the ANL facility, i.e. from approximately 1.6 to 2.1km south of Elizabeth Drive. However, impacts to the pavement north of the ANL facility are due to the combined truck loadings from the Boral and ANL operations, in addition to any other heavy commercial traffic which may be generated from other operations along Martin Road.

Martin Road is currently serviceable although is in need of considerable maintenance for its entire length. Boral proposes no increase in truck traffic as a result of the proposed Project, however, and instead would lead to a decrease in peak hour truck movements from the Project Site. Consequently the impact of the proposed Project on Martin Road will remain largely the same as current operations.

As part of the existing and ongoing operations at the Project Site, a detailed pavement investigation and rehabilitation program would be considered to protect the value of the existing road structure.

13.5 Mitigation Measures

The Traffic Impact Assessment concludes that the Project would have a negligible impact on the performance of the Martin Road and Elizabeth Drive intersection and that no mitigation measures are necessary. However, the following mitigation measures would be implemented in relation to the management of traffic:

- 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, avoidance of the AM and PM peak periods and vehicle speed limits on Martin Road.
- 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 Martin Road and parking.
- Unnecessary vehicle movements would be minimised where possible.
- 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 AM and PM periods.

13.6 Conclusion

During peak hours, traffic generated by the proposal would be less than existing traffic during peak hours, due to the proposed extended operating hours of the brick product storage yard and improved efficiency of truck transport. The extended operating hours spreads the impact of the trucks over a longer period of time, thereby reducing the traffic impact to the intersection of Martin Road and Elizabeth Drive in the peak hours.

Project generated traffic is considered to have a negligible impact on the performance of the Martin Road and Elizabeth Drive intersection in 2029, as it accounts for a very small proportion of the forecast traffic volumes in the SWGC.

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14.0 Geology and Soils

The Project involves the extraction of clay and shale material for brick production and therefore has the potential to impact upon soils and geology. This chapter examines the geological characteristics of the area and the characteristics of soils on the Project Site and makes recommendations for the management and mitigation of impacts on this basis.

14.1 Existing Environment

14.1.1 Landform

The Project Site is located in the Cumberland Lowlands subregion, one of the seven physiographic subregions of the Sydney Geological Basin. The Sydney Basin Region is underlain by Triassic sediments which dip gently from the east and north to a central lowland area southwest of Parramatta. The centre of the basin, the Cumberland Lowlands, consists of plains and gently undulating to low hills on the youngest of the Triassic rocks, the Wianamatta Group (DPI, 2005).

14.1.2 Geological Context

The Sydney Basin can be divided into five stratigraphic phases, each of which has a distinctive structural and tectonic association. These are listed below:

a) Late Carboniferous (Stephanian);
b) Early Permian: dominantly marine;
c) Late Permian: dominantly fluvial with coal measures;
d) Early Triassic: dominantly fluvial but some marine and volcanics; and
e) Middle Triassic: dominantly fluvial but some marine and volcanic.

The stratigraphic phases identified as being representative of the Sydney Basin geology are summarised in **Table 50**.

Table 50: Stratigraphic Phases of the Sydney Basin Geology.

Age	Group	Stratigraphic Unit	Indicative Depth (m)	Geological Description
Middle Triassic	Wianamatta Group	Bringelly Shale	30	The Middle Triassic Wianamatta Group is found on the Cumberland Lowlands. It lies over the Mittagong Formation or the Hawkesbury Sandstone and occupies about one third of the Sydney sheet. It is divided into two formations, the Ashfield Shale and the overlying Bringelly Shale. The Ashfield Shale is the most extensive and occurs to the west of Sydney. It also caps many ridges north of Sydney along the Pacific Highway and along two ridges extending north from Dural to Glenorie and Fiddletown. The Ashfield Shale consists of black to dark grey siltstone and laminate and fine to medium grained lithic sandstone. The Bringelly Shale consists of shale (claystone and siltstone), with occasional calcareous claystone, laminate, coal and fine to medium grained lithic sandstone. Small areas of Bringelly Shale occur at Castle Hill and Carlingford on the Hornsby Plateau and west
		Minchinbury	70	

Age	Group	Stratigraphic Unit	Indicative Depth (m)	Geological Description
		Sandstone		of Burwood in the Cumberland Lowlands.
		Ashfield Shale	110	
		Mittagong Formation	120	The Mittagong Formation consists of interbedded and laminated, fine to medium grained quartz sandstone and dark grey siltstone. This Formation occurs discontinuously as passage beds between the Hawkesbury Sandstone and the overlying Ashfield Shale of the Wianamatta Group. The Mittagong Formation outcrops irregularly on or near the plateau surface.
		Hawkesbury Sandstone	300	Sandstone outcrops extensively on the Hornsby Plateau and the Macdonald Ranges. Consists of medium to very coarse-grained quartz sandstone, very minor laminated mudstone, shale, claystone and siltstone lenses.
	Narrabeen Group	Burralow Subgroup	320	The Triassic Narrabeen Group outcrops in the Erina Hills along the coast north of Narrabeen. These sediments consist of interbedded laminate, shale, quartz sandstone, claystone, comglomerate and lithic sandstone.
		Gosford Subgroup	340	
Early Triassic	Narrabeen Group	Grose Subgroup		As above
		Gosford Subgroup	340	
		Caley Subgroup		
		Clifton Subgroup	360-660	
Late Permian		Gerringong Volcanics		Latite, trachyte tuff with pebbly bands, sandstone, minor siltstone and conglomerate.
	Singleton Supergroup	Newcastle Coal Measures		Coal seams, claystone, siltstone, sandstone, conglomerate, tuff and shale.
		Tomago Coal Measures		
	Maitland Group	Mulbring Siltstone		Lower fine-grained marine section and upper fine-grained marine part separated by minor regressive sandstone referred to as Nowra Sandstone in S and Muree Sandstone.
		Muree Sandstone		

Age	Group	Stratigraphic Unit	Indicative Depth (m)	Geological Description
		Branxton Formation		
	Shoalhaven Group	Berry Siltstone		Basaltic to andesitic lava and shallow intrusives, shoshonitic; sandstone, conglomerate, mudstone, siltstone, shale, claystone; rare tuff, carbonate, evaporite.
		Broughton Formation		
		Budgong Sandstone		
		Nowra Sandstone		
		Wandrawandian Siltstone		
	Narrabeen Group	Wombarra Claystone		Grey Shale and minor quartz-lithic sandstone.
		Coal Cliff Sandstone		Fine to medium grained quartz-lithic sandstone.
	Illawarra Coal Measures	Bulli Coal	690	Shale, quartz-lithic sandstone, grey siltstone and claystone, conglomerate, chert, sporadically carbonaceous mudstone, clay, laminate, and coal and torbanite seams.
		Loddon Sandstone		
		Balgownie Coal Member		
		Lawrence Sandstone		
		Eckersley Formation		
		Wongawilli Coal	750	
		Kembla Sandstone	760	
		Allans Creek Formation	770	
		Darkes Forest Sandstone	790	
		Bargo Claystone	820	
		Tongarra Coal	850	
Early Permian	Maitland Group	Branxton Formation		
		Greta Coal Measures		Coal seams, siltstone, sandstone, conglomerate.
	Shoalhaven Group	Wandrawandian Siltstone		
		Snapper Point Formation		

Age	Group	Stratigraphic Unit		Indicative Depth (m)	Geological Description
		Yadboro and Tallong Conglomerate			
		Pebbly Beach Formation			
	Talaterang Group	Clyde Coal Measures			
		Wasp Head Formation			
	Dalwood Group	Upper	Farley Formation		
			Rutherford Formation		
		Lower	Allandale Formation		
			Lochinvar Formation		
		Seaham Formation			
Late Carboniferous (Stephanian)		Paterson Volcanics			
		Johnson Formation			

Source: DPI, 2005

14.1.3 Site Geology

A bore log detailing geological characteristics on the Project Site was taken from the proposed Pit 4 area in 2002 (refer **Appendix I**). This shows that the Project Site is underlain by the lower part of the Bringelly Shale of the Wianamatta Group.

Table 51 provides a description of the three formations of the Wianamatta Group of relevance to the Project Site.

Table 51: Wianamatta Group Formations

Formation	Description
Bringelly Shale	Top most unit, comprising of: claystone, carbonaceous claystone, siltstone, laminite, sandstone and tuff. Maximum thickness of less than 250 m.
Minchinbury Sandstone	Quartz-lithic, fine to medium grained quartz lithic sandstone, separating the underlying Ashfield shale from overlying Bringelly shale; Thickness of up to 6 m.
Ashfield Shale	Basal dark grey to black sideritic siltstone, which becomes increasingly sandy towards the top, gradually passing into a laminite (Mulgoa laminite member); Thickness of about 45 to 60 m.

The mineralogical aspects of the Project Site are outlined in **Table 52**.

Table 52: Mineralogical aspects of the site

Mineral	Details
Siderite	Occurs throughout all lithologies as discrete nodules (irregular, ranging in size from 1 to 2 cm diameter, up to 10 cm in diameter). It occurs predominantly in non-carbonaceous units either concentrated along well defined bands, or distributed throughout the sequence, or as finely disseminated material throughout the horizon; Also occurs as small grains or granules in light grey siltstones, and as finely disseminated particles throughout the dark grey siltstone fractions of laminites; and Weathers to limonite in the weathered surface zones.
Calcite	Occurs as thin veins less than 1mm in thickness generally oblique to bedding, or as thicker horizontal bands (approximately 2 mm in thickness) interbedded with claystone, siltstone, or sandstone sequences; Occasionally found within siderite nodules; Calcite formation is a late stage of mineralisation that occurs after faulting; and Horizontal calcite bands have been recorded in all RP bore cores drilled throughout the area.

The Bringelly Shale layer has been excavated during the past 30 years of quarry operations on site. Characteristics of the Bringelly Shale are detailed in **Table 53**.

Table 53: Characteristics of Bringelly Shale

Bringelly Shale Characteristics	
Rock Types	Claystone, siltstone, laminate.
Mineralogy	Kaolinite (55%) Illite-smectite (mixed layer) Siderite (less than 10%, variably distributed mainly in the form of nodule layers and grain aggregates).
Plasticity	Moderate; PI5 (i.e. laminites) 8.5 (i.e. shales)
Fired Colour	Siderite *rich*: Orange/Red Siderite *poor*: Cream

The variable plasticity of the Bringelly Shale makes it suited for brick making operations involving extrusion, with shales having a higher plasticity and laminites having lower plasticity.

The variable Siderite content allows for a range of firing colours (i.e. cream to red) related to the amount of iron oxide present in the weathered Bringelly shale (i.e. fires red due to the presence of iron oxides, and fires white/cream due to a lack of iron oxides). The weathered Bringelly shale also offers a higher plasticity than unweathered Bringelly shale, making it suitable for extrusion and brick making.

With regard to brick making on the Project Site, the 'fired colours' can be broadly characterised as:

- Pale (white to cream): approximately 43%;
- Dark (red, orange, brown): approximately 46%; and
- Unknown: approximately 4%.

These individual layers with different fired colours can be selectively mined.

14.1.4 Soils

A review of the Soil Conservation Service maps *Penrith Soil Landscape Series Sheet 9030*, shows the dominant soil groups in the landscape are the Blacktown and South Creek soil landscapes as summarised in **Table 54**.

Table 54: Soil Characteristics and Limitations

Soil Landscape	Characteristics	Limitations
Blacktown	• The landscape is described as gently undulating rises on the Wianamatta Group shales and Hawkesbury shale; • Crests and ridges are broad (200-600 m) and rounded with gently inclined slopes; • Rock outcrop is absent; • Local relief is 10-30 m, slopes are usually <5% but up to 10%; and • Soils consist of shallow to moderately deep (<100 cm) *Red and Brown Podzolic Soils* on crests, upper slopes and well drained areas, and deep *Yellow Podzolic Soils and Soloths* on lower slopes and in areas of poor drainage.	• Soil limitations include moderately reactive highly plastic subsoil, low soil fertility and poor soil drainage; • Erosion hazard for non-concentrated flows is generally moderate and may range from moderate to high; • The general fertility of the soils is low to very low; and • Soils have low to moderate available water capacity, low Cation Exchange Capacity (CEC) values, hardsetting surfaces, very low phosphorus and low to very low nitrogen levels.
South Creek	• Landscape is described as flat to gently sloping alluvial plain with floodplains, valley flats and drainage depressions of the channels on the Cumberland Plain; • Slopes <5% and local relief <10 m; and • Soils are characterised as often very deep layered sediments over bedrock or relict soils. *Structured plastic clays* or *structured loams* are located in and immediately adjacent to drainage lines where pedogenesis has occurred. *Red* and *yellow podzolic soils* are most common on terraces with small areas of structured *grey clays, leached clay* and *yellow solodic soils.*	• Limitations associated with this soil type include flood hazard and very high to extreme erosion hazard. Streambank erosion and sheet erosion of floodplains are common; and • Other soil limitations include hardsetting surface, low fertility (low CEC, nitrogen and phosphorus), acidity (Acid Sulphate Soils - ASS), shrink swell potential, waterlogging, salinity and stoniness.

Areas of the Project Site adjacent to Badgerys Creek are also likely to encounter alluvium deposits, gravel, sand, silt and clay as described by the Sydney Geological Map Sheet 1:25000.

Soil management at the Project Site is generally well established, with controls in place to ensure erosion is minimised and sediment is captured on site, as discussed in **Section 14.3**.

14.1.5 Clay/Shale Resource

The DMR reports a known clay/shale resource reserve across the site, which is supported by geological investigations across the site.

The site geology has been extensively investigated since the development of the site to accommodate the Pacific Brick Plant in 1975. Detailed investigations of the southern and western portions of the Site, (which have since been quarried) took place in 1982, with eight diamond boreholes drilled at selected locations across this section of the site at drill depths ranging from 33m to 51m.

Subsequent investigations of the eastern and northern parts of the site, (the section of the site to which the current application relates), were undertaken in 1993. Investigations involved the drilling of 16 diamond boreholes of depths varying between 19.7m and 49.3m. For the purposes of the study, the eastern and northern parts of the site were divided into extraction cells (1-25) (refer to **Table 55**).

The ceramic properties of the site material were also tested. A wide variety of brick colours was produced including cream, light brown, light mid brown, light mauve, light orange brown, mauve and orange brown. Four colour categories were determined as follows:

- Category A (25% occurrence) – High grade cream, minimal to no discolouring
- Category B (36% occurrence) – includes light orange, light brown and dark cream
- Category C (32% occurrence) – includes light-mid brown, light mauve and light orange-brown
- Category D (7% occurrence) – includes mauve and orange-brown.

Site investigations identified the volume of resource available within the eastern and northern portions of the site (areas occupied by Pit 3, Pit 4 and Pit 5), as shown in **Table 55**.

Table 55: Volume of resource available within the eastern and northern portions of the site

Extraction Cell	Pit	Volume (m^3)					
		Category A	Category B	Category C	Category D	Completely weathered material	Partially weathered material
1	N/A	72,391	172,625	172,628	139,214	156,714	88,804
1a	N/A	294,153	45,644	167,363	-	268,628	114,808
2	Partly 5	62,208	43,067	373,253	-	120,764	88,309
3	5	-	513,876	90,684	-	165,633	162,320
4	5	92,273	28,391	73,345	42,587	66,274	157,732
5	5	132,593	340,953	-	-	69,486	79,908
6	4	183,526	-	162,749	-	32,916	-
7	4	222,294	54,338	212,354	-	83,670	17,738
8	Future	177,927	105,794	197,163	-	122,496	37,098
9	Future	158,117	117,006	41,110	-	177,660	-
10	Future	80,640	59,674	20,966	-	186,747	135,816
11	Future	82,965	30,697	21,571	-	192,131	139,732
12	Future	91,150	67,451	23,699	-	211,084	153,516
13	4	283,343	-	251,266	-	50,818	-
14	4	224,227	54,811	219,244	-	84,397	17,892
15	Future	184,852	136,790	48,061	-	52,815	124,995
16	Future	56,639	118,797	69,225	-	137,708	123,937
17	Future	104,481	77,316	27,165	-	241,956	175,968
18	Future	56,755	41,998	14,756	-	131,433	95,588
19	4	-	254,522	155,997	-	75,672	-
20	Partly 4/partly	-	111,633	207,319	-	61,416	122,832

Extraction	Pit	Volume (m^3)					
	future						
21	Future	-	97,603	181,264		65,616	160,759
22	Future	29,379	97,930	35,907	-	62,012	99,220
23	3	51,079	150,235	99,155	-	63,862	-
24	3	115,530	173,295	-	-	60,424	109,971
25	future	58,312	138,491	94,757	-	64,576	105,581

Investigations across the Project Site identified rock types consisting of claystone, carbonaceous claystone, siltstone, laminate, sandstone and rare thin coal bands.

Sandstones and laminites vary considerably in thickness and were found to be rarely continuous across the area studied on the Project Site or between adjacent boreholes.

Investigations found that Claystone and siltstone were the most dominant lithologies present on the Project Site, occurring in thin horizons less than 1m in thickness in the lower 14m of the Bringelly Shale, increasing to 4m in thickness above this level. Claystone-siltstone units comprise several types of fine grained sediment including light grey "leached" claystone, dark grey to black carbonaceous claystone and non-carbonaceous to slightly carbonaceous mid to dark grey claystone and siltstone.

Laminites include very thinly interbedded sequences of claystone, siltstone and sandstone. Laminites range from thinly interbedded siltstone-claystone laminites to more consistent sandstone-claystone laminites with sandstone comprising 90% of the unit. Laminites were found to be predominant in the lower parts of the sequences and in the sandy phases.

Sandstone was found to be prevalent throughout the Project Site and was recorded in all boreholes.

Cobbitty Claystone Bed is a weathered tuff horizon varying in thickness from 4cm to 6cm. It is predominately a cream to buff coloured, waxy clay and occurs on the Project Site overlying the Minchinbury Sandstone.

14.1.6 Geotechnical Assessment

D. Katauskas a Consulting Geotechnical Engineer examined Pits 1 and 2 to provide a qualitative assessment of the batter slope stability in 2005 producing a Geotechnical Assessment (see **Appendix J**). While it is acknowledged that the purpose of the examination was to gain an understanding of the slope stability of Pits 1 and 2, a number of generic comments were made relating to site operation and the geology in this region, which are applicable to further development on the site.

The assessment states that batter slope design is based on established practice and procedures with due regard to knowledge of the local geology and water drainage issues, rather than design principles, which is generally justifiable.

The assessment concludes in relation to the Project Site that "*no significant stabilisation works are required, however surface run-off should be properly managed*". The assessment's findings are likely to apply to Pits 3, 4 and 5 as they are to be used for the same purpose and are subject to similar geological conditions.

14.1.7 Historical Land use and Contaminated Land

While the majority of contaminated land is associated with industrial land use, there is the potential for historical land uses, such as livestock intensive industries, to result in soil contamination. The Project Site consists of, and is in the vicinity of, areas of agricultural and industrial lands that may have involved activities with the potential to result in contaminated materials.

An investigation of the DECCW Contaminated Land records for the Liverpool LGA indicated that the Project Site has not been recorded as a contaminated land or been remediated. Further, the Project Site is not to be used for a sensitive land use.

14.2 Potential Impacts

The proposed works could have potential impacts on the soils and geology of the Project Site including:

- Soil erosion and sedimentation;
- Sediment laden runoff;
- Poor drainage;

- Interception of Acid Sulfate Soils (ASS); and
- Potential contamination through fuel and oil spills.

14.2.1 Soil erosion and sedimentation

There is potential for soil erosion to arise on the Project Site at the quarry pits (past, present and future), the raw material and waste stockpiles and unsealed access roads, due to the removal of topsoil materials through clearing and excavation of pits. This erosion could give rise to migration of coarse to fine sediments in surface runoff.

14.2.2 Sediment laden runoff

The stockpiling of soil materials from excavation pits has the potential to result in sediment laden runoff and dust if not managed appropriately. These impacts could include an increased water content of the raw material extracted from current and future pits and may impact on the manoeuvrability of vehicles around the Project Site.

14.2.3 Poor drainage

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. In the flatter areas of the Project Site water is likely to pond impacting on vehicle movement and increasing erosion and sedimentation.

14.2.4 Interception of Acid Sulfate Soils

The Project Site is classified by the Australian Soil 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.

14.2.5 Potential contamination through fuel and oil spills

The Project Site is used for industrial purposes that include extensive vehicle movements and the importation of drill mud, both of which have the potential to contaminate soils through spillages during the unloading of drill mud and refuelling of vehicles. Additionally, there is the potential for oil leaks from vehicle engines.

14.3 Mitigation Measures

The continuation and expansion of operations at the Project Site would be governed by management practices in the SWMP, which would be updated as appropriate to reflect the proposed project.

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;
- Temporary structural methods (including silt fencing) would be used where required to protect newly treated areas, which are generally highly susceptible to erosion.
- Disused stockpiles would be revegetated;
- Bunding and batter slopes for new quarry pits would be designed to minimise the potential for erosion in accordance with the RP for the Project Site;
- Roadways would be maintained for the productive life of the pit;
- 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 RP for the Project Site (**Appendix D**);
- Overburden and unusable material would be used to rehabilitate Pit 2 such that no new stockpiles would be created; and
- Water carts would be used to assist with control of erosion.

14.4 Conclusion

Disturbances to the soils and geology are likely during the continuation and expansion of operations on the Project Site, however these impacts are likely to be locally confined and would be mitigated through the use of appropriate erosion and sediment controls and safeguards, as detailed in the SWMP.

15.0 Visual Impacts

This chapter considers the existing landscape setting of the Project Site and the key visual features related to the project. The chapter identifies key views and visual receptors and provides an assessment of the likely effect of the continuation and expansion of operations at the Site on the landscape characteristics and draws conclusions with regard to the potential impacts of the Project on visual amenity.

15.1 Existing Environment

15.1.1 Landscape Context

Land surrounding the Project Site is generally cleared and is characterised by rural residential development interspersed with agricultural enterprises and industry.

The landscape context is characterised by agricultural pastures and grasslands with some remnant or regrowth vegetation, particularly along drainage lines and creeks including Badgerys Creek, South Creek and tributaries.

The topography surrounding the Project Site is gently undulating. Land to the west of the Project Site rises to a spot height of 93 m AHD near Badgerys Creek. Further to the south-west, near The Northern Road, land rises to 110 m AHD and to the east, the land is undulating to flat, at a level of between 50 -70 m AHD.

15.1.2 Project Site

The Project Site occupies approximately 200 ha of relatively flat land.

The landscape of the Project Site is dominated by the existing quarry pits, voids, stockpiles, sedimentation basins, as well as structures including two residences (one tenanted, one vacant), a dairy and buildings associated with the single storey brick making facility.

Vegetation along South Creek, Badgerys Creek and the tributary of Badgerys Creek provides screening of the Project Site from neighbouring properties. Also, overburden mounds, bunds and vegetation provide some screening of the Project Site when viewed from surrounding properties.

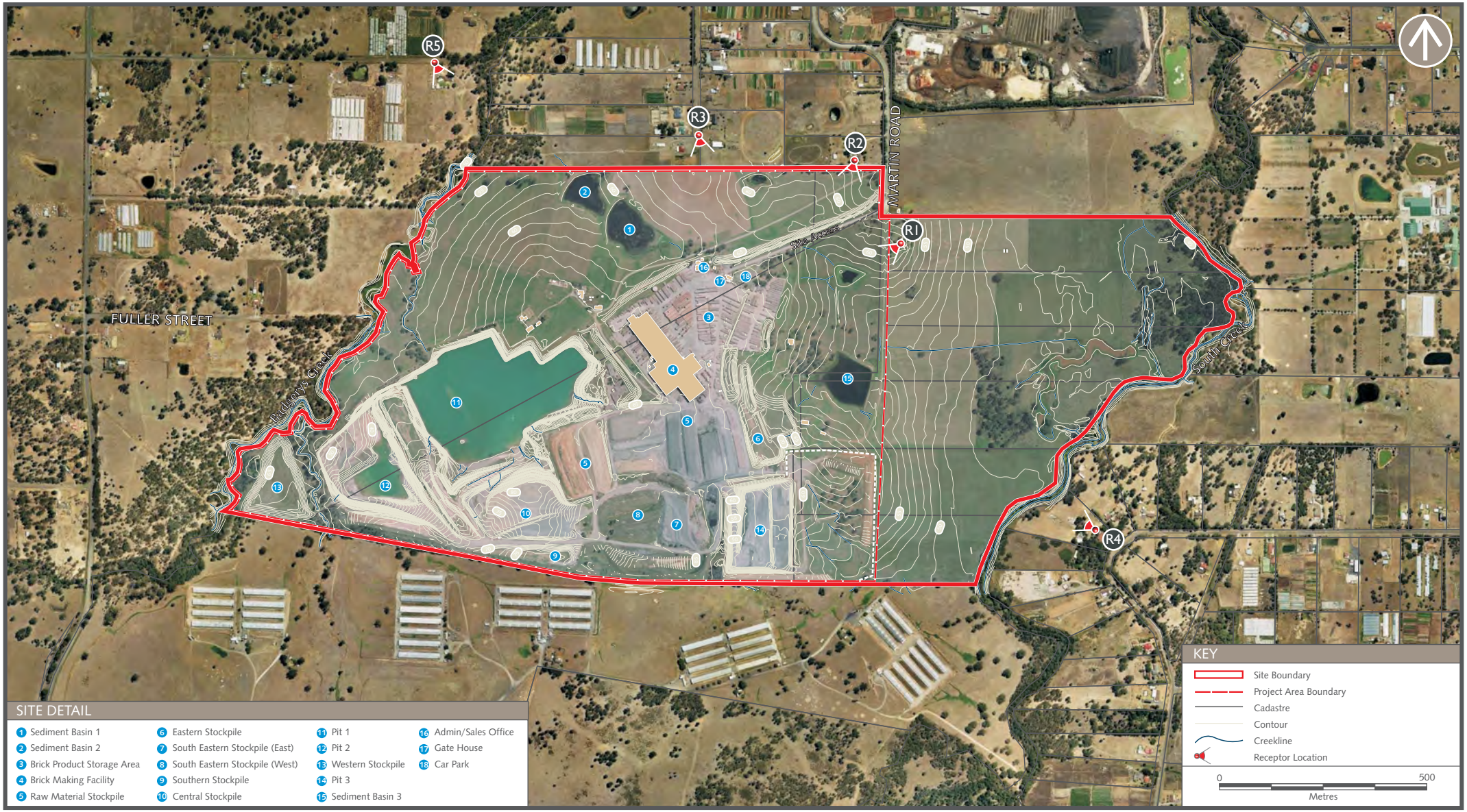
The portion of the Project Site east of Martin Road is pastoral land and is not actively quarried.

15.1.3 Visual Receptors

Analysis of topographical information and aerial photographs has determined a visual catchment, from which parts of the Project Site may be seen. Due to the relatively flat topography of the immediate area and low comparative height of Project Site features, the visual catchment does not extend beyond approximately 250 m. A residence at Fullers Street to the north west is approximately 270 m from the Project Site's western boundary and was not identified as a receptor as the topography and vegetation along Badgerys Creek screens the residence from views of the Project Site. The visual catchment can be defined further by selecting those locations that are permanent receptors (residences or public facilities) and those used by transient receptors (transport corridors and places of work).

Transient receptors surrounding the Project Site include Inghams chicken breeding farms to the south and northwest, dairy farming to the northeast, ANL to the northeast, and the local road network including Martins Road and Lawson Road.

Permanent receptors include various private landowners and residences as shown in **Figure 14** and described in **Table 56.**



AECOM

VISUAL RECEPTORS

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 14

Table 56: Permanent Receptors within Visual Catchment

Receptors	Location
R1 Dairy Farmer's residence	On Martin Road, within the north-eastern sector of the Project Site.
R2 Rural residential properties	The southern end of Martin Road, north of the Project Site entrance.
R3 Residential properties	The southern end of Lawson Road, along the northern Project Site boundary.
R4 Residential properties	East of South Creek on Victor Avenue.
R5 Residential properties	West of Badgerys Creek on Longleys Road.

Views of the Project Site from the R5 receptors are screened by thick vegetation along Badgerys Creek. The visual catchment for the R1 receptor would include the proposed Pit 4 and Pit 5 however, this property is leased from Boral and is located within the existing quarry. The focus of this visual assessment is therefore on the R2, R3 and R4 receptors.

15.2 Potential Impacts

As the Project Site is an existing quarry, which has been in operation for 30 years, potential visual impacts of the Project would be substantially the same as existing but would occur on different areas of the Project Site. Operations to the north and east of the brick making facility would represent the greatest potential for visual impacts. Project components that would generate potential visual impacts include the proposed quarry pits, proposed bunds and the use of equipment, machinery and vehicles throughout this area during quarry campaigns. As use of equipment, machinery and vehicles would be temporary and transient in nature, potential visual impacts would be primarily related to the future quarry pits and the bunds to be constructed along the northern and eastern boundaries of the Project Site. No additional stockpiles would be created as a result of the proposed works.

The future Pit 5 in the northern part of the Project Site would be located on land currently used for dairying and grazing and would therefore result in a change in the character and landscape of this portion of the Project Site. Receptors within the visual catchment of the future Pit 5 include R2 and R3. Rural residential properties to the west of Badgerys Creek, on Longleys Road, are partially screened by thick vegetation along Badgerys Creek resulting in minimal views of the Project Site from these properties. The future Pit 4 in the eastern sector of the Project Site, north of the Pit 3, would be located on land currently used for stock watering and irrigation of pastures. Receptors R1 and R4 would potentially have views of Pit 4.

The far eastern portion of the Project Site is not subject to quarrying activities under the current proposal and would remain open pasture land.

As the Project Site and its surrounding area are earmarked for future industrial use in the Metropolitan Strategy it is likely that potential future visual receptors in the surrounding area would be of an industrial nature, and not therefore, sensitive to any visual impact created by the site, in comparison to residential development.

15.3 Mitigation Measures

The potential visual impacts arising from the proposed project and proposed mitigation measures are summarised in **Table 57**.

Table 57: Potential visual impacts and proposed mitigation measures

Receptor	Pit 3	Pit 4	Pit 5
R1	Unobstructed views across cleared agricultural land. Views would be screened by proposed bunding along eastern Project Site boundary.	Direct views west onto the Future Pit 4. Views would be screened by proposed bunding along eastern Project Site boundary.	Currently unobstructed views to Pit 5 area. Views screened by bund along entrance road, existing operations and the Future Pit 4.
R2	Views screened by bund wall to the south of the entrance road. In the longer term, views would be further screened by proposed bunding along northern boundary.	Views screened by bund wall to the south of the entrance road. In the longer term, views would be further screened by proposed bunding along northern boundary.	Current views to Pit 5 area partially screened by bund wall. Views would be screened by proposed bunding along the northern site boundary.
R3	Views screened by existing operations (site office/sales area) and bund along entrance road. In the longer term, views would be further screened by proposed bunding along northern boundary.	Views restricted by existing site operations. In the longer term, views would be further screened by proposed bunding along northern boundary.	Currently unobstructed views to Pit 5 area. Views would be screened by proposed bunding along the northern Project Site boundary.
R4	Views currently screened by vegetation along South Creek. Views would be screened by proposed bunding along eastern Project Site boundary.	Views currently screened by vegetation along South Creek. Views would be screened by proposed bunding along eastern Project Site boundary.	Current views to proposed Pit 5 area screened by vegetation along South Creek, existing operations and brick making facility and bund along entrance road. Views would be further screened by proposed bunding along eastern Project Site boundary.
R5	Views restricted by vegetation along Badgerys Creek, existing operations and brick making facility. In the longer term, views would be screened by proposed bunding along northern site boundary and northern extent of western site boundary.	Views restricted by vegetation along Badgerys Creek, existing operations and brick making facility. In the longer term, views would be screened by proposed bunding along northern site boundary and northern extent of western site boundary.	Current views to Pit 5 area partially screened by vegetation surrounding Badgerys Creek. Views would be screened by proposed bunding along northern site boundary and northern extent of western site boundary.

In summary the following mitigation measures would be implemented as part of the Project in relation to visual impacts:

- Earthen bunds of approximately10 m in height would be established along the northern site boundary, eastern site boundary and the northern extent of the western site boundary to provide visual (as well as acoustic) screening of the Project Site from surrounding visual receptors;
- Existing disused stockpiles would be rehabilitated in accordance with the RP prepared for the Project Site and included as **Appendix D** to this EA; and
- A 50 m riparian corridor would be established along Badgerys Creek providing vegetative screening of the Project Site along the western boundary.

15.4 Conclusion

It is expected that the overall visual character of the site would remain largely unchanged as a result of the proposal, however the extent of disturbed areas would increase with the movement of extraction into Pits 4 and 5. Much of the Project Site would be screened from surrounding receivers by bunding along the northern and eastern site boundaries. Visually, the site would therefore be generally unobtrusive when viewed from surrounding properties and public roads. The proposal relates to an existing operation which has been in place on the site for some 30 years. The existing operation is generally integrated with the surrounding landscape and is not out of character with existing development which includes large-scale rural industrial and commercial operations such as ANL. Future land use is likely to include increased industrial development which would result in significant change to the existing surrounding land use character, within which the proposed operations would integrate with minimal impact. Proposed bunding 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.

16.0 Heritage

An Aboriginal Heritage Impact Assessment has been undertaken to inform the EA. The assessment establishes the Aboriginal heritage values of the proposed pit areas, identifies potential development impacts and provides management and mitigation measures to minimise any potential impact.

16.1 Existing Environment

16.1.1 Archaeological context

Over 4,000 archaeological sites have been recorded across the Sydney region, and hundreds have been excavated (Attenbrow 2002: 48). These sites commonly contain stone artefacts, midden material, engraved or pigmented images, and scarred trees. While these sites occur to varying frequencies in different regions, the archaeology of the Cumberland Plain is characterised by open stone artefact sites.

The prevailing climate and the availability of permanent water from South Creek and Badgerys Creek indicates that the study area is likely to have had sufficient resources to support medium sized groups of Aboriginal peoples. Evidence of such occupation is usually found in proximity to water sources. Additionally, the composition of current flora and fauna species is suggestive of Aboriginal occupation of the area.

16.1.2 Database investigations

A search of DECCW's AHIMS database conducted on the 22 October 2009 revealed 16 registered Aboriginal sites within a two kilometre radius of the study area. Two of these sites (45-5-2704 and 45-5-0213) lie within the Project Site. However, no AHIMS sites were located within the proposed Pit 3 Extension, Pit 4 and Pit 5 areas.

Additional information relating to the presence of Aboriginal heritage within the study area has been gathered from previous studies carried out in the Badgerys Creek area. Based on the distribution of Aboriginal archaeological sites described in previous reports and listed on the AHIMS register, it is predicted that artefacts are likely to occur in areas adjacent to creek lines and watercourses consisting of stone artefact scatters, stone flakes, cores and retouched implements.

A review of LLEP 2008 found that there are no European Heritage items listed on the Project Site. The closest Heritage Item in LLEP 2008 is located approximately 908 metres north west of the Project Site. Additionally, the State Heritage Register does not list any European Heritage items on the Project Site or in the vicinity of the Project Site.

16.1.3 Field survey

Due to the relatively small study area i.e. Pit 3, Pit 4 and Pit 5, complete survey coverage (100%) was considered the appropriate field methodology. Pedestrian survey was conducted on the 26 November 2009 within the proposed pit areas with archaeologists and Aboriginal stakeholder representatives walking in a line at approximately five metre intervals. Representatives from the GLALC, DCAC, DTAC, DACHA, YA, and DLO participated in the survey.

In addition to survey of the Pit 5 location itself, a section of Badgerys Creek located approximately 200 m west of the proposed pit area was also surveyed. This was considered prudent given the pit's close proximity to the creek.

Notes on landform, soils and surface exposure were recorded. Records consisted of descriptive notes, Differential Global Positioning System[3] (DGPS) positions (MGA format), and photographs. Artefact locations were recorded using a Trimble GEO-XM differential Global Positioning System (GPS).

16.1.4 Survey Findings

One Aboriginal site was recorded within the proposed quarry areas during the site survey. The site, BC-01-09 (MGA 292062E 6247272N), is located within the Pit 5 area on a level area, behind a derelict dairy complex, approximately 250 m from Badgerys Creek (**Figure 15**). The site is an isolated find consisting of one indurated mudstone broken flake on a cattle track. The area in which the find was made has been cleared of vegetation and used for grazing (refer to **Appendix K** for further information).

[3] Trimble GEO-XM, employing GPS Pathfinder Office software.

AECOM

PROPOSED WORKS AND ARCHAEOLOGICAL SITE LOCATIONS

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 15

Site types similar to BC-01-09 are commonly found within the Cumberland Plain and consequently are considered to have low significance based on rarity. As this site type is commonly found within the Cumberland Plain, it is well-represented in the local and regional picture and consequently the Project Site is considered to have low significance value based on representativeness. Additionally, it is considered to offer low research potential and hence has little potential to provide technological and tool information about the local and regional area.

Representatives from the six Aboriginal stakeholder groups were consulted regarding the cultural heritage values of the study area. Preliminary requests for information on cultural heritage values did not elicit any specific response.

16.2 Potential Impacts

16.2.1 Construction Impact

The proposed quarrying activity at Pit 5 would impact upon Site BC-01-09, which is considered to be of low significance value. Furthermore, the proposed quarrying would disturb the ground and therefore has the potential to impact upon unknown Aboriginal sites. However, the potential to disturb unknown intact sites is reduced by the previous agricultural use of the land. Additionally, areas of highest Aboriginal archaeological sensitivity within the region have been identified as occurring adjacent to Badgerys Creek and South Creek. Given that the proposed quarry plan does not encroach within 50 m of these creeks, impacts are not considered likely.

The potential location of Aboriginal artefacts in proximity to watercourses, previous disturbance of the ground and low significance of the one Aboriginal Site located within the study area indicates, that the potential for disturbance of artefacts is considered to be low. Consequently, it is considered that the works are unlikely to disturb significant Aboriginal sites.

16.2.2 Cumulative Impacts and Significance

The scientific significance of a heritage site is typically assessed by comparison with other sites. A stone artefact site which might be considered unexceptional in character compared to 100 other similar stone artefact sites in an area increases in value if the other 100 sites are destroyed. A significant number of Aboriginal stone tool sites of a similar nature to the site found within the area of future excavation have been previously recorded and excavated throughout the Cumberland Plain. A study recently undertaken for the development of Oran Park and Turner Road Precincts (ENSR AECOM 2009), 15 km south of the present study area provides adequate opportunities for future research, heritage conservation and education in relation to stone artefact sites (**Appendix K**). Consequently, the cumulative impact and significance of the Project Site's Aboriginal Heritage is considered to be low and the proposal would not lead to a cumulative decline in the value of Aboriginal heritage within the Cumberland Plain area.

16.3 Mitigation Measures

There are no known European heritage items on site or in the vicinity of the subject site.

Aboriginal Site BC-01-09, which is considered to be of low significance value would be impacted by proposed quarrying at Pit 5. The potential for further disturbance of artefacts is considered low, however, the following mitigation measures would be required to ensure that potential impacts are minimised:

- Should relics be uncovered during the course of the approved works, works shall cease. In cases where historical items have been uncovered, the NSW DoP Heritage Branch shall be advised or should indigenous items be uncovered the National Parks and Wildlife Service (NPWS) shall be advised;
- Workers/contractors shall be informed of their obligations under the NPW Act, namely that it is illegal to disturb, damage or destroy a relic without the prior approval of the Director General of the DECCW; and
- Should human remains be found in, on, or under the land during construction, the responsible party shall:
  - Contact the local police;
  - Not disturb or excavate the remains;
  - Immediately cease all work at the particular location;
  - Notify the DECCW office as soon as practicable and provide any available details of the remains and their location; and
  - Not recommence any work at the particular location until authorised in writing by the DECCW.

16.4 Conclusion

One Aboriginal site (BC-01-09) consisting of a single stone artefact would be impacted by the construction of Pit 5. However, this site was determined to have low archaeological (scientific) significance and the loss of this site would not have an impact on the heritage values of the study area. Additionally, a review of potential European Heritage sites was undertaken for the study area and found that no European Heritage items are located within the study area.

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17.0 Ecology

An Ecology Impact Assessment has been undertaken to inform the EA. This chapter considers the existing ecological environment and assesses potential impacts to flora and fauna as a result of the proposed works.

17.1 Introduction

The Project Site is located in the Sydney Basin Bioregion. Historically, the area comprised highly diverse vegetation communities of Coastal Valley Grassy Woodlands (Keith, 2004); however, the Project Site and surrounding areas are now highly modified as a result of extensive clearing.

17.2 Existing Environment

17.2.1 Ecological Communities

A site investigation carried out on 4 November 2009 indicated that three vegetation communities are present within the Boral property:

- Exotic Grassland;
- River Flat Eucalypt Forest on Coastal Floodplains (RFEF); and
- Cumberland Plain Woodland (Shale Hills Woodland and Shale Plains Woodland) (CPW).

These vegetation communities are described below and are shown in **Figure 16.**

Exotic Grassland

As a result of extensive clearing, the majority of the vegetation on the site comprises exotic grassland. This community also comprises isolated mature native trees and a ground cover of weeds and grasses.

Eucalyptus tereticornis (Forest Red Gum) is the only canopy species recorded in this community.

The ground cover mainly comprises weed and grass species common to modified land such as;

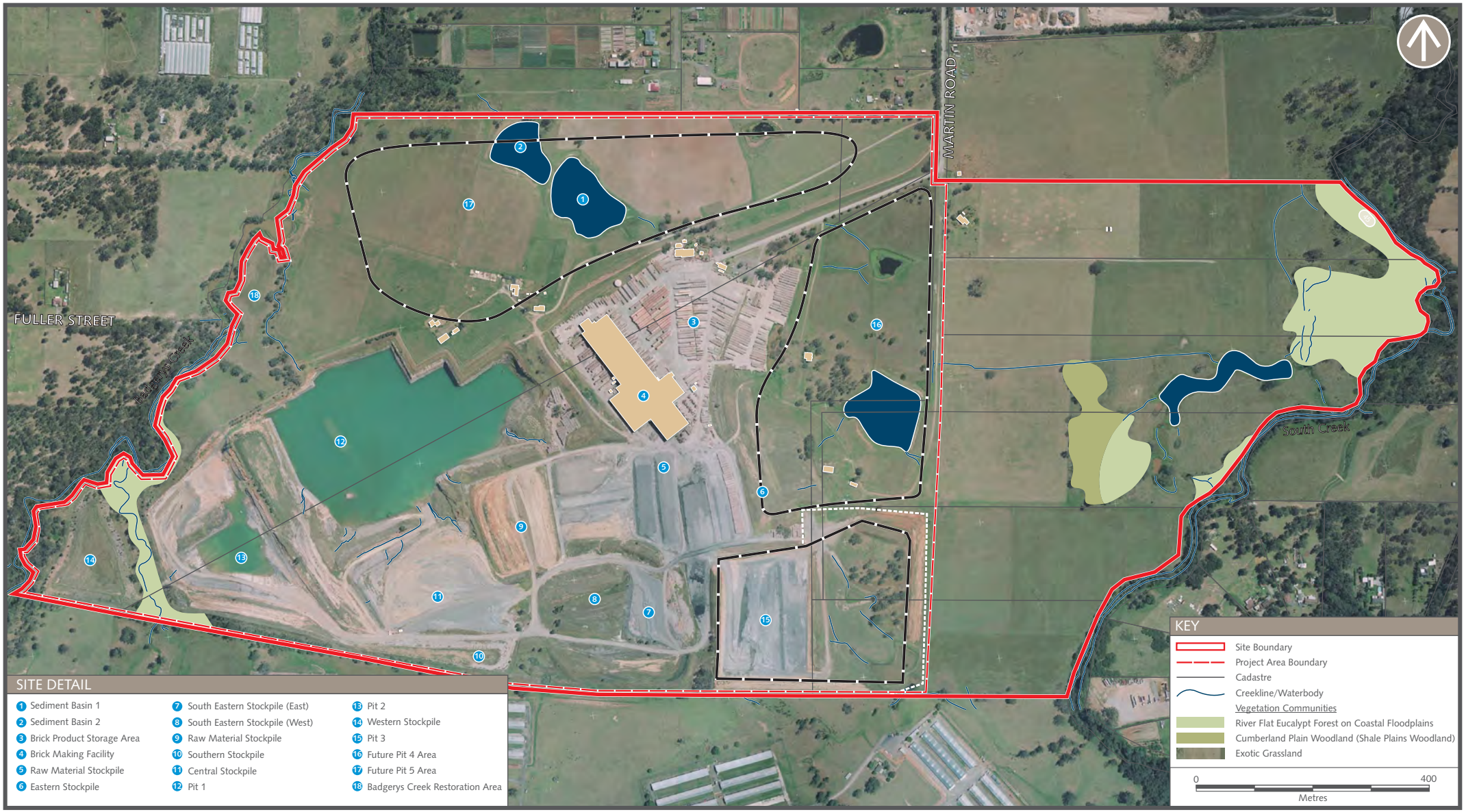
- *Chloris gayana, C. virgata* and *C. truncata* (Rhodes Grass).
- *Setaria pumila* (Pale Pigeon Grass).

The habitat value of this vegetation community is restricted to the scattered native trees, particularly those that occur in the vicinity of waterbodies. These trees provide habitat and refuge for species utilising any available water contained within the waterbodies.

River Flat Eucalypt Forest

RFEF is an endangered ecological community (EEC) listed under the TSC Act. It is found on the river flats of the coastal floodplains and comprises a tall open tree layer of eucalypts, such as Forest Red Gum, *Eucalyptus amplifolia* (Cabbage Gum), *Angophora floribunda* (Rough-barked Apple) and *A. subvelutina* (Broad-leaved Apple). Smaller trees include *Melaleuca decora, M. styphelioides* (Prickly-leaved Teatree), *Backhousia myrtifolia* (Grey Myrtle), *Melia azaderach* (White Cedar), *Casuarina cunninghamiana* (River Oak) and *C. glauca* (Swamp Oak). Scattered shrubs include *Bursaria spinosa, Solanum prinophyllum, Rubus parvifolius, Breynia oblongifolia, Ozothamnus diosmifolius, Hymenanthera dentata, Acacia floribunda* and *Phyllanthus gunnii*. The groundcover is composed of abundant forbs, scramblers and grasses including *Microlaena stipoides, Dichondra repens, Glycine clandestina, Oplismenus aemulus, Desmodium gunnii, Pratia purpurascens, Entolasia marginata, Oxalis perennans* and *Veronica plebeia*.

The riparian vegetation along Badgerys Creek, the Badgerys Creek tributary located in the south west portion of the Project Site between Pit 2 and the western stockpile as well as along South Creek comprises this EEC. The vegetation in this area is degraded and lacks a diverse species assemblage.



AECOM

VEGETATION COMMUNITIES

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 16

Cumberland Plain Woodland

Between the riparian areas and the open paddocks, there is an ecotonal change from RFEF to CPW. CPW is an EEC listed under the TSC Act and EPBC Act. Two forms of CPW have been identified in vegetation mapping of the area: Shale Plains Woodland and Shale Hills Woodland.

Shale Plains Woodland is the most widely distributed and is the form that occurs at the Project Site (NSW NPWS, 2004). The dominant canopy trees comprise *Eucalyptus moluccana* (Grey Box) and Forest Red Gum. The shrub layer is dominated by *Bursaria spinosa* (Blackthorn) and it is common to find abundant grasses such as *Themeda triandra* (Kangaroo Grass) and *Microlaena stipoides var stipoides* (Weeping Meadow Grass).

This EEC occurs in small patches scattered throughout the Project Site and is likely to have once covered most of the cleared areas, which is evidenced by the presence of mature Forest Red Gum in these areas. The patches are degraded and some are likely to have resulted from the regeneration of cleared Shale Plains Woodland as the stands are monotypic, consisting of young trees. It is likely they have regenerated from the seed store of cleared woodland or individual remnant Forest Red Gums.

Shale Hills Woodland does not occur at the Project Site.

17.2.2 Flora

The flora investigation assessed the structural characteristics and condition of the vegetation, the presence of non-native species and the dominant species in each structural component of the vegetation.

General Description

As a result of extensive clearing at the property, vegetation is restricted to Badgerys and South Creeks, scattered patches and isolated trees throughout the property. Remnant vegetation is restricted to the scattered paddock trees with the remaining vegetation comprising regrowth.

The vegetation patches are generally in poor condition with a lack of diversity and degraded understorey and ground layer. This is likely a result of historical clearing and current grazing activities.

The riparian vegetation is dominated by species associated with RFEF such as Forest Red Gum, Cabbage Gum, Rough-barked Apple and River Oak. The understorey is dominated by *Melaleuca decora* (White-feather Honeymyrtle) and Blackthorn. Sections of the understorey are dominated by introduced species. The ground layer is dominated by pasture grasses and weeds. A native ground layer is largely lacking.

Vegetation occurring in the paddocks is degraded and comprises stands of trees and scattered paddock trees. Forest Red Gum is the main canopy species and occurs as isolated remnant trees and small regrowth patches. An understorey is lacking and the groundcover comprises introduced pasture grasses.

Threatened Flora

A search of the NSW DECCW Wildlife Atlas (DECC, 2007) and the *EPBC Protected Matters Search Tool* (DEWHA, 2009) was conducted on the 3 November 2009 to obtain ecological information within 20 km of the Project Site. The results of these searches are provided in **Appendix L**.

A total of 16 flora species known or potentially occurring within 10 km of the Project Site are identified as being endangered or vulnerable under the EPBC Act and / or the TSC Act. Of these, 10 are EPBC Act listed species (1 critically endangered, 3 endangered and 6 vulnerable) and 14 are listed under the TSC Act (10 endangered and 4 vulnerable).

None of the threatened flora species were recorded at the Project Site and none are considered to have potential habitat within the proposed development area.

Appendix L lists these species, their preferred habitat and whether the species or their preferred habitat was recorded during the field inspection.

Weeds

The following declared weeds were recorded in the riparian vegetation along South Creek and Badgerys Creek:

- *Lantana camara* (Lantana).
- *Rubus fruticosis* (Blackberry).

These weeds are listed as noxious weeds under the NW Act in the Liverpool LGA. Both weeds are also recognised by the Commonwealth Government as Weeds of National Significance (WONS).

17.2.3 Fauna

The fauna values of the study area were based upon an assessment of habitat quality and condition.

General Description

Fauna habitat values within the proposed quarry footprint are limited due to the degraded nature of the Project Site. There are no hollow bearing trees, fallen logs, leaf litter or dense understorey and groundcover.

Within the vegetated areas on the property that occur outside the proposed quarry footprint, there are some scattered tree hollows (with a hollow entrance diameter of less than 20 cm) and some scattered fallen logs. Leaf litter is scarce. This vegetation is likely to provide foraging and shelter resources for common native species, particularly birds. The creeks and artificial waterbodies provide habitat for aquatic species such as ducks and frogs.

SEPP 44 Koala Habitat Protection

SEPP 44 applies to the Project Site as it falls within the Liverpool LGA, which is listed in Schedule 1 of the SEPP. A number of Forest Red Gums were observed at the Project Site. These were confined to the vegetated areas around Badgerys Creek, South Creek and small patches in the eastern portion of the Project Site. It is estimated that Forest Red Gum comprises greater than 15 % of the vegetated area of the Project Site; however, no koalas and no evidence of recent koala activity was observed; i.e., there were no scratch marks or koala scats observed at the Project Site. Thus, the Project Site does not appear to contain core koala habitat.

Threatened Fauna

A total of 29 fauna species known or potentially occurring within 10 km of the Project Site are identified as being endangered or vulnerable under the EPBC Act and / or the TSC Act. Of these, 16 are EPBC Act listed species (5 endangered and 11 vulnerable) and 22 are listed under the TSC Act (7 endangered and 15 vulnerable). Appendix A of the Ecology Assessment Report (refer to **Appendix L)** lists these species, their preferred habitat and demonstrates that none of the threatened fauna species were recorded at the Project Site and none are considered to have potential habitat within the proposed development area.

17.2.4 Aquatic Habitats

The Project Site is bounded to the east by South Creek and to the west by Badgerys Creek. A tributary of Badgerys Creek also occurs in the south west portion of the Project Site, between the Phase 2 Pit and the Western Stockpile as has previously been described. Two sediment ponds occur to the north of Pit 1 in the location of the proposed Pit 5 and two dams occur in the east portion of the Project Site, in the location of the proposed Pit 4.

One of the sedimentation ponds is located within the proposed area for Pit 4 and would be removed as quarrying progresses across the Project Site. The habitat value of the sedimentation ponds is limited, as significant vegetation does not occur within the water or in its immediate vicinity. The sediment ponds do not provide habitat for threatened species, populations or ecological communities listed under the FM Act. The ponds are used by common aquatic birds such as ducks and may be used as a water resource by other common native species that occur in the area.

17.2.5 Wildlife Corridors

Wildlife corridors have been identified in the *Liverpool City Council Biodiversity Strategy* (LCC, 2003) as contributing to the maintenance of healthy wildlife populations and biodiversity. In particular, riparian corridors and buffer systems have been identified as being of importance to enhance local connectivity and viability of remnant vegetation (Liverpool City Council, 2003).

The vegetation along Badgerys Creek and South Creek form narrow riparian corridors. While this riparian vegetation is degraded, its importance is increased due to the lack of remnant native vegetation throughout the surrounding area. The local area has undergone extensive clearing and there are no substantial native bushland areas within 5 km of the Project Site. Kemps Creek Nature Reserve is a small area of native bushland located 3.8 km to the east of the Project Site, however, there are no direct linkages between this reserve and the vegetation at the Project Site.

17.2.6 Critical Habitat and Threatened Populations

There are no areas of declared critical habitat within or in the vicinity of the Project Site.

Two threatened populations occur or have the potential to occur within 10 km of the Project Site:

- *Marsdenia viridiflora* subsp. *viridiflora* (*Marsdenia viridiflora* subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs).

This species is a climber with twining stems to 4 m high. It grows in vine thickets and open shale woodland. There is no habitat for this species on the Project Site.

- *Dillwynia tenuifolia* (*Dillwynia tenuifolia,* Kemps Creek)

This endangered population occurs in the area bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek (DECC, 2005). This area is located approximately 2.5 km to the northeast of the Project Site.

17.3 Potential Impacts

The proposed works would occur in areas that have already been largely cleared to accommodate past and current uses of the land. The works would involve clearing of the vegetation within the proposed quarry footprint, including some of the isolated mature native trees and the stand of regrowth Forest Red Gum that occurs within proposed location of Pit 4.

The proposed development has been sited to minimise the extent of native vegetation to be cleared and to avoid the EECs that occur at the Project Site. As a result, impacts to the ecological values of the Project Site are assessed to be minimal as the works would be restricted to areas that are already cleared and degraded.

17.3.1 Threatened Ecological Communities, Populations and Species

As shown in **Figure 16**, it is unlikely that threatened flora species occur within the proposed quarry footprint as it comprises exotic grassland.

The areas with potential to be used by threatened fauna species for foraging or shelter, such as the woodland areas in the vicinity of Badgerys Creek and South Creek, would not be affected by the proposed development. The habitat requirements of the threatened species listed in **Appendix L** include flowering eucalypts, tree hollows, fallen logs and a dense native shrub or grass understorey. These habitat values do not occur in the Project Site and would not be affected by the proposed development.

The proposed development would not impact upon the EECs at the Project Site as they occur outside the proposed quarry footprint. A 50 m buffer around Badgerys Creek and South Creek would be maintained and rehabilitated as part of the proposal.

17.3.2 Key Threatening Processes

The 'Clearing of native vegetation' is a Key Threatening Process under Schedule 3 of the TSC Act. Tree clearing impacts threatened species by many mechanisms, including the reduction in nest sites, particularly tree hollows, reduction in food resources; for example, loss of nectar producing trees and mistletoes, loss of woody debris that provide habitat for invertebrates and small terrestrial vertebrates and loss of grass seed. Fragmentation also allows aggressive species, both native and exotic, to compete for food and nest sites.

The proposed works would involve clearing of native vegetation. However, the native vegetation to be removed is restricted to isolated paddock trees and a patch of regrowth Forest Red Gum and would not significantly impact significant species. The removal of these trees would be offset by the proposed mitigation measures, in particular, rehabilitation of a 50 m buffer area along Badgerys Creek.

17.3.3 Aquatic Habitats

A man-made sedimentation pond falls within the proposed quarry footprint. This sedimentation pond does not contain habitat for threatened aquatic species, populations or ecological communities. The works do not involve a key threatening process, as listed under the FM Act.

Other aquatic habitats that occur on or adjoining the Project Site would not be affected by the proposed works.

17.4 Mitigation Measures

The following measures are recommended to minimise potential impacts associated with tree removal:

- The canopy of the trees is to be visually inspected prior to clearing to assess for the presence of fauna. Where bird species are detected the tree is to be nudged prior to felling to encourage the fauna to vacate the tree prior to felling. The trees should be left in situ until the birds leave the canopy.
- Felled trees should be left in-situ for at least 24 hours to allow fauna species to relocate. Ensure qualified personnel are on hand to check for wildlife and relocate them.
- Felled wood should be relocated to the remnant woodland (and not placed in piles) or chipped and used in rehabilitation areas.
- If any wildlife is inadvertently injured during the proposed works, WIRES or an accredited veterinarian should be contacted.
- A 50 m buffer area should be provided along Badgerys Creek and the Badgerys Creek tributary. This area is to undergo rehabilitation works in accordance with the RP prepared as part of this EA.
- Five native tree seedlings should be planted for each mature native tree that is removed. The plantings should be located adjacent to the riparian vegetation along Badgerys Creek and its tributary.

17.5 Conclusion

The ecological values of the proposed quarry footprint are limited as these areas have been largely cleared. The proposed works have been sited to avoid areas containing EECs. The vegetation that occurs within the proposed Pit 4 and Pit 5 areas comprises exotic grassland with some isolated mature native trees and regrowth patches of vegetation.

The proposed works would not have a significant impact on the ecological values of the Project Site. Rehabilitation works would be undertaken in the riparian areas adjacent to Badgerys Creek and the Badgerys Creek tributary.

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18.0 Socio-Economic Impacts

This Chapter examines the social and economic environment within which the project is located and the potential interactions of the project with this environment.

18.1 Existing Environment

18.1.1 Community Profile

The City of Liverpool is located in Sydney's South West subregion approximately 25 km from the Sydney CBD. Liverpool LGA is bounded by Penrith and Fairfield LGAs in the north, Bankstown City in the east, Sutherland Shire in the south-east, Campbelltown and the Camden LGAs in the south and Wollondilly Shire in the west.

Liverpool is a rapidly growing residential area with substantial industrial, commercial and rural areas. Liverpool LGA encompasses a total land area of approximately 305 km^2, including extensive military training facilities in the Holsworthy-Moorebank area (Liverpool Community Profile, 2008).

In the period 2003 – 2008, Liverpool LGA experienced moderate growth with an increase of 1.4% and 1.9% for the 2007 - 2008 year, ranking amongst the top four fastest growing LGAs in the State (ABS, 2009). It is expected that Liverpool LGA will continue to experience growth in the land release areas within the SWGC, which is expected to be developed within the next 30 years.

Analysis of the age structure of the Liverpool LGA in 2006 compared to the State shows Liverpool has a relatively young population comparative to the NSW average with a higher percentage of the population aged under 54, and fewer mature and aged adults over 54 as shown in **Table 58.** The median age is significantly lower at 32 years compared to the NSW average of 37.

Table 58: Age summary for Liverpool LGA (2006 Census)

Characteristic	Liverpool		NSW Average	
	No. of persons	% of persons	No. of persons	% of persons
Infants (0-4)	13,605	8.3	420,434	6.4
Children (5-14)	27,322	16.6	878,483	13.4
Young Adults (15-24)	23,876	14.5	871,714	13.3
Adults (25-54)	72,135	43.8	2,753,218	42.0
Mature Adults (55-64)	14,105	8.6	719,551	11.0
Aged (65+)	13,559	8.2	905,778	13.8
Population (total)	**164,602**		**6,549,177**	
Median age of persons	32		37	

Source: ABS Census 2006

18.1.2 Predicted Growth in the South West

The South West Subregion is comprised of four LGAs including Camden, Campbelltown, Liverpool and Wollondilly. As discussed in **Section 12.3**, the subregion includes the SWGC which is projected to include 155,000 new dwellings with a population of over 230,000, and supply 89,000 new jobs within existing and future employment and industrial lands.

Liverpool's population is set to significantly increase in the next 10 to 20 years (as illustrated in **Table 59**), with many of the area's rural suburbs set aside for high density residential housing development.

The *NSW Statistical Local Area Population Projections 2001 – 2031* (2005 release) issued by the DIPNR (now DoP) outlines the projected population for LGAs as part of the SWGC.

Table 59: Population Projections of within the SWGC 2001-2031

LGA	Year							Average Growth (%)[1]	
	2001	2006	2011	2016	2021	2026	2031	Annual	Total
Camden	45450	52080	63660	80420	109390	136760	165140	3.8	2.6
Campbelltown	150150	152600	159760	167680	178150	184410	187000	0.3	0.2
Wollondilly	38420	42240	46050	48850	51710	54380	56800	0.9	0.5
Liverpool	159050	174040	192860	213920	228770	247500	266160	1.5	0.7

Source: NSW Statistical Local Area Population Projections 2001-2031 (2005 release)

Liverpool maintains the highest population of all LGAs within the SWGC and has a rapidly growing population. The likely population increase in the area over the life of the project may have implications in terms of social impacts. However, the predicted growth in the SWGC provides a ready market for product from the Boral brick making Facility. The proposed site's proximity to this large potential market would ensure that travel costs and impacts such as GHG emissions and added road traffic are minimised. Furthermore demand for the proposal's product would also be expected from new industrial premises to be located within close proximity of the Project Site.

18.1.3 Economic Profile

Employment

Liverpool LGA has a greater proportion of its workforce in full time employment compared to the State average, although it also had a significantly higher unemployment level of 7.1% in 2006 as shown in **Table 60**. The economic structure of the area is reasonably diverse with almost a fifth of the workforce engaged in manufacturing activities and almost 14% in the construction trades, both of which Boral operations encompass.

Table 60: Employment summary for Liverpool LGA

Employment Status	Liverpool LGA		NSW	
	No. of persons	%	No. of persons	%
Full time	46,914	64.3	1,879,631	60.8
Part time	16,058	22.0	842,714	27.2
Employed Away*	2,064	2.8	103,522	3.3
Employed Not stated	2,682	3.7	83,576	2.7
Employed (total)	67,718	92.9	2,909,443	94.1
Unemployed (total)	5,213	7.1	183,157	5.9

Source: ABS Census 2006

Income

Table 61 shows that median incomes in the Liverpool LGA are comparable with average incomes across the State as a whole. It is noted however that one half of the population surveyed earned less than $500 per week which is a direct reflection of the employment distribution in the area.

Table 61: Personal Income data

Income	Liverpool	NSW
Median individual income ($/weekly)	440	461
Median household income ($/weekly)	1,082	1,036
Median family income ($/weekly)	1,155	1,181

18.2 Potential Impacts

The quarry and brick making facility has been operating from the Project Site for the last 30 years without adverse impact on surrounding land uses. 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 at **Chapters 8, 9, 12, 13, 15** and **17** of this report.

18.2.1 Social

The potential social impacts of the project relate largely to impacts on general amenity such as visual, noise, air quality (dust) and traffic impacts as well as land use impacts. These potential impacts would be largely related to the quarrying activities. A range of mitigation measures have been recommended throughout this EA that would be implemented as part of the project to ensure that potential social impacts are minimised.

Visual impacts are not expected to be significant due to the existing character of the Project Site and the lack of sensitive visual receptors. Screening and rehabilitation works would be undertaken where appropriate as described in **Section 4.3** of the EA. Continued operations at the Project Site would remain consistent with future industrial land use identified for the SWGC.

The proposal would continue to provide social benefits through the ongoing employment of full time / part time staff and contractors. The Project would not place additional strain on community or social infrastructure in the local area over and above existing impacts, which have been minimised through effective communication with the local community. Boral has during past operations maintained a good relationship with its residential neighbours and would continue to maintain a complaints register and provide a prompt response to any issues that may arise.

18.2.2 Economic

As discussed previously in this EA, the importance of securing a cost-effective materials supply to meet the demands of future residential, commercial and industrial development is considered vital to the social and economic growth of the local area and the South West region. 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 proposal would have a continued positive economic impact on the local area and wider South West region through the direct flow of construction and operation expenditure to staff and contractors. Continued operations would generate approximately $5 million in capital investment value expenditure and continue to employ approximately 76 staff and up to ten direct contract employees related to the quarrying of pits, the operation of the brick making facility and general transport works such as forklift or heavy vehicle drivers. Indirect employment would also be generated through demand for goods and services 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.

18.3 Mitigation Measures

Safeguards addressing potential social impacts related to land use, noise, air quality, traffic and visual impacts are provided throughout this EA. 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.

18.4 Conclusion

Potential social impacts of the project are related to visual, noise, air quality (dust) and traffic impacts as well as land use impacts, which are largely related to the quarrying activities. The location of the Project Site within the SWGC means that surrounding development is likely to change significantly over the life of the Project. A range of mitigation measures have been recommended throughout this EA which consider the changing nature of the Project Site surrounds. These mitigation measures would be implemented as part of the project to ensure that potential social impacts are minimised.

The Project Site's proximity to the SWGC provides a ready market for the product. The Project Site's market proximity would ensure that travel costs and impacts such as GHG emissions, noise and congestion are minimised.

The residual socio-economic impacts of the Project are considered to be generally positive, given that the quarry/brick making facility has been operating on the Project Site for the past thirty years without significant adverse impacts upon amenity and the contribution the project stands to make in the local and wider area in economic terms.

19.0 Waste

This chapter addresses the legislative requirements and classification of waste management in NSW, and details waste generation anticipated from the proposed continuation and expansion of operations on the Project Site. Mitigation measures and proposed waste management procedures are detailed to manage waste generation and minimise potential generation of waste.

19.1 Overview

The *NSW Waste Avoidance and Resource Recovery Strategy 2007* (the Waste Strategy) sets out principles promoting the adoption of measures which avoid unnecessary resource consumption, and encourage resource recovery, including reuse, reprocessing, recycling and energy recovery. Four key areas are identified where outcomes must be achieved in order to avoid and manage waste. These include:

- Preventing and avoiding waste;
- Increasing use of recovery and use of secondary materials;
- Reducing toxicity in products and materials; and
- Reducing litter and illegal dumping.

Waste management measures proposed for the Project Site would encourage efficient resource use alternatives, re-use and recycling. Waste that cannot be re-used or recycled would be disposed of in an appropriate manner.

The DECCW Waste Classification Guidelines (DECC, 2008) describe a number of pre-classified wastes and provide specific direction on the classification of wastes, based on chemical composition and associated environmental impacts. Waste streams require different management, transportation and disposal depending on their classification. The six waste categories are:

- Special waste (e.g. Clinical and related, asbestos and tyres);
- Liquid waste;
- Hazardous waste (e.g. waste with pH ≤ 2, coal tar, lead paint waste, etc);
- Restricted solid waste;
- General solid waste (putrescibles) (e.g. household wastes, manure, food wastes, etc); and
- General solid waste (non-putrescible) (e.g. glass, plastic, rubber, garden waste, etc).

Potential wastes generated from the continuation of operations on the Project Site are described in the following sections.

19.2 Boral Waste Management Plan

Boral has a *Standard Operating Procedures Waste Management Plan* (August 2009, (WMP)) which details the waste management strategy used on the Project Site (refer to **Appendix M**). The aim of this plan is to *ensure that the amount of waste to landfill is reduced and also to minimise the harm on the environment*. This plan outlines the responsibilities of those on site and details the waste management procedures for a range of wastes including:

- Clean Green, dry and fired brick waste:
  - DECC Waste Classification: Solid '*Non-chemical waste generated from manufacturing and services (free from metal, timber, paper, ceramics, plastics, thermosets and composites)*';
  - 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 brick making process.

- Yard and sales area waste:
  - This waste is deemed 'clean' unless contaminated by other material, such as concrete, soil, grass, wood and metal;
  - Only clean brick waste can be re-used in the brick making process;
  - Waste streams from these areas are identified as:
    - Truck transport damage;
    - Returns from the site;
    - Display walls replaced;
    - Dropped packs;
    - Broken packaging;
    - Forklift damage; and
    - Sample boxes.
  - Every effort is made to eliminate any contaminants from these waste streams before it is added to the clean waste area for reuse in brickmaking.
- Contaminated waste:
  - DECC Waste Classification: *Solid 'Non-chemical waste generated from manufacturing and services (including metal, timber, paper, ceramics, plastics, thermosets and composites)'*;
  - Contaminated green and dry waste is placed in the red steel bins provided on the Project Site;
  - These red bins are emptied in the Contaminated Waste Storage Area;
  - Due to the contaminants in this area, the material is not used as a raw material for brick making.
- Waste oil:
  - DECC Waste Classification: *Liquid Group A;*
  - Waste oil is collected by a nominated, licensed, waste oil recycler.
- Empty oil drums:
  - DECC Waste Classification: *Solid ' Non-chemical waste generated from manufacturing and services (including metal, timber, paper, ceramics, plastics, thermosets and composites)'*;
  - Empty oil drums are purged to ensure residual oil is removed and to prevent content seepage. The drums are then placed into the scrap metal bins on the Project Site.
- General waste:
  - DECC Waste Classification: *Solid Municipal Waste;*
  - Includes other general waste including strapping, plastic wrapping, raw material bags, solid building waste, oily rags, gloves and wood;
  - Placed in green or blue wheelie bins, which are subsequently loaded into blue Veolia bins.
- Effluent:
  - DECC Waste Classification: *Liquid Group C*;
  - Plant, Office and Farmhouse Sewage Systems – Liquid effluent is managed via absorption trenches. Retained solid effluent is removed by an effluent disposal contractor monthly for the Office and bi-annually for the Plant and Farmhouse;
  - Despatch Hut Sewage System – effluent is removed by an effluent disposal contractor weekly.
- Waste water:
  - The Project Site SWMP allows for zero discharge to offsite waterways.

- Scrap metal:
  - DECC Waste Classification: *Solid 'Non-chemical waste generated from manufacturing and services (including metal, timber, paper, ceramics, plastics, thermosets and composites)';*
  - Scrap is sorted into steel, copper wire and electric motors;
  - General steel products are disposed of in the general scrap metal bin;
  - Copper wire and electric motors are separated, stacked and stored separately;
  - Collection is arranged as required.

To date, the WMP has been successful in appropriately managing the wastes on site.

19.3 Potential Impacts

The proposed continuation and expansion of operations on the Project Site is not anticipated to impact significant on waste generation and management. The quarry operates on a campaign basis, consisting of a two to three month long campaign per year and the proposed operations would continue to occur on this basis. The waste generated from quarrying activities is therefore expected to remain generally consistent.

The types of waste generated through the continuation and expansion of operations on the Project Site would be the same as those listed above. It is anticipated that the existing WMP for the Project Site would adequately manage this waste generation.

19.4 Mitigation Measures

Throughout the continuation and expansion of operations on the Project Site, management measures would be implemented in accordance with the existing WMP in order to ensure that waste generation is minimised and that waste suitable for reuse or recycling is handled appropriately

The following environmental safeguards would be implemented to ensure that waste generated on site is minimised:

- The WMP for the Project Site would be followed and updated as required;
- Waste generated on the Project Site would be reused or recycled where possible (as per the WMP);
- Waste to be disposed offsite would be classified, transported and disposed of in accordance with the *Waste Classification Guidelines* (*DECCW, 2008*); and
- Plant Managers, Team Leaders, Operators, visitors and contractors would be informed of waste management and disposal procedures to be undertaken on site.

19.5 Conclusion

The continuation of operations on the Project Site would result in the generation of types and quantities of wastes comparable with current waste streams. Potential waste management impacts would be minimised through the use of appropriate mitigation and management measures and through the continued implementation of the WMP for the Project Site.

The generation of waste from the continuation of operations on the Project Site is therefore considered to be manageable and does not represent a significant constraint to the project.

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20.0 Hazard and Risk

This chapter establishes the status of the 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 generally in line with relevant guidelines.

20.1 Introduction

The document, *Applying SEPP 33 – Hazardous and Offensive Development Application Guidelines* was prepared by the DIPNR (now the NSW DoP) in 1994 to provide assistance primarily to councils and to industry, consultants and other government agencies in implementing SEPP 33.

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 subject site and the distance of the storage area to the nearest site boundary.

The guidelines state that the first step to determining whether SEPP 33 applies to a project is to consider whether the proposed use falls within the definition of *industry* adopted by the planning instrument which applies.

The proposed Project does not fall within the definition of *industry* under the relevant EPI (refer **Chapter 5**), therefore the provisions of SEPP 33 do not strictly apply. However, in order to address the issue of hazard and risk in relation to the Project, a consideration of the potential hazard and risk impacts of the Project has been undertaken, generally in line with the SEPP 33 guidelines.

20.2 Existing Environment

The following potential hazards have been identified in relation to the existing and proposed operations on the Project Site:

- storage and handling of dangerous goods;
- refuelling of vehicles and plant;
- storage areas;
- stockpile areas; and
- contaminated run-off.

Dangerous Goods stored on the Project Site are limited to fuel and a number of additives used in the brick making process. Refuelling of vehicles and plant is carried out within the south east corner of the brick making facility where a 15,000L, bunded diesel tank is situated. Approximately 170,000 L of diesel is consumed at the Project Site per annum.

A 1000 L die lubricant tank servicing the extrusion machine is located within the brick making facility. Various other oils and lubricants are stored in a bunded area at the southern end of the brick making facility.

Other chemicals and additives used and stored at the Project Site are listed in the following table.

Table 62: Chemicals and Additives Used and Stored On-site

Chemical/Additive	Unit	Total	Storage Type
Ball Clay	Kg	43,000	Bulk Bag
Red Oxide	Kg	350	25 kg Paper Bag
Mullite	Kg	13,950	Bulk Bag
Calgon	Kg	50	25 kg Paper Bag
Clay Ceram	Kg	32,700	Bulk Bag
Charcoal	Kg	9,900	Bulk Bag
Frit KBG 3801(Granular)	Kg	600	25 kg Paper Bag
Frit KBF 3880 (Flake)	Kg	200	25 kg Paper Bag
Cullet	Kg	52,800	Bulk Bag
Sawdust	Kg	240	Stockpiled inside
Manganese Dioxide	Kg	30,000	Bulk Bag
White Sand 1.5mm	Kg	24,000	Bulk Bag
White Sand 5mm	Kg	19,500	Bulk Bag
Dextrin TW	Kg	75,000	Bulk Bag
White Sand 3mm	Kg	236,700	Bulk Bag
30/60 Fine Sand	Kg	50,500	Bulk Bag
Colormax N70	Kg	57,375	IBC
Tiona	Kg	1,325	25 kg Paper Bag
Additive ZA	Kg	7,522	IBC

20.3 Potential Impacts

The process of extracting clay and shale and the production of bricks is described in **Chapter 4** of this EA. Potentially hazardous operations identified in relation to quarrying and brick making 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 manufacture of bricks, stockpile stability and potentially contaminated runoff 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 surrounding areas.

Potential impacts or risks associated with the identified hazards are detailed in the followings sections and are related to risks to both human health and the environment.

20.3.1 Spilling 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.

20.3.2 Refuelling of Vehicles and Plant

As described above, fuel spills could potentially occur where the refuelling of vehicles and plant is carried out however, the magnitude of a spill would be restricted in area given that appropriate bunding is 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 mobile plant at the Project Site there is a potential for ignition and fire. Heat radiation from such fires could impact adjacent bushland in the areas alongside Badgerys and South Creek resulting in bushfire.

20.3.3 Storage Areas

Chemical storage areas and in particular, 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 runoff and may result in contaminated run-off.

In appropriately bunded areas, spills could potentially occur, however 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.

20.3.4 Stockpile Areas

A number of stockpiles are maintained across the Project Site including raw material, overburden and deeper excavated material not currently suitable for brick making purposes. These stockpiles could pose a risk to the safety of on-site workers, particularly those personnel operating trucks and other machinery in the vicinity of the stockpiles. Stockpiles could potentially become unstable and would then be prone to collapse.

20.3.5 Contaminated Run-off

Contaminated run-off could potentially be sourced from stockpile areas, from the truck wash facility and from areas where vehicles and plant are stored and/or refuelled.

Hydrocarbon contamination would generally be associated with the addition of fuels including diesel to runoff due to a spill or leakage from vehicles and/or plant. 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 underlying geology present at the Project Site. Sediment sourced from stockpile areas may contribute to highly turbid conditions in surface water run-off which may have detrimental impacts if introduced to surface drainage systems.

20.4 Mitigation Measures

Mitigation measures that would be adopted as part of the project in relation to the management of hazard and risk include:

- 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 Project Site with quarry machinery and plant during quarry campaigns.
- 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.
- Bunding would be upgraded as appropriate around the die lubricant tank and in other locations where chemicals are stored.
- Stockpiles on the Project Site would be maintained at appropriate height and slope of batter and stabilised in accordance with best practice and the RP prepared for the Project Site.
- Drains, silt fences and bunding would be used to direct runoff into appropriate sediment basins.

20.5 Conclusion

Hazards identified as having the potential to pose a risk to the human, built and natural environments associated with quarrying and brick making operations at the Project Site are generally centred on the refuelling of vehicles and plant, the storage of fuel and chemicals associated with quarrying and brick production, stockpile areas and contaminated surface runoff.

The hazards identified are not considered to pose a significant constraint on the proposal provided appropriate mitigation measures are implemented.

21.0 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.

21.1 Cumulative Impacts of Continued Operations

The cumulative impacts of the continued operation of the quarry and brick making facility at Badgerys Creek have been considered in relation to each of the identified issues in **Chapters 8** to **Chapter 20** of this EA. Impacts of the project, particularly with respect to noise, traffic, air quality and water management have been considered in technical studies undertaken as part of this EA. The mitigations proposed in each of the chapters have been targeted at:

- Amelioration of potential impacts associated with individual risks; and
- Minimising the overall cumulative impacts of the development.

The proposed project involves the continuation (with some expansion) of existing quarrying and brick making activities. The proposal would not result in an increase in traffic on the local or regional road network and would not result in significant cumulative impacts in terms of noise. Existing management measures in respect of air quality, particularly dust control, would be augmented with additional measures as described in this EA, 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, however quarrying activities would occur in other areas of the Project Site which are not currently subject to extraction. As a result, additional voids would be created on the Project Site with subsequent visual impacts. However, mitigation measures such as the construction of a bund along the northern and eastern site boundaries would restrict views across the Project Site, thus minimising impacts.

A RP has been prepared as part of this EA with the aim of guiding short to medium term rehabilitation activities at the Project Site and providing a conceptual final landform for the Project Site at the end of the proposed 20 year life of the project approval. Rehabilitation works on the Project Site would aim to minimise impacts upon the environment whilst maintaining flexibility for possible future use on the Project Site for further extraction or redevelopment in line with the Metropolitan Strategy.

Rehabilitation strategies planned for the Project Site include:

- Stockpile stabilisation; and
- Fencing and revegetation of a 50 m riparian corridor adjacent to Badgerys Creek.

Overall, with the implementation of recommended mitigation measures, the cumulative impacts of the Project are not expected to be significant, given that the proposal is for the continuation of the existing quarry and brick making facility which has been operating alongside surrounding rural residential and industrial users since 1976 without conflict.

21.2 Cumulative Impact with Other Projects

The cumulative impacts of the continued operation of quarrying and brick making at Badgerys Creek have been considered with respect to existing development and operations, as well as major development planned for the local area.

In considering the cumulative impacts of the project in conjunction with other major development planned for the local area, it was identified that there were 8 ‘major developments’ for the Liverpool LGA have been identified on the NSW DoP Major Project Register. Of these projects, three are new projects, with the remaining projects being modifications to existing applications, additional infrastructure and ancillary development.

Table 63: Projects proposed within the Liverpool LGA

Project	Description	Status	Timing of Construction	Operational Workforce Numbers	Construction Timeframe Overlap	Location
Warwick Farm Printing Project	Developing a printing, warehouse and distribution facility and associated infrastructure.	Proponent Reviewing Submissions	Construction due for completion March 2011.	185 – 190	Likely to overlap	Warwick Farm
Southern Sydney Freight Line	Construction of approximately 30 km of new railway track within an existing 36 km long railway corridor, allowing passenger and freight services to operate independently between Macarthur and Sefton.	Approved (December 2006)	Construction commenced in late 2006 with construction ongoing.	300 (Construction Workforce)	Likely to overlap	New track to be constructed within the central portion of the Liverpool LGA, east of Project Site.
Aldi warehouse and Distribution Centre	Construction and operation of a warehouse and distribution centre at Prestons.	Approved (December 2007)	Not provided	Not provided	Unknown	Prestons
Liverpool Hospital	Consolidation and refurbishment of some existing buildings.	Approved (April 2009)	Unknown	Unknown	Unknown	East of Project Site
Liverpool Hospital	Development of a new clinical services complex at Liverpool Hospital.	Approved (December 2008)	Unknown	Unknown	Unknown	East of Project Site

Project	Description	Status	Timing of Construction	Operational Workforce Numbers	Construction Timeframe Overlap	Location
Liverpool Hospital	Concept Plan Application for the redevelopment of Liverpool Hospital including expansion and associated works.	Approved (February 2007)	Unknown	Unknown	Unknown	East of the Project Site
Liverpool Hospital	Project Application for the redevelopment of Liverpool Hospital including expansion and associated works.	Approved (February 2007)	Unknown	Unknown	Unknown	East of the Project Site
South West Rail Link	Construction and operation of the South West Rail Link, a heavy railway between Glenfield and Leppington with associated infrastructure including stations, train stabling, roadways, car park, bus interchanges and public amenities.	Approved (August 2007)	Unknown	Unknown	Likely to overlap	East of Project Site

While it is acknowledged that there are likely to be other developments occurring in the region concurrently with the proposed project, the projects identified in **Table 63** are considered to be the largest and of most relevance to the project in terms of cumulative impacts in the short to medium term.

Of the major projects identified within the Liverpool LGA, some have the potential to be in construction at the same time as the project including the Warwick Farm Printing Project, the Southern Sydney Freight Line and construction of the South West Rail Link, however these projects are located outside the geographic range of the Project Site and would not therefore combine with the works at the Project Site to create a cumulative stress on transport infrastructure or cumulative environmental impacts.

Some potential exists for the construction periods of other projects to overlap with the proposal. This is likely to increase the volume of traffic on the road network. However, as the proposed project would not generate additional traffic in relation to either construction or operation, there are not expected to be any additional cumulative impacts on the strategic road network.

In terms of existing surrounding development in the vicinity of the Project Site, two of the larger industrial operations include:

- ANL located immediately north of the Project Site on Martin Road; and
- SITA Advanced Waste Treatment Facility (SAWT) located at Kemps Creek, north of Elizabeth Drive.

As described earlier in the EA, ANL is a wholesale landscape supply establishment with access from Martin Road. Whilst there are currently no known proposed changes to ANL's operations, the cumulative impacts of the proposed continuation of operations at the Project Site should be considered. The Project Site has been operating concurrently with ANL for some time with minimal issue. The main potential for cumulative impacts with ANL is related to dust, noise and traffic.

An AQIA was undertaken as part of the EA and a range of mitigation measures were recommended to augment those already employed on the Project Site for the control of dust. The AQIA considered the cumulative impacts of the project and concluded that, with the implementation of recommended mitigation measures, the cumulative air quality impacts of the project would be within relevant criteria. Similarly with regard to noise, the noise assessment undertaken as part of the EA concluded that, with appropriate safeguards in place, the noise impacts of the project (in consideration of existing background noise levels) would be within project specific noise criteria. In relation to traffic, the proposed project would not result in the generation of additional traffic movements to and from the Project Site, therefore there would be no cumulative impacts over and above those already existing under current operations.

The SAWT Facility is not located within the Liverpool LGA however, the facility would utilise the same regional road network as the proposed operation and is therefore considered in relation to potential cumulative impacts in terms of traffic movements. As discussed previously, the proposed Project would not result in an increase in traffic movements to and from the Project Site and therefore there would be no additional cumulative impacts in this regard.

Given that both ANL and the SAWT are currently in operation, and that no new known developments are planned for these sites, further cumulative impacts associated with the continued operation of the quarry and brick making facility related to the operations at both ANL and SITA are likely to be negligible.

There is potential for cumulative impacts to occur at some point in the future in relation to the development of the SWGC. However, at this point, there is no certainty about the exact nature, form, scale or timing of this development. Therefore any attempt to assess cumulative impacts in relation to this future development would not be of significant value to the EA. As an owner of land within the SWGC, it is anticipated that Boral would be consulted with regard to future development proposals as part of the SWGC and that potential impacts associated with this development would be considered at this point.

21.3 Conclusion

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 proposed project. Provided these mitigation measures are adopted, the project would have negligible cumulative impacts given the proposal involves the continuation of an existing operation.

22.0 Environmental Management and Commitments

22.1 Introduction

Environmental Commitments are those environmental management measures formally established to mitigate and manage the potential environmental impacts of the project. These commitments would be incorporated into an EMP for the Project Site. The Proponent currently has a range of environmental policies and procedures under which the existing Project Site activities operate including:

- Waste and Water Management Guidelines; and
- Energy and Greenhouse Gas Management Guidelines.

Prior to commencing operations on site, the selected contractor together with the Proponent would review the completed plans and the EMP (to be prepared for the Project Site). The EMP would contain details of environmental monitoring to be carried out and procedures for reporting the environmental performance of the project.

Boral embraces the principle of sustainable development and is committed to pursuing industry specific best practice. Boral's commitments in relation to the environment (as specified in its *Environmental Policy*) include:

- *Conducting its operations to minimise environmental risk and, wherever practicable, eliminate adverse environmental impacts;*
- *Continual improvement of environmental performance including regular review and the setting of rigorous environmental objectives and quantified targets – particularly with regard to:*
  - *Efficient use of energy (including appropriate use of alternative fuels);*
  - *Conservation of water;*
  - *Minimisation and recycling of wastes;*
  - *Prevention of pollution; and*
  - *Effective use of virgin and recovered resources and supplemental materials.*
- *Open, constructive engagement with communities surrounding operations;*
- *Reducing greenhouse gas emissions from processes, operations and facilities;*
- *Protecting and, where possible enhancing biodiversity values at and around its facilities;*
- *Complying with environmental legislation, regulations, standards and codes of practice relevant to the particular business as the absolute minimum requirement in each of the communities in which it operates;*
- *Conducting business with suppliers and contractors who have a commitment to the values and objectives contained in its environmental policy;*
- *Consulting and collaborating with customers and suppliers in the development of sustainable products;*
- *Remediating its contaminated sites to standards internationally acceptable for the site purpose.*

Boral's *Environmental Policy* also states that Boral would progressively implement and maintain environmental management systems for its businesses based on the international standard ISO-14001 or its equivalent.

In relation to Health and Safety, Boral is committed to providing safe and healthy working conditions for all people involved in the business, including contractors, visitors and the general public. An induction would be held for all personnel prior to the commencement of works at the Project Site to raise awareness of Boral's Occupational Health and Safety (OH&S) plan.

22.2 Summary of Mitigation Measures

Table 64 below summarises the mitigation measures for the project.

Table 64: Summary of Mitigation Measures

Issue	Mitigation Measures
Air Quality	Dust control measures to be employed on the Project Site as follows: • Haul roads to be watered at a rate equal to or greater than 2 L/m^2/hr; • Unloading of trucks containing raw or unusable extracted material to be controlled using water sprays; • Dust from raw material stockpile to be controlled using water sprays; • Dust from existing stockpiles of unusable material and open pits to be controlled using water sprays with chemical additives (surfactants); and • Completed pits to be revegetated as soon as practicable after completion of quarrying activities. Preparation of an AQMP for the Project Site which would include measures to control dust and emissions from the Project Site. Specifically, the AQMP would include details of a dust mitigation program for the Project Site including: • Instantaneous dust monitoring at the most affected Project Site boundary through the installation of an instantaneous dust monitor (such as a TEOM) to alert Project Site personnel when elevated dust levels occur such that operations can be modified to reduce dust impacts; • Revegetation of disturbed soil surfaces on the Project Site in accordance with the RP (**Appendix D**); and • Review of operational practices to ensure 'best practice' techniques are being employed and that operational equipment is working efficiently.
Noise	• Construction of a 10m high earth mound along the northern and eastern Project Site boundary, wrapping around to the western boundary for a length of 150 m and extending around to the southern boundary for 100 m, as illustrated in **Figure 7** of the EA and the Noise Assessment Report located at **Appendix F** of this report. The earth mound is to be constructed in stages as shown in **Figure 7** and detailed in the Noise Assessment Report. • Construction works associated with the earth mound within 300 m of any residences, shall be limited to 7am to 6pm Monday to Friday and 8am to 1pm on Saturdays. • Application of noise reduction treatments to mobile plant used within the quarry to achieve a minimum reduction of 10 dB from noise levels of standard equipment. These treatments may include: - Enclosure of the engine within an acoustic enclosure and/or sealing of gaps around the engine bay; - Use of acoustic louvres / treatments on engine air intakes and cooling air exhausts; - Installation of high attenuation engine exhaust mufflers; and - Lining of the trays/bodies of dump trucks with high impact rubber to reduce loading noise, or using specially designed suspended dump bodies (e.g. Duratray).

Issue	Mitigation Measures
Surface Water	• Adoption of an updated SWMP for soil and water management across the Project Site, including consideration of: - Reconfiguration of the catchment to proportion runoff going to storage pits according to their storage capacity. - Installation of infrastructure to allow Pit 1 to spill to Pit 4 and Pit 4 to spill to Pit 3. - Options for the reuse of water stored on-site for beneficial use in order to increase the extraction regime to improve on-site storage capacity. - Monitoring of storage levels in Pits1, 3 and 4 such that spill risk is managed and the need for additional storage and/or extraction can be readily identified; • The continued use of drains, silt fences and bunding to direct Project Site runoff into appropriate sediment basins and to control erosion; • Stabilisation of disused stockpiles to minimise the risk of erosion; • Diversion of stormwater runoff from Sediment Basins 1, 2 and 3 to Pit 1 upon establishment of Pits 4 and 5; • The use of flocculants in sedimentation basins to increase sediment removal rates if required; • The removal of oil and grease within the sediment basin by volatilisation if required; • Routine maintenance and inspections of drains, sediment basins and bunds; and • The continued supplementation of town water with recycled water for the brick making process.
Groundwater	• Appropriate storage of fuels and hazardous chemicals and the implementation of appropriate work procedures as well as regular inspections and maintenance of equipment and plant to minimise potential for contamination due to spills; • Implementation of an alluvial assessment and groundwater monitoring program in accordance with the methodology provided in **Chapter 11** of the EA to minimise or negate the likelihood of impacts to the alluvial aquifer, base flow to the creeks and groundwater dependant ecosystems (if present). This program would be commenced at least two years prior to the commencement of extraction in Pit 4. • Modification of the proposed pit size as required to ensure the alluvial sediments are not disturbed by the development. • Establishment of a 50 m buffer zone adjacent to Badgerys Creek within which no quarrying activities would take place in order to minimise the likelihood of impacts upon the alluvial aquifer.
Land Use	• Ongoing consultation with the relevant authorities managing the release of land for industrial and urban development within the vicinity of the Project Site to ensure that project activities and management of infrastructure is effectively integrated with future development in the area. • Adherence to the management strategies recommended as part of the RP for the Project Site, to ensure that the full range of options for the future use of the Project Site are preserved.
Rehabilitation	• Rehabilitation works to be carried out on the Project Site generally in accordance with the RP included as **Appendix D** to the EA **Figure 5** and showing the conceptual final landform.

Issue	Mitigation Measures
Traffic and Transport	• 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, avoidance of the AM and PM peak periods and vehicle speed limits on Martin Road. • 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 and parking. • Unnecessary vehicle movements would be minimised where possible. • Deliveries would be scheduled on larger capacity 'Truck and Trailer' vehicles rather than 'Truck Only' vehicles where possible to minimise truck movements. • A number of improvements in relation to shoulder widths, and the alignment and sight distances within the vicinity of the horizontal reverse curves would be investigated and may include: - Construction of shoulders at minimum standard widths where required; - Clearing of existing roadside vegetation to improve sight lines within the vicinity of the reverse curves; and - Provision of 'W1-4(L)' warning signposting in advance of the reverse curves to advise motorists of the upcoming curved alignment. • As part of the existing and ongoing operations at the Project Site, a detailed pavement investigation and rehabilitation program would be considered to protect the value of the existing structure of Martin Road.
Geology and Soils	• Stockpiles and batter faces would be stabilised and erosion and sediment controls such as silt fencing would be used on site as temporary measures in the mitigation of sediment pollution to down slope lands and waterways; • Temporary structural methods (including silt fencing) may be used where required to protect newly treated areas, which are generally highly susceptible to erosion. • Disused stockpiles would be revegetated in accordance with the RP prepared for the project; • Bunding and batter slopes for new quarry pits would be designed to minimise the potential for erosion in accordance with the RP for the Project Site; • Roadways would be maintained for the productive life of the pit; • Rehabilitation of the Project Site would be carried out in accordance with the RP for the Project Site (**Appendix D**); • Overburden and unusable material would be used to rehabilitate Pit 2 such that no new stockpiles would be created; and • Water carts would be used to assist with the control of erosion in accordance with the AQMP.
Visual	• Earth bunds of 10 m in height would be erected along the northern and eastern Project Site boundaries and parts of the western and southern Project Site boundaries, to provide acoustic and visual screening of the Project Site from surrounding visual receptors; • Existing disused stockpiles would be rehabilitated in accordance with the RP prepared for the Project Site and included as **Appendix D** to this EA; and • A 50 m riparian corridor would be established along Badgerys Creek providing vegetative screening of the Project Site along the western boundary.

Issue	Mitigation Measures
Cultural Heritage	• Should relics be uncovered during the course of the approved works, works shall cease. In cases where historical items have been uncovered, the NSW DoP's Heritage Branch shall be advised or should indigenous items be uncovered the NPWS shall be advised; • Workers/contractors shall be informed of their obligations under the NPW Act 1974, namely that it is illegal to disturb, damage or destroy a relic without the prior approval of the Director General of DECCW; and • Should human remains be found in, on, or under the land during construction, the responsible party shall: - Contact the local police; - Not disturb or excavate the remains; - Immediately cease all work at the particular location; - Notify the DECCW office as soon as practicable and provide any available details of the remains and their location; and - Not recommence any work at the particular location until authorised in writing by the DECCW.
Ecology	• The following measures would be adopted to minimise potential impacts associated with any required tree removal: - The canopy of the trees would be visually inspected prior to clearing to assess for the presence of fauna. Where bird species are detected the tree is to be nudged prior to felling to encourage the fauna to vacate the tree prior to felling. Trees would be left in situ until the birds leave the canopy; - Felled trees to be left in-situ for at least 24 hours to allow fauna species to relocate. Qualified personnel would be on hand to check for wildlife and relocate them; - Felled wood would be relocated to the remnant woodland (and not placed in piles) or chipped and used in rehabilitation areas; - Should any wildlife be inadvertently injured during the proposed works, WIRES or an accredited veterinarian would be contacted; - A 50 m buffer area would be provided along Badgerys Creek and the Badgerys Creek tributary. Rehabilitation works to be undertaken in this area in accordance with the RP prepared as part of this EA; and - Five native trees would be planted for each mature native tree that is removed. The plantings shall be located adjacent to the riparian vegetation along Badgerys Creek and its tributary.
Waste	• The WMP for the Project Site would be followed and updated as required; • Waste generated on the Project Site would be reused or recycled where possible (as per the WMP); • Waste to be disposed offsite would be classified, transported and disposed of in accordance with the *Waste Classification Guidelines (DECCW, 2008);* and • Plant Managers, Team Leaders, Operators, visitors and contractors would be informed of waste management and disposal procedures to be undertaken on site.

Issue	Mitigation Measures
Hazard and Risk	• 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 Project Site with quarry machinery and plant during quarry campaigns. • 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. • Bunding would be installed as appropriate around the die lubricant tank and in other locations where chemicals are stored. • Stockpiles on the Project Site would be maintained at appropriate height and slope of batter and stabilised in accordance with best practice and the RP prepared for the Project Site. • Drains, silt fences and bunding would be used to direct runoff into appropriate sediment basins.

22.3 Statement of Commitments

In accordance with the DGRs issued under Part 3A of the EP&A Act, the following SoC has been developed for the project. The SoC states the Proponent's environmental commitments and details the environmental management and monitoring of the proposed Project. The Proponent is committed to ensuring the preparation and implementation of the environmental management and monitoring plans, further investigations and studies and environmental mitigation measures detailed in the SoC for the proposed Project.

The SoC, prepared in respect of the Project, has been compiled on an issues basis and is informed by the environmental risk analysis and impact assessment undertaken as part of this EA.

Table 65: Statement of Commitments

Issue	Commitment
General	
General	1) The Proponent shall implement all practicable measures to prevent or minimise harm to the environment that may result from the construction, operation or rehabilitation of the Project.
Air Quality	2) The Proponent shall prepare an AQMP for the project to the satisfaction of the Director-General. The AQMP shall detail measures to control dust and emissions from the Project Site including the following measures: • Haul roads to be watered at a rate equal to or greater than 2 L/m2/hr; • Unloading of trucks containing raw or unusable extracted material to be controlled using water sprays; • Dust from the raw material stockpile to be controlled using water sprays; • Dust from existing stockpiles of unusable material and open pits to be controlled using water sprays with chemical additives (surfactants); • Completed pits to be revegetated as soon as practicable after completion of quarrying activities; • Instantaneous dust monitoring to be installed at the most affected Project Site boundary; • Disturbed soil surfaces to be revegetated in accordance with the RP for the Project Site; and • Operational practices to be reviewed to ensure 'best practice' techniques are being employed and that operational equipment is working efficiently.
Noise	3) The Proponent shall implement all practicable measures to undertake the development in a way that minimises the noise generated. 4) The Proponent shall conduct quarrying activities at the Project Site only between the following hours: • 7.00 am to 6.00 pm Monday to Saturday 5) The Proponent shall operate the Brick making facility at the Project Site 24 hours a day, Monday to Sunday. 6) The Proponent shall conduct activities within the storage yard (including deliveries and dispatch) only between the following hours: • 6.00 am to 10.00 pm Monday to Friday • 6.00am to 6.00pm Saturday

Issue	Commitment
	7) The Proponent shall construct an earth bund of a minimum height of 10 m along the northern and eastern Project Site boundary and part of the western and southern Project Site boundaries as shown in **Figure 7** of the EA. The earth mound shall be constructed in stages as specified in **Figure 7** of the EA. 8) Construction works associated with the construction of the earth bund within 300 m of any residences, shall be limited to 7am to 6pm Monday to Friday and 8am to 1pm on Saturdays. 9) The Proponent shall apply a combination of noise reduction treatments to mobile plant used within the quarry to achieve a reduction of 10 dB from noise levels of standard equipment.
Surface Water	10) The Proponent shall manage surface water on the Project Site in accordance with the SWMP prepared for the Project Site (ERM, 2002), including Addendum dated April 2010 (AECOM, 2010) and included as **Appendix C** to this EA.
Groundwater	11) The Proponent shall prepare and implement a Groundwater Monitoring Program for the Project Site generally in accordance with the methodology provided in **Chapter 11** of the EA, subject to consultation with the NOW and the satisfaction of the Director-General of the DoP. The program shall commence at least two years prior to the commencement of extraction in proposed Pit 4. 12) The Proponent shall report the results of the Groundwater Monitoring Program to the Director-General of the DoP on an annual basis. 13) The Proponent shall implement appropriate management measures in relation to groundwater as indicated by the Monitoring Program and agreed with the Director-General. 14) A licence to authorise any groundwater monitoring installation, required as part of this project, shall be obtained from the NOW prior to any drilling commencing. 15) The proponent shall implement an alluvial aquifer mapping and assessment program to inform: - The definition of the boundaries of the alluvial system; - Adjustment to the extent of proposed pits to avoid impacts to the alluvial aquifer; and - The establishment of further mitigation measures (if required) to minimise potential impacts upon the alluvial aquifer. This program shall commence at least two years prior to the commencement of extraction in Pit 4 and the results shall be reported to the NOW and the Director-General of the DoP.
Rehabilitation	16) The Proponent shall carry out rehabilitation works at the Project Site in accordance with the RP prepared for the Project Site and included as **Appendix D** to this EA.

Issue	Commitment
Traffic and Transport	17) The Proponent shall manage traffic movements to and from the Project Site generally in accordance with the following: • 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, avoidance of the AM and PM peak periods and vehicle speed limits on Martin Road. • 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 and parking. • Unnecessary vehicle movements would be minimised where possible. • Deliveries would be scheduled on larger capacity 'Truck and Trailer' vehicles rather than 'Truck Only' vehicles where possible to minimise truck movements.
Cultural Heritage	18) The Proponent shall adopt the following measures in relation to the management of cultural heritage on the Project Site: • Should relics be uncovered during the course of the approved works, works shall cease. In cases where historical items have been uncovered, the NSW DoP's Heritage Branch shall be advised or should indigenous items be uncovered the National Parks and Wildlife Service shall be advised; • Workers/contractors shall be informed of their obligations under the NPW Act 1974, namely that it is illegal to disturb, damage or destroy a relic without the prior approval of the Director General of the DECCW; and • Should human remains be found in, on, or under the land during construction, the responsible party shall: - Contact the local police; - Not disturb or excavate the remains; - Immediately cease all work at the particular location; - Notify the DECCW office as soon as practicable and provide any available details of the remains and their location; and - Not recommence any work at the particular location until authorised in writing by the DECCW.
Ecology	19) The Proponent shall adopt the following measures in relation to the removal of any trees on the Project Site: • The canopy of the trees to be visually inspected prior to clearing to assess for the presence of fauna. Where bird species are detected the tree is to be nudged prior to felling to encourage the fauna to vacate the tree prior to felling. Trees to be left in situ until the birds leave the canopy; • Felled trees are to be left in-situ for at least 24 hours to allow fauna species to relocate. Qualified personnel are to be on hand to check for wildlife and relocate them; • Felled wood is to be relocated to the remnant woodland (and not placed in piles) or chipped and used in rehabilitation areas; • Should any wildlife be inadvertently injured during the proposed works, WIRES or an accredited veterinarian shall be contacted; • A 50 m buffer area shall be provided along Badgerys Creek and the Badgerys Creek tributary. Rehabilitation works are to be undertaken in this area in accordance with the RP prepared as part of this EA; and • Five native trees shall be planted for each mature native tree that is removed. The plantings shall be located adjacent to the riparian vegetation along Badgerys Creek and its tributary.

Issue	Commitment
Waste	20) The Proponent shall manage waste in relation to the Project in accordance with the existing WMP for the Project Site, included as **Appendix M** to the EA.
Environmental Management	21) The Proponent shall prepare an EMP for the Project Site to provide environmental management practices and procedures to be followed during the operation of the Project. The EMP shall include, but not necessarily be limited to: • identification of statutory and other obligations that the Proponent is required to fulfil in relation to operation of the Project; • a description of the roles and responsibilities for all key personnel involved in environmental management of the Project; • the environmental policies and principles to be applied to the operation of the Project; and • describe in general terms how the environmental performance of the Project would be monitored and managed.

22.4 Training and Induction

Boral has a *Health and Safety Policy* which outlines its commitment to providing safe and healthy working conditions for all people involved in their business including contractors, visitors and the general public. With any new project involving Boral personnel it is normal procedure to undertake a risk assessment based on the scope of works and then prepare a customised induction for both employees and subcontractors. Project personnel would be required to attend an induction and/or training required for specific sites prior to the commencement of works at the Project Site. The induction would ensure that all personnel are fully aware of their OH&S and environmental responsibilities and gain the necessary knowledge and skills to fulfil their responsibilities. Induction would address general environmental and OH&S management issues including:

- Introduction to Boral Bricks and overview of scope of operations.
- Overview of Company Policies, including OH&S and Environmental and explanation of company safety culture and standards.
- Overview of scope of operations at Badgerys Creek.
- Description of proposed works/project to be conducted.
- Location of, and respect for neighbours and adjoining properties.
- Permitted hours of quarrying operations/specific noise limitations.
- Site OHS requirements including.
    - Heavy and light plant and equipment operations/restrictions;
    - Site Traffic control and Traffic Management Plan/hours of operation/access;
    - Job Safety Analyses/Safe Work Method Staments/Risk Assessment/OHS legislative requirements/Hazards/Controls/Systems and Procedures;
    - Authority to work permits;
    - Emergency response and notification including site evacuation/fire etc;
    - Chemical handling and storage;
    - Manual Handling; and
    - Spill response and procedures;
- Emergency contacts and incident reporting procedures.
- Supervisors and key personnel.
- Site dust and noise monitoring and requirements.
- Waste controls and recycling.
- Site water controls and systems including erosion control.
- Restricted areas and special operations/sensitive areas.

- Location and description of site facilities/amenities.

Where identified in the risk assessment the following items would be included in the induction:

- Discharges to air/water.
- Cultural issues and notification processes should work be carried out in a sensitive area.
- Weed and pest control and flora and fauna preservation/fire controls.

22.5 Inspection, Monitoring and Auditing

Inspection, monitoring and auditing would be undertaken to assess and record whether activities are in compliance with regulatory requirements and the objectives outlined in the Health, Safety and Environment Management System, which guides Project Site operations.

In addition to the conditions of the Minister's approval and the Proponent's SoCs, the proposed works would be carried out in accordance with:

- The relevant requirements of any future Mining Lease;
- Conditions specified pursuant to the EPL.

22.6 Outline of Environmental Reporting

- Environmental reporting is a significant tool for environmental management as it can facilitate the collection of information on environmental impacts and issues and assist in identifying possible solutions in order to minimise these impacts. Environmental reporting also brings benefits to the performance and efficiency of an operation. Environmental reporting is carried out both through the Boral Sitesafe internal reporting system, on a daily basis, and directly to senior management through monthly reports. The key features of the Environmental reporting system include:
- Daily inspection and identification of issues by supervisory staff.
- Entry into the Boral Sitesafe System which provides:
  - Unique identification of each issue including non compliance;
  - Description of the issue;
  - Investigation;
  - Actions;
  - Action completion timeframe and responsibility;
  - Monitoring of action due dates and close out;
  - Management signoff; and
  - Data base of records / incidents.
- The Observations section of Sitesafe allows stakeholder consultation and meetings to be recorded and actions allocated.
- Any internal or external auditing actions are entered into the Sitesafe database.
- Site dust monitoring is conducted monthly at Badgerys Creek.
- An Environmental Report is submitted to Boral Senior Management monthly detailing:
  - Any site non compliance with statutory and licence requirements;
  - Inspections and audits by statutory authorities;
  - Any project or improvement work being conducted on site; and
  - Any complaints received during the month.

The Proponent would ensure that all reporting undertaken in relation to environment and OH&S issues would be in compliance with the relevant licence conditions and regulatory requirements.

22.7 Outline of Environmental Auditing

Environmental compliance auditing would be undertaken to assist in identifying the environmental impacts associated with the construction and operational phases of the Project. Inspection of activities would be undertaken on a regular basis by supervisory staff. On-going monitoring of these activities is essential to ensure compliance with regulatory requirements and conditions of approval. Auditing, together with the implementation of inspection and monitoring programs, would assess the compliance of the Project with regulatory requirements during construction and operation. The Proponent would ensure that records are kept of all auditing that is conducted. Based on results of the audits, the Proponent would ensure modifications and corrective actions are undertaken to rectify any identified environmental impacts or concerns of the project.

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23.0 Residual Risk

23.1 Approach

The Residual Environmental Risk Analysis for the proposed Project is based on a process adapted from *Australian Standard AS 4360:2004 Risk Management*, as well as environmental risk tools developed by other organisations. The process is qualitative and is based on the Residual Risk Matrix shown in **Table 66**. Residual Environmental Risk is assessed on the basis of the significance of environmental effects of the proposed Project and the ability to confidently manage those effects to minimise harm to the environment.

The significance of environmental effects is given a numerical value between 1 and 5 based on the receiving environment, the level of understanding of the type and extent of impacts and community response to the environmental consequences of the Project. This enables both the actual and perceived impacts to be considered. The manageability of environmental effects is similarly given a numerical value between 1 and 5 based on the complexity of mitigation measures, the known level of performance of the safeguards proposed and the opportunity for adaptive management. The numerical value allocated for each issue is based upon the following considerations:

Significance of Effects

5.	*Extreme*	Undisturbed receiving environment; type or extent of impacts unknown; substantial community concern.
4.	*High*	Sensitive receiving environment; type or extent of impacts not well understood; high level of community concern.
3.	*Moderate*	Residual receiving environment; type and extent of impacts understood; community interest.
2.	*Minor*	Disturbed receiving environment; type and extent of impacts well understood; some local community interest.
1.	*Low*	Degraded receiving environment; type and extent of impacts fully understood; uncontroversial project.

Manageability of Effects

5.	*Complex*	Complicated array of mitigation measures required; safeguards or technology are unproven; adaptive management inappropriate.
4.	*Substantial*	Significant mix of mitigation measures required; limited evidence of effectiveness of safeguards; adaptive management feasible.
3.	*Straightforward*	Straightforward range of mitigation measures required; past performance of safeguards is understood; adaptive management easily applied.
2.	*Standard*	Simple suite of mitigation measures required; substantial track record of effectiveness of safeguards; adaptive management unlikely to be required.
1.	*Minimal*	Little or no mitigation measures required; safeguards are standard practice; adaptive management not required,

The numbers are added together to provide a result which provides a ranking of potential residual effects of the Project when the safeguards identified in this EA are implemented.

Table 66: Residual Risk Matrix

Significance of Effects	Manageability of Effects				
	5 Complex	4 Substantial	3 Straightforward	2 Standard	1 Minimal
1 Low	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)	3 (Low)	2 (Low)
2 Minor	7 (High/Medium)	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)	3 (Low)
3 Moderate	8 (High/Medium)	7 (High/Medium)	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)
4 High	9 (High)	8 (High/Medium)	7 (High/Medium)	6 (Medium)	5 (Low/Medium)
5 Extreme	10 (High)	9 (High)	8 (High/Medium)	7 (High/Medium)	6 (Medium)

23.2 Analysis

The analysis of residual environmental risk for issues related to the proposed Project is shown in **Table 67.** This analysis indicates the environmental risk profile for the proposed Project based on the assessment of environmental effects, the identification of appropriate safeguards, and the SoC included in this EA.

Table 67: Risk Profile

Issue	Significance	Manageability	Residual Risk
Air Quality	2	3	5 (Low/Medium)
Noise	2	3	5 (Low/Medium)
Surface Water	2	2	4 (Low/Medium)
Groundwater	2	3	5 (Low/Medium)
Land Use	2	3	5 (Low/Medium)
Rehabilitation	2	3	5 (Low/Medium)
Traffic and Transport	2	1	3 (Low)
Geology and Soils	2	1	3 (Low)
Visual	2	3	5 (Low/Medium)
Cultural Heritage	2	1	3 (Low)
Ecology	2	1	3 (Low)
Socio-Economic	2	2	3 (Low)
Waste	1	1	2 (Low)
Hazard and Risk	2	2	4 (Low/Medium)

The above residual risk analysis indicates that the proposed Project presents an overall low/medium risk in relation to each of the identified environmental issues provided that the recommended mitigation measures are implemented.

24.0 Project Justification

24.1 Ecologically Sustainable Development

The term ESD was introduced by the Commonwealth Government in June 1990, defined as:

> *Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased. (ref: Ecologically Sustainable Development: A Commonwealth Discussion Paper)*

ESD Working Groups were subsequently established and involved representatives of government, industry, environment, union, welfare and consumer groups. The ESD Working Groups developed a series of policy directions and recommendations which provided the foundation for development of the *National Strategy for Ecologically Sustainable Development (1990)*.

The *National Strategy for Ecologically Sustainable Development* was endorsed by the Council of Australian Governments in December 1992. In addition, the *Intergovernmental Agreement on the Environment* (IGAE) was signed in 1992 by Federal and State Governments, Territories and the Australian Local Government Association, promoting intergovernmental cooperation.

ESD is a concept firmly entrenched in NSW environmental legislation and government policy. The concept of ESD has been given legal definition in NSW by the *Protection of the Environment Administration Act 1991* (NSW). Section 6(1)(a) of that Act requires the NSW DEC (now DECCW) to have regard to the need to maintain ESD, requiring the effective integration of economic and environmental considerations in decision making processes.

Schedule 2 of the EP&A Regulation clearly establishes four guiding principles to assist in achieving ESD, as follows:

- **The precautionary principle** – namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- **Inter-generational equity** – namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
- **Conservation of biological diversity and ecological integrity** – namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.
- **Improved valuation and pricing of environmental resources** - namely, that environmental factors should be included in the valuation of assets and services, such as polluter pays, full life cycle costing, and utilising incentive structures/market mechanisms to meet environmental goals.

The EPBC Act also identifies a fifth principle for consideration in environmental impact, namely:

> *Decision making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations.*

These five principles are interrelated and need to be considered both individually and collectively as part of determining whether or not a project would be consistent with the principles of ESD in Australia.

24.1.1 Precautionary Principle

This EA has considered the project in terms of potential impacts to the environment, and in particular, the extent to which potential impacts may pose a significant risk to the environment. Specialist impact assessments have been undertaken in areas where potential impacts were uncertain or unable to be quantified otherwise.

A number of alternatives have been considered for the continuation and expansion of operations at the Project Site (see **Chapter 3**), including:

- The continuation of quarrying and brick making operations at the Project Site:
  - Continuing extraction from deeper geological units from within already established pits (Pits 1, 2 and 3);
  - The selection of alternative locations for the proposed Pits 4 and 5.
- Ceasing quarrying and brick making operations at the Project Site and rehabilitating or reusing the land for an industrial purpose:
  - Cease extraction and rehabilitate the land now for a 'future industrial' land use in accordance with the intent of the *Sydney Metropolitan Strategy*.
- Ceasing quarrying and brick making operations at the Project Site and adopting a 'do nothing' approach:
  - The 'do nothing' approach could be adopted, ceasing quarrying and brick making operations at the Project Site and leaving the Project Site in its current condition.

The EA has been undertaken on the basis of the most recent and accurate scientific data relating to the Project Site. Where uncertainty in the data used in the assessment has been identified, a conservative worst-case scenario analysis has been undertaken and contingency measures have been identified to manage the uncertainty.

Environmental safeguards and mitigation measures recommended in this EA have been developed in accordance with current and accepted best management practice to achieve a neutral or beneficial effect on the environment.

24.1.2 Intergenerational Equity

The principle of 'intergenerational equity' requires that decisions made by the present generation would not result in a degradation of the environment for future generations.

The objectives of the project are to continue and expand existing quarrying operations at Badgerys Creek. The project would provide access to clay and shale brick making resources in a manner that achieves the best safety, environmental, social and economic outcomes, maximising the use of existing infrastructure and minimising associated environmental impacts.

Potential environmental implications of the project in terms of greenhouse gases impacts are discussed in **Chapter 8**. Other potential impacts which have the capacity to potentially affect the health, diversity or productivity of the environment have been assessed as part of this EA. Environmental safeguards identified for specific issues, and the SoC in **Chapter 22** of this EA form a fundamental part of the project to minimise the impact on the environment to the greatest extent reasonably possible.

24.1.3 Biological Diversity and Ecological Integrity

The principle of 'biological diversity and ecological integrity' requires a full and diverse range of plant and animal species to be maintained and conserved.

Consideration of the impacts of the proposed project on flora and fauna has been undertaken as part of development of the project through environmental investigations. The flora and fauna assessment (**Chapter 17**) concluded that the proposed project would not significantly impact upon threatened species or ecological communities.

The flora and fauna assessment found that the ecological values of the development area are limited as these areas have been largely cleared. It was determined that there is very limited potential for the proposed works to have a significant impact on threatened ecological communities, important fauna habitats or movement corridors or potentially present threatened flora or fauna species or populations. Additionally, Boral is committed to rehabilitation works which would be undertaken across the Project Site and in the riparian areas bounding the Project Site (see **Section 4.3**). Rehabilitation activity is ongoing at Badgerys Creek, relating to previous quarrying operations, including the stabilisation and restoration of a tributary of Badgerys Creek which runs between the Western Stockpile and Pit 2.

24.1.4 Valuation and Pricing of Environmental Resources

The IGAE and POEO Act require improved valuation, pricing and incentive mechanisms to be included in policy making and program implementation. In the context of environmental assessment and management, this would translate to environmental factors being considered in the valuation of assets and services.

Integration of environmental and economic goals is a key principle of ESD, which can be measured undertaking a cost-benefit analysis, that is, by measuring the costs of proceeding with a project against the benefits arising from the project.

Given the different values placed on the environment, and the various components of an environment, it is difficult to assign a monetary value against the environmental costs and benefits associated with the project. Given this, the approach adopted for this project is the management of environmental impacts through appropriate safeguards, and to include the cost of implementing recommended safeguards, in the total cost of the project.

The value of the environment is also managed through the legislative process by imposing financial penalties or requirements to rehabilitate on persons responsible for polluting the environment.

Boral would implement the safeguards and monitoring requirements outlined in this EA to minimise potential environmental and social impacts from the proposed project, and to minimise the potential for pollution to occur.

24.1.5 Decision Making Process

The proposed project requires approval under Part 3A of the EP&A Act.

An assessment of the short, medium and long term impacts of the proposed project, taking into account the principles of ESD is described in this EA. The SoC, provided in **Section 22.3**, forms the environmental mitigation, management and monitoring requirements for the project and its proposed operations.

The project approval process prescribed under Part 3A of the EP&A Act and subsequent environmental management frameworks, ensure that decision making and monitoring of the project would be undertaken in an integrated manner, having regard to relevant issues associated with the project within its context.

Additionally, transparency throughout the decision making process for the design, impact assessment and development of management measures has been carried out through consultation with Government authorities, community members, Aboriginal groups and other stakeholders during the preparation of the EA (see **Chapter 6**). This has allowed comment and discussion regarding potential environmental impacts, revision of aspects of the proposal and the development of site specific environmental management procedures.

24.2 Climate Change

GHGs are gases found in the atmosphere that absorb outgoing heat that is reflected from the sun. The absorption of the heat energy warms the air, enabling life to survive, and is known as the Greenhouse Effect. The primary GHG is carbon dioxide (CO_2).

Human activities, such as the combustion of carbon-based fuels, increase the amount of GHGs in the atmosphere. This leads to greater absorption of heat and increases in atmospheric temperature, known as the Enhanced Greenhouse Effect. The atmospheric concentration of CO_2 has risen from 280 parts per million (ppm) in 1860 to approximately 388 ppm in January 2010[4]. At the same time, the average global temperature has increased by nearly 1 °C. Projections show that if this trend continues, global temperatures could rise between one and four degrees by the end of the 21st century, with annual average temperatures in Australia projected to increase by 0.4 - 2.0 °C by 2030 and by 1 – 6 °C by 2070 compared to 1990 levels[5].

[4] National Oceanic and Atmospheric Administration, US Department of Commerce, ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_mm_mlo.txt; accessed 16 February 2010

[5] WBCSD (2004). *The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised edition.* World Business Council for Sustainable Development / World Resources Institute, Washington, D.C.

Australia's per capita GHG emissions are among the highest in the world[6] (AGO, 1998) and, overall, the total net GHG emissions in Australia increased by 2.2 % between 1990 and 2005. Most of the increases resulted from energy generation and industrial processes.

The NSW Government has committed to a long-term target of a 60 % reduction in GHG emissions by 2050 and a return to year 2000 GHG emission levels in NSW by 2025. There are, however, no legislative limits for emissions of GHGs.

The total emissions from the facility were estimated to be some 0.4% of total emissions from the mining non-energy sector in Australia, and 0.07% of total Australian emissions. As such, the overall contribution of the facility to GHG emissions and climate change is very small. As such, the proposed development would not result in significant additional impacts in this regard.

Approximately 60% of GHG emissions from the Project Site are generated from the combustion of natural gas in the production process. GHG emissions from natural gas combustion are lower than those associated with the combustion of other fossil fuels.

Accordingly, the GHG assessment undertaken as part of this EA (refer to **Section 8.5**) found the overall impact of the proposal in terms of climate change and greenhouse are expected to be minimal.

24.3 Conclusion

The proposed continuation and expansion of operations on the Project Site has been considered in the context of the principles of ESD and considered to be consistent with these principles. The project is not expected to result in significant environmental impacts provided the current environmental management regime is maintained at the Project Site and recommended additional safeguards and mitigation measures are implemented.

[6] *AGO. (1998). National Greenhouse Strategy, Strategic Framework for Advancing Australia's Greenhouse Response, Australian Greenhouse Office, Commonwealth of Australia, Canberra, 1998.*

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25.0 Conclusion

25.1 The Project

The Project comprises the continuation of quarrying and brickworks operations at the Project Site for a further 20 years, including some increase in the volume of extraction and throughput of the brick making facility. The primary purpose of the project is to allow for the continued productive use of a valuable natural resource to meet the needs of the construction industry in the Greater Sydney area in line with existing and projected demand. The Project would also provide benefits in relation to the rehabilitation of the Badgerys Creek riparian corridor along the western boundary of the Project Site and the progressive rehabilitation of certain areas of the Project Site to ensure suitability for future productive use.

In order to facilitate the continuation of operations, Boral is seeking Concept Plan and concurrent Project Approval for the works which have been declared as a 'Major Development' under SEPP 2005. The Minister for Planning is the approval authority for the application.

25.2 Justification for the Project

The Project has been subject to environmental assessment in accordance with Part 3A of the EP&A Act and the requirements issued by the Director-General of the DoP. The EA undertaken concludes that whilst the Project would have some residual impacts, 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 stands to provide significant public benefit in terms of the provision of a vital resource for the construction industry. This resource would contribute to meeting projected future demand for such materials associated with the future growth planned for the Sydney Metropolitan Area, in particular the identified Growth Centres within which the Project Site is located. These benefits are considered to outweigh the residual environmental impacts identified in this EA.

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

25.3 Sustainability of the Project

The Project is sustainable in terms of:

- The acceptability of risks;
- Protection of ecological integrity and biodiversity;
- Social equity considerations; and
- A precautionary approach to analysis, management and monitoring of impacts and risks to the environment.

25.4 Conclusion

Potential environmental impacts resulting from the Project have been identified and measures and safeguards have been incorporated throughout the EA to manage these. 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.

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Worldwide Locations

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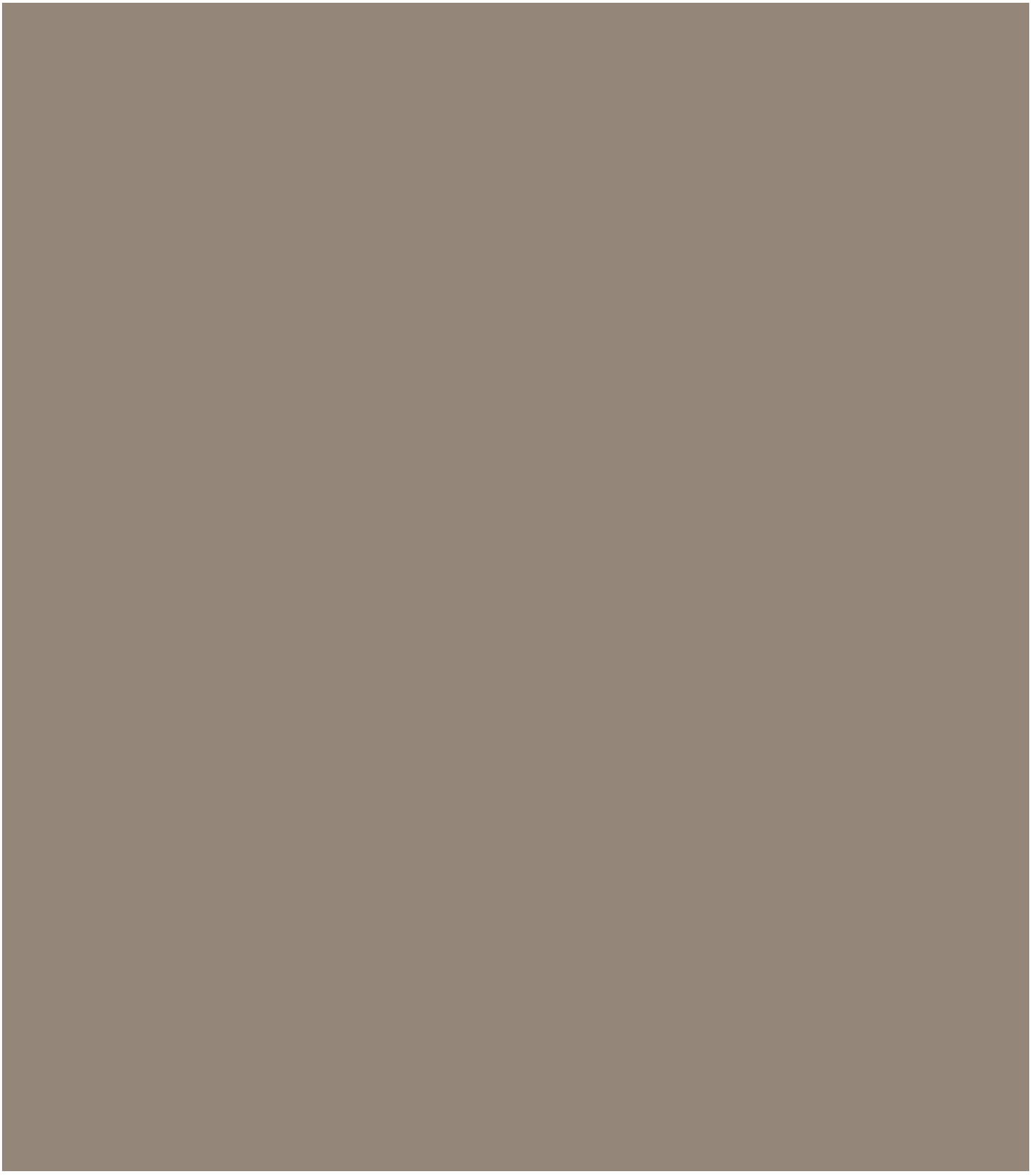

ENVIRONMENTAL ASSESSMENT PUBLICATIONS

Continued Operation of Quarry and Brick Making Facility
Boral, Badgerys Creek

Volume 1

Main Environmental Assessment Document

Volume 2

Appendix A: Existing Consents / Approvals
Appendix B: Director-General's Requirements
Appendix C: Soil and Water Management Plan
Appendix D: Rehabilitation Plan
Appendix E: Air Quality Impact Assessment
Appendix F: Noise Assessment

Volume 3

Appendix G: Traffic Impact Assessment
Appendix H: Road Alignment and Pavement Assessments
Appendix I: Bore Log Data
Appendix J: Geotechnical Investigations
Appendix K: Aboriginal Heritage Assessment
Appendix L: Ecological Search Tool Results
Appendix M: Boral Standard Operating Procedures Waste Management Plan