

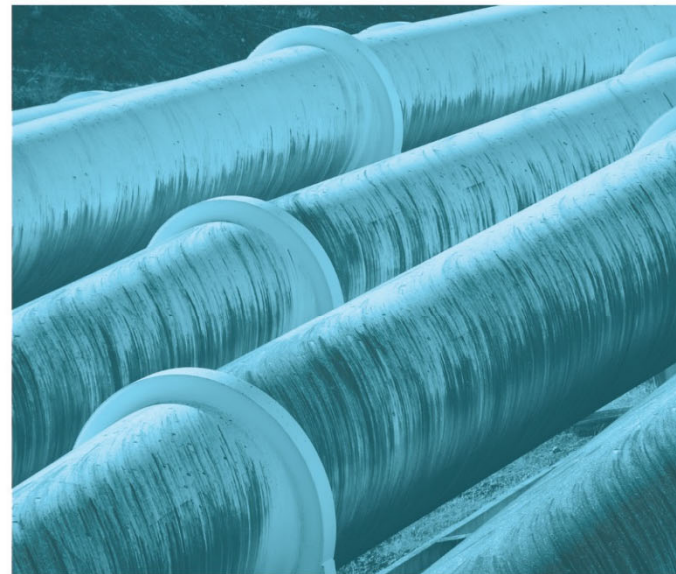


# Volume 2 - Appendices Environmental Impact Statement

Mugga Quarry Overburden Expansion Project | 321 Mugga Lane,  
Symonston, ACT

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Prepared for Boral Resources (Country) Pty Ltd  
April 2019





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Appendix A

# Scoping document for EIS

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**ACT**  
Government

**Environment, Planning and  
Sustainable Development**

## Scoping Document

Under Division 8.2.2 of the *Planning and Development Act 2007*

<b>APPLICATION NUMBER:</b> 201800033		<b>DATE OF THIS NOTICE:</b> 19 October 2018	
<b>DATE LODGED:</b> 7 September 2018		<b>DATE OF EXPIRY OF THIS NOTICE:</b> 19 April 2020	
<b>PROJECT:</b> Mugga Quarry Overburden Expansion Project			
<b>BLOCK:</b> 2031	<b>SECTION:</b> 0	<b>DISTRICT:</b> Jerrabomberra	
<b>ADDRESS:</b> 321 Mugga Lane			
<b>PROPONENT:</b> Boral Resources (Country) Pty Ltd			
<b>APPLICANT:</b> EMM Consulting Pty Ltd			
<b>LAND CUSTODIAN OF BLOCK 2031:</b> Boral Resources (Country) Pty Ltd			

### SCOPING DOCUMENT

The planning and land authority (the Authority) within the Environment, Planning and Sustainable Development Directorate received your application under section 212(1) of the *Planning and Development Act 2007* (the PD Act) for Scoping of an Environmental Impact Statement (EIS) for the above proposed development. Pursuant to section 212(2) of the PD Act, the Authority has:

- a) Identified the matters that are to be addressed by an EIS in the relation to the development proposal; and
- b) Prepared a written notice (the **scoping document**) of the matters.

*NB: The EIS must conform to the requirements of this scoping document. This document does not indicate approval or support in any way.*

### TERM OF SCOPING DOCUMENT

Pursuant to section 213(2) of the PD Act, the proponent must give the draft EIS to the Authority by the end of the period of 18 months starting on the day the Authority gives the scoping document for the development proposal to the applicant.

### FORM AND FORMAT OF EIS

The proponent must engage a suitably qualified independent consultant to prepare an EIS, OR the proponent must submit, with the draft EIS, an independent review of the draft EIS undertaken by a suitably qualified consultant. The EIS must be in the following form and format:

- The EIS must be prepared in accordance with section 50 of the *Planning and Development Regulation 2008*.
- The EIS must be written in plain English and avoid the use of jargon as much as possible.
- The EIS is required to be provided in the same structure as described in this Scoping Document, as closely as possible. A table that cross-references the EIS to the scoping document must be included in the EIS submission.



**ACT**  
Government

**Environment, Planning and  
Sustainable Development**

## Scoping Document

Under Division 8.2.2 of the *Planning and Development Act 2007*

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- The report must reference any figures or supporting information used to the supporting appendix and page number, table or figure.
- Additional technical detail, including relevant data, technical reports and other sources of the EIS analysis must be provided in appendices.
- Maps, diagrams and other illustrative material should be included in the EIS to assist readers to interpret information.
- The EIS document is to be sized A4 with maps and drawings in A4 or A3 format.
- The proponent must supply a copy of all draft EIS and revised EIS documents in electronic formats for circulation and web posting. These are to be supplied by email, USB, or another agreed method.
- Digital files must not exceed 20 MB each.
- The proponent must supply three hard copies of the draft EIS and 2 copies on individual USB's once it has been accepted for lodgement and three hard copies and 3 copies on individual USB's of the revised EIS once it had been accepted for lodgement.

### **COST OF PREPARATION OF EIS**

The proponent is responsible for the preparation of the draft and revised EIS and any related applications and associated costs. This includes additional copies of the draft and revised EIS and other associated documents as required by the Authority from time to time.

### **NEXT STEPS**

The proponent is now required to prepare a document (a **draft EIS**) that addresses each matter raised in the scoping document for the proposal within the timeframe provided in this scoping document. Once the draft EIS has been accepted for lodgement, a public notification fee is payable in order for notification, referrals and assessment to commence. After the notification period has closed, the Authority will provide comments and any public representations received for the proponent to address in preparing a **revised EIS**, and any further instructions on the application.

If you have any queries about the requirements outlined in this scoping document, please contact Jacob Treloggen to arrange a suitable time to discuss.

**Delegate of the planning and land authority**

George Cilliers  
A/g Executive Director  
Planning Delivery Division  
Environment, Planning and  
Sustainable Development Directorate

**Contact**

Jacob Treloggen  
Assessment Officer  
Impact Assessment and Business Improvement  
Environment, Planning and  
Sustainable Development Directorate  
E: [Jacob.treloggen@act.gov.au](mailto:Jacob.treloggen@act.gov.au)  
T: (02) 6205 7391

## GENERAL REQUIREMENTS FOR THE EIS

### 1. Cover Page

The cover page must clearly display the following:

- The name of the proposal (project title)
- The block identifier(s) and street address for the proposal
- The date of the preparation of the document
- Full name and postal address of the designated proponent
- Full name and postal address of the designated applicant
- Name and contact details of the person/organisation who prepared the documents (if different to the above)

### 2. Glossary

Provide a glossary of technical terms, acronyms and abbreviations used in the EIS.

### 3. Executive Summary

Provide a non-technical summary of the EIS including a description of the proposal, key findings and recommendations.

### 4. Introduction

Summarise the proposal background and justification for the proposal.

### 5. Proposal Details

#### 5.1. Project Description

Provide a description of the proposal, including:

- a) The objectives and justification for the proposal;
- b) The location of the land to which the proposal relates, including detailed maps;
- c) The division and/or district names and block and/or section numbers of the land under the *Districts Act 2002*;
- d) If the land is leased – the lessee's name;
- e) If the land is unleased or public land – the custodian of the land;
- f) The purposes for which the land may be used;
- g) A clear identification of all lands subject to direct disturbance from the proposal and associated infrastructure and geomorphic features such as waterways and wetlands. This is to be supported by a map showing all affected lands;
- h) An outline of any developments that have been, or are being, undertaken by the proponent, or other person(s) or entities, within the proposal area and broadly in the region. Describe how the proposal relates to those in the region affected by the proposal;
- i) A description of all the components of the proposal, including the proposal specifications, the predicted timescale for implementation (design, approvals, construction and decommissioning) and project life;

- 
- j) A plan/description of the precise location of any works to be undertaken, structures to be built or elements of the proposal that may have relevant impacts; and
  - k) A description of the construction methodologies for the proposal.

## 5.2. Alternatives to the proposal

Provide details of any alternatives to the proposal considered in developing the proposal including a description of:

- a) Any alternatives to the proposal and provide reasons for selecting the preferred option with an analysis of site selection as an attachment to the EIS;
- b) The criteria used for assessing the performance of any alternative to the proposal considered;
- c) Any matters considered to avoid or reduce potential impacts prior to the selection of the preferred option; and
- d) Details of the consequences of not proceeding with the proposal.

## 6. Legislative and Strategic Context

A description of the EIS process including any statutory approvals obtained or required for the proposal, and how the proposal is aligned with strategic priorities for the ACT.

### 6.1. Statutory requirements

The description must include information on statutory requirements for the preparation of an EIS:

- *Planning and Development Act 2007*
- *Planning and Development Regulation 2008*
- Related statutory approvals.

### 6.2. Climate change

The EIS must include information on how the proposal will reduce the risks from climate change impacts and include proposed adaptation measures to reduce vulnerability and increase resilience of the community and the Territory, particularly the extreme events of heatwaves, droughts, storms with flash flooding and bushfires. The information must address impacts on the local microclimate and how it will avoid contribution to urban heat and positively contribute to urban cooling measures.

Additionally, the EIS must address the contribution the proposal will make to reducing greenhouse gas emissions and meeting the legislated target for a net zero emissions Territory (by 2050 at the latest). Preparation of the EIS must consider the ACT Government's policies:

- ACT Climate Change Adaptation Strategy, 2016
- AP2 – A new climate change strategy and action plan for the Australian Capital Territory, 2012

### 6.3. Other requirements

The description must also include information on how each of the following has been considered in the preparation of the EIS and the development of the proposal:

- Territory Plan 2008
- ACT Planning Strategy
- National Capital Plan

- Sustainability Policies
- Environment Protection Act
- Any relevant Master Plan
- Other relevant planning and environmental guidelines and management plans.

### **6.3.1. Ecologically sustainable development (ESD)**

Provide a description of how the proposed development demonstrates ESD. This is to include long-term and short-term considerations related to economic development, social development and environmental protection at local, regional and national scales. The proponent should ensure that the EIS adequately addresses the ESD principles as defined by section 9 of the PD Act.

### **6.3.2. Territory Plan strategic directions**

A statement must be provided regarding the proposal's consistency with the principles in the Statement of Strategic Directions in the Territory Plan 2008 (Section 2.1 - Strategic Direction).

## **7. Risk Assessment**

### **7.1. Risk Assessment Methodology**

Provide a risk assessment in accordance with the Australian and New Zealand Standard for risk management AS/NZS ISO 31000:2009 *Risk Management – Principles and guidelines*. The proposed criteria for determining which risks are potentially significant impacts must be described. This should be based upon the Preliminary Risk Assessment (PRA) submitted with your request for the scoping application.

Should any risk levels change during the preparation of the EIS or any new risks become apparent, these must be assessed and included within the EIS, and where relevant, the residual risk assessment.

<b>-Assessment guide-</b>			
Provide a table with the headings below to describe the risks identified and the original risk rating without any mitigation strategies in place. This table format is one option, however alternative formats can be used provided the methodology is clearly described and in accordance with AS/NZS ISO 31000:2009 <i>Risk Management – Principles and guidelines</i>			
Risk	Likelihood	Consequence	Risk rating

## 8. Assessment of Impacts

Sufficient information is required to provide the Authority with an adequate understanding of the environmental impacts associated with the proposal. Each potentially significant impact rated with a risk rating of medium and above as identified in the risk assessment must be addressed with the information required by sections 8.1.1- 8.1.7 of this scoping document.

Table 1 identifies the issues that the Authority has identified as potentially significant risks, and the relevant sections of the scoping document that must be addressed in the EIS. The risks and their associated risk levels were determined from the information submitted with the PRA, comments received from entities on the request for scoping document application and the Authority's assessment.

**Table 1 – Identified impacts and requirements to be addressed in the EIS**

Environmental Theme	Risk identified	See section/s below for further detail
Biodiversity	<ul style="list-style-type: none"> <li>Impacts to Flora and Fauna</li> <li>Impacts to ecological communities</li> </ul>	8.1.1
Air Emissions (Dust)	<ul style="list-style-type: none"> <li>Impacts off-site during construction</li> <li>Impacts off-site during operation</li> </ul>	8.1.2
Aboriginal cultural heritage	<ul style="list-style-type: none"> <li>Impacts to known Aboriginal cultural heritage</li> <li>Impacts to unknown Aboriginal cultural heritage</li> </ul>	8.1.3
Visual	<ul style="list-style-type: none"> <li>Visual impacts on the non-urban area, including lighting</li> </ul>	8.1.4
Soil and hydrology	<ul style="list-style-type: none"> <li>Impacts to the existing surface flow regime</li> <li>Flooding during construction and operation</li> </ul>	8.1.5
Noise and Vibration	<ul style="list-style-type: none"> <li>Noise during operation</li> </ul>	8.1.6
Hazards and risks	<ul style="list-style-type: none"> <li>Fire from equipment failure impacting on surrounding properties</li> <li>Liquid trade waste</li> </ul>	8.1.7

### 8.1. Required detail for addressing impacts (Table 1)

The following items (sections 8.1.1 - 8.1.7), relate to the potentially significant environmental impacts identified in Table 1. They must be addressed in detail in the EIS.

NOTE: The information provided under the following headings is not an exhaustive list of matters that may be required to accurately detail the assessment scenarios.

#### 8.1.1. Biodiversity

- Describe all ecological communities and protected species present in the proposed area of construction.
- Describe whether any ecological communities or species that have the potential to occur in the proposed area are listed as critically endangered, endangered, vulnerable or conservation dependent, or protected, under any of the following Acts:

- 
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
  - Nature Conservation Act 2014
  - Tree Protection Act 2005
  - Ecological studies must be conducted and provided as part of the draft EIS to determine the presence, or absence, of environmental values including but not limited to native vegetation, threatened species and ecological communities, and within the impact zone (EPBC Act and NC Act).
  - Define any areas where habitat rehabilitation will occur after the completion of works.
  - Identify the potential direct and indirect impacts associated with the proposal on native vegetation and threatened ecological communities and threatened species (and their habitats), within, or surrounding, the impact zone and any offsets proposed.
  - Provide tree assessment/plans indicating the tree type, health, size, species and canopy and outline strategies to minimise the impact on planted and native trees along the corridor.
  - Identify if coconut ants are present on site and if so, search for the caterpillars, pupae, eggs and butterflies of the Small Ant Blue Butterfly, a rare species known to occur in the area.
  - Describe all avoidance measures for the proposed development and associated works including measures relating to critical habitat within proximity of the site.
  - Include a description of mitigation measures aimed at reducing impacts on ecological communities and protected species.

#### **8.1.2. Air Emissions (Dust)**

- An air quality and odour impact assessment must be completed by a suitably qualified environmental consultant and in accordance with the South Australian EPA's *Ambient Air Quality Assessment August 2016*.
- Detail potential dust generation or dust movement during construction.
- Detail any potential impacts on existing air quality caused by the use of the site.

#### **8.1.3. Aboriginal Cultural Heritage**

- Indicate how any unexpected Aboriginal places or objects will be managed during construction.
- Describe reporting techniques that will be used for the discovery of any Aboriginal sites or artefacts that are encountered during construction.
- Provide a copy of the Statement of Heritage Effects (SHE) & Cultural Heritage Assessment (CHA) to be incorporated as part of the EIS.

#### **8.1.4. Visual**

- Conduct a visual impact assessment that details predicted impacts the proposal may have on the landscape character of the site and surrounds.
- Provide perspectives and/or a visual analysis of the proposal from local vantage points.
- The visual assessment should include information as to the maximum height of the new permanent bund and temporary emplacement area.
- Detail restoration methods for disturbed areas which will ensure that landscaped areas will be restored to their original condition in accordance with the land custodian's requirements.

#### **8.1.5. Soil and Hydrology**

- Describe how groundwater runoff will be managed.
- Outline any potential impacts to surrounding blocks.
- Describe how overland water flow will be managed if a significant rain event occurs during construction.
- Describe all mitigation measures that will be implemented to reduce the impact from

construction runoff into surrounding areas.

- Provide information on stormwater/waste water management during construction.

**8.1.6. Noise and Vibration**

- Describe the staging for the construction of the development including expected completion of each stage.
- Describe the proposed time of day that the construction will be undertaken.
- Describe any mitigation measures to reduce the impact of noise and vibration on existing surrounding uses.

**8.1.7. Hazards and Risk**

- Describe the potential for hazard and risk associated with the construction and operation of the project including fire, flooding and accidents.
- Identify, assess and detail mitigation measures for any risks associated with the impacts.
- Identify potential public hazards from construction and describe mitigation measures to reduce the risk.
- Include any temporary management measures for public areas.
- Outline whether there will be any non-domestic sewage produced at the proposed facility during operation. If non-domestic sewage (trade waste or liquid trade waste) is produced, details are required for how the proposed wastewater will be in accordance with Icon Water’s liquid trade waste requirements.
- The design and construction of all water bodies to minimise the potential for them to become a local mosquito nuisance.

**8.2. Investigating impacts (Table 1)**

Each potentially significant environmental impact identified within Table 1 should be addressed/structured as per sections 8.2.1 - 8.2.5.

-Assessment Guide-		
<p><b>Assessment Scenarios:</b> The proponent should describe and use baseline case, application case and planned development case in their EIS to describe and address impacts at all stages of the project (construction, operation, decommissioning and reclamation)</p>		
<p><b>Baseline case</b> The baseline case establishes and describes the conditions that exist prior to the development or if the project were not developed. Describe the environmental conditions that include the effects of existing land uses of the area.</p>	<p><b>Application case</b> The application case describes the baseline case with the effects of the proposal added. Information is provided to allow regulators to determine how project operations should be controlled and how adverse effects can be mitigated and managed.</p>	<p><b>Planned development case</b> The planned development case describes the environmental conditions of the project when integrated with the existing conditions and any other planned projects which can be reasonable expected to occur.</p>

**8.2.1. Environmental conditions and values**

Describe the environmental conditions and identify the environmental values for the environmental themes identified in Table 1. This section should discuss the baseline conditions for the area.

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### **8.2.2. Investigations**

Identify the findings and results of any environmental investigation in relation to the land to which the proposal relates.

### **8.2.3. Impacts**

Describe the effects of the environmental impact as a result of construction and operation for the environmental themes identified in Table 1 (including cumulative, consequential and indirect effects) on physical and ecological systems and human communities. Particular emphasis should be placed on the potentially significant impacts identified in the risk assessment and this scoping document. Include a discussion of the timeframes of impacts i.e. short or long term, their nature and extent and whether they are reversible or irreversible, unknown or unpredictable. Include an analysis of the significance of the relevant impacts. Information must include any technical data and other information used or needed to make a detailed assessment of the relevant impacts.

### **8.2.4. Mitigation and potential offsets**

Discuss the proposed safeguards and mitigation measures proposed to be taken for the environmental management of the land to which the proposal relates for the environmental themes identified in Table 1. This is to include:

- a) A description and an assessment of the proposed impact prevention, mitigation or offsetting measures to deal with the environmental impact of the proposal
- b) A description of the expected or predicted effectiveness of the mitigation measures
- c) Any statutory or policy basis for the mitigation measures
- d) An outline of an environmental management plan (EMP) that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing
- e) The frequency, duration and objectives of monitoring proposed
- f) The name of the agency responsible for endorsing or approving each mitigation measure or monitoring program
- g) A description of the cost effectiveness of environmental mitigation or rehabilitation measures proposed and the expected or predicted effectiveness of those measures

A description of any offsets proposed in relation to the site. If offsets are proposed, the offset package must provide compensation for any unavoidable impacts arising from the proposal on listed threatened species and communities. The offset package must include, but not be limited to, measures to address the long-term protection and management of relevant listed threatened species and communities at offset sites in the ACT (or surrounding area) and may also include management measures to improve the ecological values. Further information on the provision of Commonwealth offsets is detailed in the *following link*: <http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy> available on the Commonwealth Department of Environment and Energy website.

### **8.2.5. Residual risk**

Provide a table that details the residual risk for the potentially significant impacts identified for the environmental themes in Table 1. A residual risk assessment is only required where the significance of the impact is determined as medium or above. The calculation of the residual risk should take into account the influence of implementation of mitigation or offsetting measures on the impacts

identified by the risk assessment. A discussion of how the calculations were determined should also be included.

-Assessment Guide-				
Provide a table with the headings below to describe the risks identified and the original risk rating without any mitigation. The residual risk assessment will include the consideration of management, mitigation and monitoring strategies applied to each risk identified. The residual risk rating describes the final risk with the mitigation measures in place.				
Risk identified in Section 7.1	Original risk rating from items identified in 7.1	Residual likelihood	Residual consequence	Residual risk rating

## 9. Community and stakeholder consultation

### 9.1. Consultation must be undertaken with:

- Lease holders and land managers of land potentially impacted by the proposal;
- Any recreational groups which may be affected by the proposal;
- Any volunteer conservation, landscape management or land care groups active in the area to be affected by the proposal; and
- The local community.

### 9.2. Methods

Describe the community consultation undertaken (methodology and criteria for identifying stakeholders and the communication methods used).

### 9.3. Consideration of community feedback

Describe how any concerns have been considered in light of the proposal and any future development planned.

### 9.4. Consideration of public representations from Draft EIS notification

The revised EIS must include the representations received, issues raised in the representations and a response to the issues and values identified. The summary response must clearly identify the representation(s) to which the responses relate.

## 10. Recommendations

Provide a summary of any commitments to impact prevention, mitigation measures, offsetting measures and other actions within the EIS.

Describe the monitoring parameters, monitoring points, frequency, data interpretation and reporting proposals.

## 11. Other relevant information

The proponent may wish to include issues outside the scope of the EIS as a separate section of the EIS. This allows the proponent to identify matters not required to be addressed in the EIS, but that would be subject to development assessment consideration and notification. This can provide additional context for members of the public regarding management of environmental issues, by ensuring that the public is aware that these issues will be addressed in the detailed design of the proposal.

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## 12. References

A reference list using standard referencing systems must be included.

## 13. Required Appendices

### 13.1. Scoping document for the EIS

A copy of the scoping document should be included in the EIS. Where it is intended to bind appendices in a separate volume from the main body of the EIS, the scoping document should be bound with the main body of the EIS for ease of cross-referencing.

### 13.2. Scoping Document Reference

Include a table that cross-references the EIS to the scoping document.

### 13.3. Proponent's Environmental History

Provide details of any proceedings under a Commonwealth or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:

- The person proposing to take the action
- For an action for which a person has applied for a permit, the person making the application.

If the person proposing to take the action is a corporation, then provide details of the corporation's environmental policy and planning framework. Enough information is required to satisfy s136(4) of the EPBC Act.

### 13.4. Information Sources

For information given the following must be stated:

- The author or any reports or studies
- The publication date
- The source of the information
- How recent the information is (i.e. when a study was conducted or when primary sources were produced)
- How the reliability of the information was tested
- What uncertainties (if any) are in the information.

### 13.5. Study team

The qualifications and experience of the study team and specialist sub-consultants and expert reviewers must be provided.

### 13.6. Specialist studies

All reports generated based on specialist studies undertaken as part of the EIS are to be included as appendices.

### 13.7. Research

Any proposals for researching alternative environmental management strategies or for obtaining any further necessary information should be outlined in an appendix.

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**Attachment A****14. ENTITY REQUIREMENTS**

Where not otherwise identified as a potentially significant impact, provide information in accordance with the requirements of the entities. If the issues raised by entities have been addressed in other sections of the EIS, this must be cross referenced in this section.

**A1. Conservator of Flora and Fauna**

- The Scoping Document Application adequately addresses our information requirements in regards to the impacts on Box-Gum Woodland and Superb Parrot habitat. The only additional information is a search for coconut ants and if present then a search for the caterpillars, pupae, eggs and butterflies of the Small Ant Blue Butterfly, a rare species known to occur in the area.

**A2. Heritage**

- No further approvals under the Heritage Act 2004 will be required for the proposal once the SHE process is complete, as it will address the heritage issues arising from the proposal.
- The outcomes of the SHE/CHA process should be incorporated into the EIS documents when they are prepared.

**A3. ICON Water**

- Icon Water notes the following information contained on pg. 23 of the Boral Resources EIS Scoping Document Application as follows;
  - *“Boral has a waste management procedure which is currently in place on site. The purpose of the waste management procedure is to describe how to manage any impact arising from waste in the operation of the plant.”*
  - *“No new septic tank(s) will be constructed as part of the project.”*
- With respect to Icon Water’s liquid trade waste requirements the EIS Scoping Document provided does not outline whether there will be any non-domestic sewage produced at the proposed facility in the operation of the plant for the Mugga Quarry Expansion Project. If non-domestic sewage (also known as “trade waste” or “liquid trade waste”) is produced, the proposed wastewater needs to be characterised and any required onsite treatment controls incorporated into the project to ensure connection is permitted to the sewage network with discharge able to be effectively treated at the Lower Molonglo Water Quality Control Centre. Information on trade waste is available on the Icon Water website: <http://www.iconwater.com.au/My-Business/Tradewaste.aspx>
- For additional information please contact the Icon Water Liquid Trade Waste Team; Email: [Trade.Waste@iconwater.com.au](mailto:Trade.Waste@iconwater.com.au) Phone: 02 6248 3222

**A4. Health**

- The design and construction of all water bodies to minimise the potential for them to become a local mosquito nuisance.
- Any influence upon existing air quality including potential dust generation or dust movement during construction.

**A5. Canberra Airport**

- No Comment

**A6. Environment, Planning and Sustainable Development Directorate**

**Strategic Planning**

- The EIS's visual assessment should include information as to the maximum height of the new permanent bund and temporary emplacement area to ensure a thorough assessment.

**A7. EPA**

- No Comment

**A8. EPP**

- No Comment

**A9. ESA**

- No Comment

**A10. EvoEnergy Electricity**

- No Comment

**A11. TCCS**

- No Comment

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**Attachment B****GLOSSARY**

**Controlled Action (EPBC):** An action defined under the EPBC Act, section 67.

**Development application (DA):** Application for development as defined under the PD Act.

**Environment:** As defined under the *Planning and Development Act 2007* (the PD Act), each of the following is part of the environment:

- (a) the soil, atmosphere, water and other parts of the earth;
- (b) organic and inorganic matter;
- (c) living organisms;
- (d) structures, and areas, that are manufactured or modified;
- (e) ecosystems and parts of ecosystems, including people and communities;
- (f) qualities and characteristics of areas that contribute to their biological diversity, ecological integrity, scientific value, heritage value and amenity;
- (g) interactions and interdependencies within and between the things mentioned in paragraphs (a) to (f);
- (h) social, aesthetic, cultural and economic characteristics that affect, or are affected by, the things mentioned in paragraphs (a) to (f).

**Environmental Impact Statement (EIS):** As defined under the PD Act.

**EPBC Act:** *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

**Impact Track:** An assessment track that applies to a development proposal defined under the PD Act, section 123.

**Long term:** Greater than 15 years duration.

**Medium term:** Greater than three (3) years to 15 years duration.

**PD Act:** *Planning and Development Act 2007* (ACT)

**Regulated waste:** waste defined under the *Environment Protection Act 1997*

**Scoping:** The process of identifying the matters that are to be addressed by an EIS in relation to the development proposal - see the PD Act, Section 212 (2).

**Short term:** Zero to three (3) years duration.

**Socio-economic:** Involving both social and economic factors.

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Appendix B

# EIS scoping document cross referencing checklist

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## B.1 EIS scoping document cross referencing checklist

<b>EIS Scoping Document</b>	<b>EIS</b>
1. Cover page	First page
2. Glossary	Page 157
3. Executive summary	ES.3-9
4. Introduction	Section 1
5. Proposal details	Section 2
5.1 Project description	Section 2.3
5.2 Alternatives to the proposal	Section 2.4
6. Legislative and Strategic Context	Section 3
6.1 Statutory requirements	Sections 3.1, 3.2, 3.4
6.2 Climate change	Section 3.5
6.3 Other requirements	Section 3.7
6.3.1 Ecological sustainable development	Section 3.6
6.3.2 Territory Plan strategic directions	Section 3.3
7. Risk Assessment	Section 4
7.1 Risk Assessment Methodology	Section 4.1
8. Assessment of Impacts	Section 5
8.1 Required detail for addressing impacts	-
8.1.1 Biodiversity	Section 5.1
8.1.2 Air Emissions	Section 5.2
8.1.3 Aboriginal Cultural Heritage	Section 5.3
8.1.4 Visual	Section 5.4
8.1.5 Soil and Hydrology	Section 5.5
8.1.6 Noise and Vibration	Section 5.6
8.1.7 Hazards and Risk	Section 5.7
8.2 Investigating Impacts	-
8.2.1 Environmental conditions and values	Sections 5.1.2, 5.2.2, 5.3.2, 5.4.2, 5.5.2, 5.6.2, 5.7.2
8.2.2 Investigations	Sections 5.1.3, 5.2.3, 5.3.3, 5.4.3, 5.5.3, 5.6.3,
8.2.3 Impacts	Sections 5.1.5, 5.2.4, 5.3.4, 5.4.4, 5.5.4, 5.6.4, 5.7.3
8.2.4 Mitigation and potential offsets	Sections 5.1.6, 5.2.5, 5.3.5, 5.4.5, 5.5.5, 5.6.5, 5.7.4
8.2.5 Residual risk	Sections 5.1.7, 5.2.6, 5.3.6, 5.4.6, 5.5.6, 5.6.6, 5.7.5
9. Community and stakeholder consultation	Section 7

9.1 Consultation must be undertaken with:

- Lease holders and land managers of land potentially impacted by the proposal Section 7.4
- Any recreational groups which may be affected by the proposal
- Any volunteer conservation, land management or land care groups active in the area to be affected by the proposal; and
- The local community

9.2 Methods

Section 7.2

9.3 Consideration of community feedback

None received

9.4 Consideration of public representations from Draft EIS notification

None received

10. Recommendations

Section 8

11. Other relevant information

Section 9

12. References

Page 153

13. Required appendices

Appendices A - P

13.1 Scoping document for the EIS

A.1

13.2 Scoping document reference

B.1

13.3 Proponent's environmental history

Section 6

13.4 Information Sources

Page 153

13.5 Study team

Appendix Q

13.6 Specialist studies

Appendices F - N

13.7 Research

N/A

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Appendix C

# Certificate of title

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AUSTRALIAN CAPITAL TERRITORY

# Certificate of Title

*Land Titles Act 1925*

Pursuant to S.44 of the Land Titles Act 1925, I certify that the registered proprietor is the owner of an estate in respect to the land described in this certificate. This Certificate of Title is subject to those unsatisfied mortgages and encumbrances, and any other interests to which the land is subject.



Brett Phillips  
Registrar-General

## LAND

Jerrabomberra Block 2031 on Deposited Plan 5976  
Lease commenced on 25/11/2011, granted on 25/11/2011, term of 25 years  
Area is 1 square kilometres 4 hectares 6000 square metres or thereabouts

## REGISTERED PROPRIETOR

### Sole Proprietor:

Boral Resources (Country) Pty Limited  
of Clunies Ross Street Prospect NSW 2145

## REGISTERED ENCUMBRANCES AND INTERESTS

Registration Date	Registration Number	Description of Interest
		Original title is <b>Volume 2028 Folio 22</b> Purpose Clause: Refer Crown Lease Market Value Lease: Applies For Term Of Lease S.251 Planning and Development Act 2007: Current Restriction on Transfer/Assignment: Applies For Term Of Lease
04/05/2012	1798497	Application to Register a Crown Lease (DCL1798496) <b>End of interests</b>



CANCELLED  
AND COMPUTER  
CERTIFICATE OF TITLE ISSUED

Entered in Register Book Vol 2028 Folio 22

- 4 MAY 2012



Brett Phillips  
Registrar-General



**This is a market value lease - s238(2)(a)(ii) Planning and Development Act 2007, and**

**Section 251 of the Planning and Development Act 2007 applies**

AUSTRALIAN CAPITAL TERRITORY

PLANNING AND DEVELOPMENT ACT 2007

Australian Capital Territory (Planning and Land Management) Act 1988 (C'th) (ss 29, 30 & 31)

LEASE GRANTED pursuant to the Planning and Development Act 2007 and the Regulations made under that Act on the twenty fifth day of November Two thousand and eleven WHEREBY THE PLANNING AND LAND AUTHORITY (“the Authority”) ON BEHALF OF THE COMMONWEALTH OF AUSTRALIA (“the Commonwealth”) in exercising its functions grants to **BORAL RESOURCES (COUNTRY) PTY LIMITED A.C.N. 000 187 002** a company having its registered office at Clunies Ross Street Prospect in the state of New South Wales (“the Lessee”) ALL THAT piece or parcel of land situate in the Australian Capital Territory containing **an area of 104.6 hectares** or thereabouts and being **Block 2031 District of Jerrabomberra** as delineated on **Deposited Plan Number 5976** in the Registrar-General’s Office at Canberra in the said Territory (“the land”) RESERVING unto the Territory all minerals and the right to the use, flow and control of ground water under the surface of the land TO HOLD unto the Lessee for the term of twenty five years commencing on the **twenty fifth day of November Two thousand and eleven** (“the date of the commencement of the lease”) to be used by the Lessee for the purpose set out in Clause 4(a) of this lease only YIELDING AND PAYING THEREFOR rent and royalty rent in the amounts and in the manner and at the times provided for in this lease and UPON AND SUBJECT TO the covenants conditions and agreements contained in this lease.

LESSEE

LAND

TERM

## INTERPRETATION

1. IN THIS LEASE unless the contrary intention appears:
  - (a) “accounting year” means each consecutive period of twelve months or proportion thereof ending on the thirtieth day of June or ending on such other date approved in writing by the Authority in each year (and on the last day of the term of the lease) the first such period commencing from the date of the commencement of the lease;
  - (b) “assessment period” means the successive triennial periods referred to in Clause 3 of this lease;
  - (c) “Authority” means the Planning and Land Authority established by section 10 of the Planning and Development Act 2007;
  - (d) “building” means any building or structure, constructed or partially constructed or to be constructed, as the context permits or requires, on or under the land;
  - (e) “Lessee” shall:
    - (i) where the Lessee consists of one person be deemed to include the Lessee and the executors administrators and assigns of the Lessee;
    - (ii) where the Lessee consists of two or more persons be deemed to include in the case of a tenancy in common the persons and each of them and their and each of their executors administrators and assigns and in the case of a joint tenancy be deemed to include the said persons and each of them and their and each of their assigns and the executors administrators and assigns of the survivor of them; and
    - (iii) where the Lessee is a corporation be deemed to include such corporation its successors and assigns;
  - (f) “premises” means the land building and any other improvements on the land;
  - (g) “quarterly period” means each consecutive period of three months or portion thereof commencing on the first day of the months of January April July and October in each year of the term of this lease and sooner determination thereof the first such period commencing from the date of the commencement of the lease;

- (h) “registered company auditor” means a registered company auditor under the provisions of the Corporations (Repeals, Consequentials and Transitionals) Act 2001 of the said Territory;
- (i) “rent” means:
  - (i) for the period of this lease commencing on the date of commencement of the lease and ending on the **twentieth** day of **DecemberTwo thousand and eleven** the amount of **fifty seven thousand five hundred dollars (\$57,500.00)** per annum;
  - (ii) for the remainder of the lease term the rent determined pursuant to Clause 3 of this lease;
- (j) “royalty rent” means:
  - (i) for the period of this lease commencing on the date of commencement of the lease and ending on the **twentieth** day of **DecemberTwo thousand and eleven** the amount of \$0.90 cents per tonne of rock extracted from the land EXCLUDING overburden and rock wastes referred to in Clause 4(c) and (d) of this lease; and
  - (ii) for the remainder of the lease term the royalty rent determined pursuant to Clause 3 of this lease;
- (k) “Territory” means:
  - (i) when used in a geographical sense the Australian Capital Territory; and
  - (ii) when used in any other sense the body politic established by section 7 of the Australian Capital Territory (Self-Government) Act 1988 (C'th);
- (l) words in the singular include the plural and vice versa;
- (m) words importing one gender include the other genders;
- (n) a reference in this lease to any statute or statutory provision shall include a reference to any statute or statutory provision that amends, extends, consolidates or replaces the statute or statutory provision and to any other regulation, instrument or other subordinate legislation made under the statute.

2. THE LESSEE COVENANTS WITH THE COMMONWEALTH as follows:

RENT

- (a) That the Lessee shall pay to the Authority:
- (i) the sum of **fifty seven thousand five hundred dollars (\$57,500.00) per annum** for the period commencing on the **twenty fifth** day of **November Two thousand and eleven** and ending on the **twentieth** day of **December Two thousand and eleven** payable by equal quarterly payments in advance on the first day of the months of January April July and October in each year and proportionately for any fraction of a quarter; and
  - (ii) for the remainder of the lease term the rent determined from time to time in accordance with the provisions of Clause 3 hereof payable by equal quarterly payments in advance on the first day of the months of January April July and October in each year and proportionately for any fraction of a quarter the first of such payments to be made on the **twenty first day of December Two thousand and eleven;**

ROYALTY RENT

- (b) IN ADDITION to the rent payable under this lease the Lessee shall pay to the Authority the royalty rent for each quarterly period in accordance with the provisions of Clauses 3(d), (e) and (f) of this lease;

ADDITIONAL RENT

- (c) That if any rent royalty rent or other moneys payable under this lease shall remain unpaid after the date appointed for its payment the Lessee shall on demand pay to the Authority as additional rent a sum calculated on the amount of the unpaid rent royalty rent or other moneys owing under the lease at a rate of fifteen per centum (15%) per annum during any period that the rent royalty rent or other moneys remain unpaid and computed from the date appointed to the date upon which such payments are made;

GOODS AND SERVICES TAX

- (d) That in addition to any other moneys payable under or in respect of this lease the Lessee shall pay to the Authority upon demand an amount equal to the amount payable by the Authority for GST in respect of this lease (where "GST" has the meaning the term has in the A New Tax System (Goods and Services Tax) Act 1999 (C'th));

MANNER OF  
PAYMENT  
OF RENT

- (e) That any rent royalty rent or other moneys payable by the Lessee to the Authority under this lease shall be paid to such person as may be authorised by the Authority for that purpose at Canberra in the said Territory without any deduction whatsoever.

3. IT IS MUTUALLY COVENANTED AND AGREED as follows:

ASSESSMENT  
PERIODS

- (a) That the lease period commencing on the **twenty fifth** day of **November Two thousand and eleven** and ending on the last day of the term of the lease shall be divided into assessment periods as follows:
- (i) the first assessment period shall commence on the **twenty first** day of **December Two thousand and eleven** and run for three years; and
- (ii) subsequent assessment periods shall be for successive triennial periods except for the last assessment period which shall commence on the day immediately after the last day of the penultimate assessment period and end on the last day of the term thereof;

DETERMINATION  
OF RENT

- (b) That the Authority shall make or cause to be made a determination of the rent and the royalty rent in respect of each assessment period as at the date of commencement of such assessment period. The Authority shall within fourteen days of the determination of the rent and the royalty rent for a period notify the Lessee of the determination and of the annual rental payable by the Lessee for the assessment period and until such notification the Lessee shall pay the rent and the royalty rent at the rate at which the rent and the royalty rent for the lease was payable immediately prior to the commencement of the assessment period;

DETERMINATION  
BINDING UNTIL  
SUBSEQUENT  
DETERMINATION

- (c) That the rent value determined by the Authority and notified to the Lessee shall be binding on both the Authority and the Lessee and shall be applied for all purposes of this lease as the rent in respect of the assessment period to which it relates unless and until a subsequent determination of such rent is made;

QUARTERLY  
STATEMENT

(d) That:

- (i) the Lessee shall within fourteen days of the last day of each day of each quarterly period furnish to the Authority a statement of all rock extracted for the land for the immediately preceding quarterly period. Such statement shall be in such form and style and shall contain such details as the Authority may reasonably require and the Lessee shall provide such further details and explanations as are reasonably required by the Authority in respect of such statement; and
- (ii) the Lessee shall tender with such statement the amount of the royalty rent found on such statement to be due to the Authority. Acceptance of the amount tendered shall be deemed to be acceptance on account and not acceptance on the amount as being correct;

ANNUAL STATEMENT (e) That:

- (i) the Lessee shall within three months of the end of each accounting year furnish to the Authority a statement certified by a registered company auditor or some other person approved in writing by the Authority as to all rock extracted from the land for the immediately preceding accounting year. Such statement shall be in such form and style and shall contain such details as the Authority may reasonably require;
- (ii) the Lessee shall tender with each such statement the amount of additional royalty rent (if any) found on such statement to be due to the Authority for the relevant accounting year. Acceptance of the amount tendered shall be deemed to be acceptance on account and not acceptance of such amount as being correct;
- (iii) the Authority shall within three months after receipt of such statement notify the Lessee whether or not the Authority accepts each such statement as correct for the purpose of calculating the royalty rent for the accounting year and in the absence of such notification such statement shall be deemed to have been accepted by the Authority as aforesaid; and
- (iv) on acceptance by the Authority of such statement as aforesaid the royalty rent for that accounting year shall be the royalty rent calculated in such statement;

AUDIT AND  
CALCULATION OF  
ROYALTY RENT

- (f) That if the Lessee shall default in submitting such statement as provided in Clauses 4(d) and (e) of this lease in the manner and within the period aforesaid or if the Authority does not accept any such statement as being correct:
- (i) the Authority shall be entitled to make or cause to be made an audit of the Lessee's books of accounts and records for that quarterly period or accounting year;
  - (ii) the Authority may make or cause to be made a calculation of the royalty rent in respect of that quarterly period or accounting year as the case may be. The Authority shall within fourteen days of such calculation of the royalty rent notify the Lessee of the calculation and of the royalty rent or additional royalty rent (if any) due to the Authority in respect of the quarterly period or accounting year as the case may be;
  - (iii) the amount of royalty rent or additional rent (if any) aforesaid shall be paid by the Lessee to the Authority within fourteen days of the date of any demand made by the Authority relating thereto and served on the Lessee;
  - (iv) all expenses incurred by the Authority in such audit shall be paid by the Lessee to the Authority on demand and from the date of demand until paid shall for all purposes of this lease be deemed to be additional rent payable under this lease on demand; and
  - (v) subject to Clause 3(f)(iii) of this lease if the Lessee disputes any calculation of the amount of royalty rent pursuant to the provisions of this sub-clause and if the Authority and the Lessee are unable to reach agreement on such amount the said amount shall be determined by arbitration and in the event of such determination being at variance with the relevant notification pursuant to Clause 3(f)(iii) of this lease an appropriate adjustment of such royalty rent shall be made.

4. THE LESSEE FURTHER COVENANTS WITH THE COMMONWEALTH  
as follows:

PURPOSE

- (a) To use the premises only for the purpose of:
- (i) quarrying rock;
  - (ii) grading, crushing, screening and processing rock;

- (iii) receiving, stockpiling, processing by crushing, screening, blending and/or reconstituting construction and demolition waste materials including concrete, concrete blocks, gravels, bricks, tiles, other clay products and asphalt;
- (iv) selling the products so obtained and processed;
- (v) manufacturing and selling bituminous concrete;
- (vi) manufacturing and selling pre-mixed concrete; and
- (vii) detonation of explosives;

## RESTORATION

- (b) That the Lessee shall rehabilitate and revegetate worked out areas benches exposed faces and other working areas of the premises so that a minimum of worked out land shall be untreated at any time and that revegetation shall take place in accordance with plans and specifications and programs prepared by the Lessee and previously submitted to and approved in writing by the Authority as follows:
  - (i) the Lessee shall have commenced the said rehabilitation and revegetation from the **twenty first day of December One thousand nine hundred and ninety nine;**
  - (ii) for the term of this lease the Lessee shall progressively carry out the said rehabilitation and revegetation in accordance with the said plans specifications and programs;
  - (iii) the Lessee shall on or before the day of the expiration or determination of this lease or within such further time as may be approved in writing for that purpose by the Territory complete the said rehabilitation and revegetation;
  - (iv) the Lessee shall furnish to the Authority on the date of the commencement of the lease for the amount referred to hereunder a guarantee or undertaking in the amount of **two hundred and fifty thousand dollars (\$250,000.00)** by a bank (or other similar institution) acceptable to the Authority containing such conditions as the Authority may require as surety for any costs and expenses incurred by the Authority on account of the Lessee being in breach of the Lessee's obligations under this Clause and effective for the lease term to pay to the Authority on demand;

- STOCKPILE TOPSOIL AND OVERBURDEN (c) That the Lessee shall stockpile topsoil and other overburden on the premises:
- (i) in areas approved in writing by the Territory for that purpose; and
  - (ii) keeping topsoil separate from other overburden for use in rehabilitation and revegetation of the premises;
- ROCK WASTE (d) That the Lessee shall place tailings excess crusher dust and other rock wastes from the premises only in areas approved in writing by the Territory for that purpose;
- INDUSTRIAL PROCESSES (e) That the Lessee shall give prior notice in writing to the Authority of the industrial processes to be conducted on the premises and of the wastes to be produced and of any substantial variation to the processes or the wastes;
- INDEMNITY (f) That the Lessee shall indemnify and keep indemnified the Territory, the Authority and their respective officers servants and agents from all actions claims suits and demands whatsoever which may be brought maintained or made or prosecuted against them or any of them by any person arising out of or in connection with the occupation of the premises by the Lessee and against all costs damages and expenses which may be incurred by the Territory, the Authority and their respective officers servants or agents in defending or settling any such actions proceedings claims or demands;
- ENVIRONMENTAL AUTHORISATIONS (g) That the Lessee shall comply with any Environmental Authorisation granted by the Territory in accordance with the Environment Protection Act 1997;
- TREES (h) That the Lessee shall not cut down fell ringbark or otherwise injure or destroy (or suffer or permit the same) any live tree or tree-like plant on the land without the previous approval in writing of the Territory;
- PROTECTION OF NATIVE TREES (i) That the Lessee shall protect native trees on the land from damage except for those approved for removal in accordance with Clause 4(h). The control of weeds should be carried out in such a manner that native trees, shrubs and regeneration in woodland areas are not affected. There should be no fertiliser application or exotic pasture seeding in the Yellow Box/Red Gum grassy woodland area;

- ADVERTISEMENTS (j) That the Lessee shall not display or permit to be displayed on the premises any advertisement sign or hoarding without the previous approval in writing of the Authority;
- CLEAN AND TIDY (k) That the Lessee shall at all times keep the premises clean and tidy and free from debris dry herbage rubbish and other unsightly or offensive matter PROVIDED ALWAYS THAT should the Lessee fail to do so the Authority may at the cost of the Lessee cause any matter or thing to be removed from the premises and restore the premises to a clean and tidy condition;
- BUILDING SUBJECT TO APPROVAL (l) That the Lessee shall not without the previous approval in writing of the Authority, except where exempt by law, erect any building, or make any structural alterations to any building, on the land;
- REPAIR (m) That the Lessee shall at all times during the said term maintain repair and keep in repair the premises to the satisfaction of the Authority;
- FAILURE TO REPAIR (n) If and whenever the Lessee is in breach of the Lessee's obligations to maintain repair and keep in repair the premises or to rehabilitate or revegetate areas of the premises in accordance with Clauses 4(b) and (m) of this lease the Authority may by notice in writing to the Lessee specifying the repairs and maintenance or rehabilitation or revegetation needed require the Lessee to effect the necessary work in accordance with the notice. If the Authority is of the opinion that a building or some other improvement on the land is beyond reasonable repair or the Lessee has failed to rehabilitate or revegetate areas of the said land the Authority may by notice in writing to the Lessee require the Lessee to remove the building or improvement or rehabilitate or revegetate the said areas of the land within the time specified in the notice WITHOUT PREJUDICE to the exercise by the Authority of the powers conferred upon it by Clause 6(a) of this lease. If the Lessee does not carry out the required work within the time specified by the Authority any person or persons duly authorised by the Authority with such equipment as is necessary may enter the premises and carry out the necessary work and all costs and expenses incurred by the Authority in carrying out the work shall be paid by the Lessee to the Authority on demand and from the date of such demand until paid shall for all purposes of this lease be a debt due and payable to the Authority by the Lessee;
- RIGHT OF INSPECTION (o) Subject to the provisions of the Planning and Development Act 2007 to permit any person or persons authorised by the Authority to enter and inspect the premises at all reasonable times and in any reasonable manner;

RATES AND CHARGES

- (p) To pay all rates charges and other statutory outgoings assessed levied or payable in respect of the premises as and when they are due for payment;

ASSIGNMENT AND SUB LETTING

- (q) That the Lessee shall not mortgage charge assign transfer sublet or part with the physical possession of the whole or any portion of the premises or procure the premises or any portion thereof licensed unto any person corporation or organisation without the previous approval in writing of the Authority.

5. THE COMMONWEALTH COVENANTS WITH THE LESSEE as follows:

QUIET ENJOYMENT

- (a) That the Lessee paying the rent and all other money due and observing and performing the covenants and stipulations on the part of the Lessee to be observed and performed shall quietly enjoy the premises without interruption by the Authority or any person lawfully claiming from or under or in trust for the Authority;

SURRENDER

- (b) That the Lessee may at any time upon payment of all rent and other moneys due to the Authority under this lease surrender this lease to the Authority but subject to any law of the Territory to the contrary the Lessee shall not be entitled to receive any compensation from the Authority in respect of such surrender or in respect of any buildings erections or improvements upon the said land.

6. IT IS MUTUALLY COVENANTED AND AGREED as follows:

TERMINATION

- (a) That if:
  - (i) any rent or other moneys payable under this lease shall remain unpaid for three months next after the date appointed for payment thereof (whether such rent or other moneys shall have been formally demanded or not); or
  - (ii) the said land is at any time not used for a period of one year for the purpose for which this lease is granted; or
  - (iii) rehabilitation and revegetation in accordance with Clause 4(b)(i) of this lease is not commenced within the period specified in the said paragraph; or
  - (iv) progressive rehabilitation and revegetation works in accordance with Clause 4(b)(ii) of this lease are not carried out in accordance with the said paragraph; or

- (v) the Lessee shall be in breach of the Lessee's obligations under Clause 4(b)(iv) of this lease; or
- (vi) the Lessee shall commit a breach of Clause 4(q) of this lease; or
- (vii) the Lessee shall fail to observe or perform any other of the covenants contained in this lease on the part of the Lessee to be observed or performed and shall have failed to remedy such breach within a period of three months from the date of service on the Lessee of a notice in writing from the Authority specifying the nature of such breach

the Authority on behalf of the Commonwealth may terminate this lease but without prejudice to any claim which the Authority or the Commonwealth may have against the Lessee in respect of any breach of the covenants on the part of the Lessee to be observed or performed;

ACCEPTANCE  
OF RENT

- (b) That acceptance of rent or other moneys by the Authority during or after any period referred to in Clauses 6(a) (i), (ii), (iii), (iv), (v), (vi) or (vii) of this lease shall not prevent or impede the exercise by the Authority of the powers conferred upon it by said Clauses;

REMOVAL OF  
IMPROVEMENTS

- (c) That the Lessee may at any time during the said term or within one month or such further time as the Authority may in writing allow after the expiration or termination of this lease remove from the premises any buildings fittings fixtures furnishing plant amenities appurtenances and other improvements as the Authority may allow in writing;

PROVISIONS  
CONTINUE TO APPLY

- (d) That notwithstanding the expiration surrender or earlier termination (including determination) for any reason of this lease the provision of Clauses 3(d), (e) and (f) and Clause 4(b) of this lease shall continue to apply for a period of twelve months following upon such expiration surrender or earlier termination;

FURTHER LEASE

- (e) Subject to the Lessee paying all money required to be paid under the provisions of the Planning and Development Act 2007 the Lessee shall be entitled to a further lease of the land for such further term and at such rent and subject to such conditions as may then be provided or permitted by Statute Ordinance or Regulation;

NOTICES

(f) That any notice requirement demand consent or other communication to be given to or served upon the Lessee under this lease shall be deemed to have been duly given or served if signed by or on behalf of the Authority and delivered to or sent in a prepaid letter addressed to the Lessee at the registered office of the Lessee in the said Territory BUT if for any reason the Lessee does not have a registered office in the said Territory then at the usual or last-known address of the Lessee or affixed in a conspicuous position on the premises;

EXERCISE OF POWERS

(g) Any and every right, power or remedy conferred on the Commonwealth or Territory in this lease, by law or implied by law may be exercised on behalf of the Commonwealth or the Territory or as the case may be by:  
(i) the Authority;  
(ii) an authority or person for the time being authorised by the Authority or by law to exercise those powers or functions of the Commonwealth or Territory; or  
(iii) an authority or person to whom the Authority has delegated all its powers or functions under the Planning and Development Act 2007.

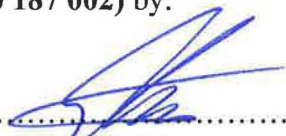
IN WITNESS whereof the Authority on behalf of the Commonwealth and the Lessee have executed this lease.

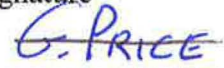
Signed by Monica Saad )  
a delegate authorised to execute this lease )  
on behalf of the Commonwealth in the )  
presence of BRONWYN PODMORE )

  
.....  
Delegate

  
.....  
Witness

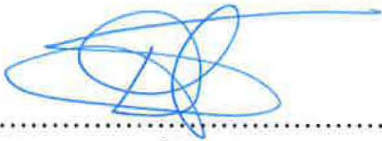
Signed by BORAL RESOURCES )  
(COUNTRY) PTY LIMITED )  
(A.C.N. 000 187 002) by: )

  
.....  
Signature

  
.....

Name in full  
GREGORY PRICE

Director/Secretary

  
.....  
Signature

DOMINIC PAUL MILLGATE

Name in full

Director/Secretary

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Appendix D

# Project plans

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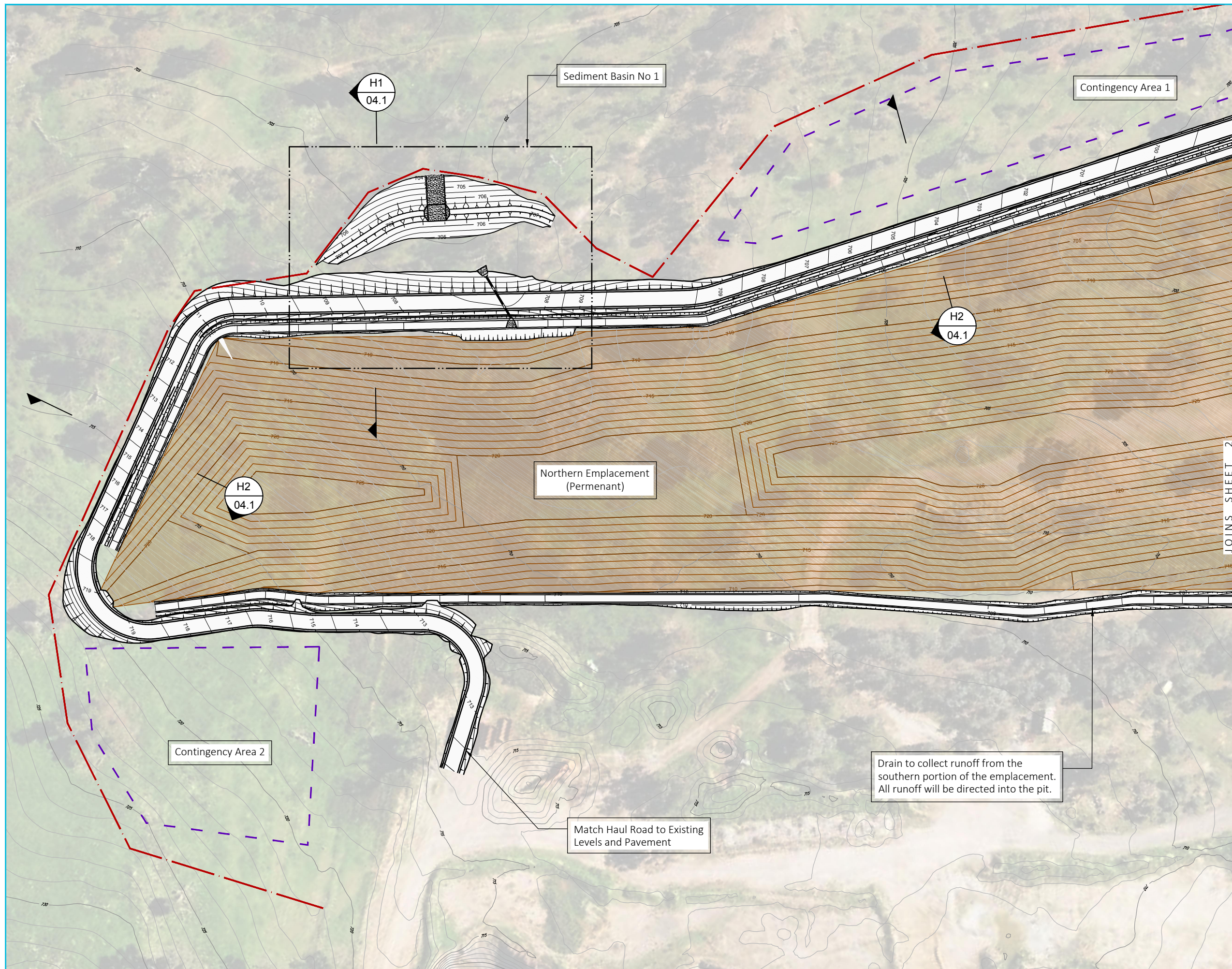
- Legend**
- Project Disturbance Boundary - - -
  - Contingency Area - - -
  - Emplacement Areas
  - Toe Drain
  - Haul Road
  - Sediment Basin

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

Site Plan

Boral Mugga Quarry  
Overburden Expansion  
Figure 01-1





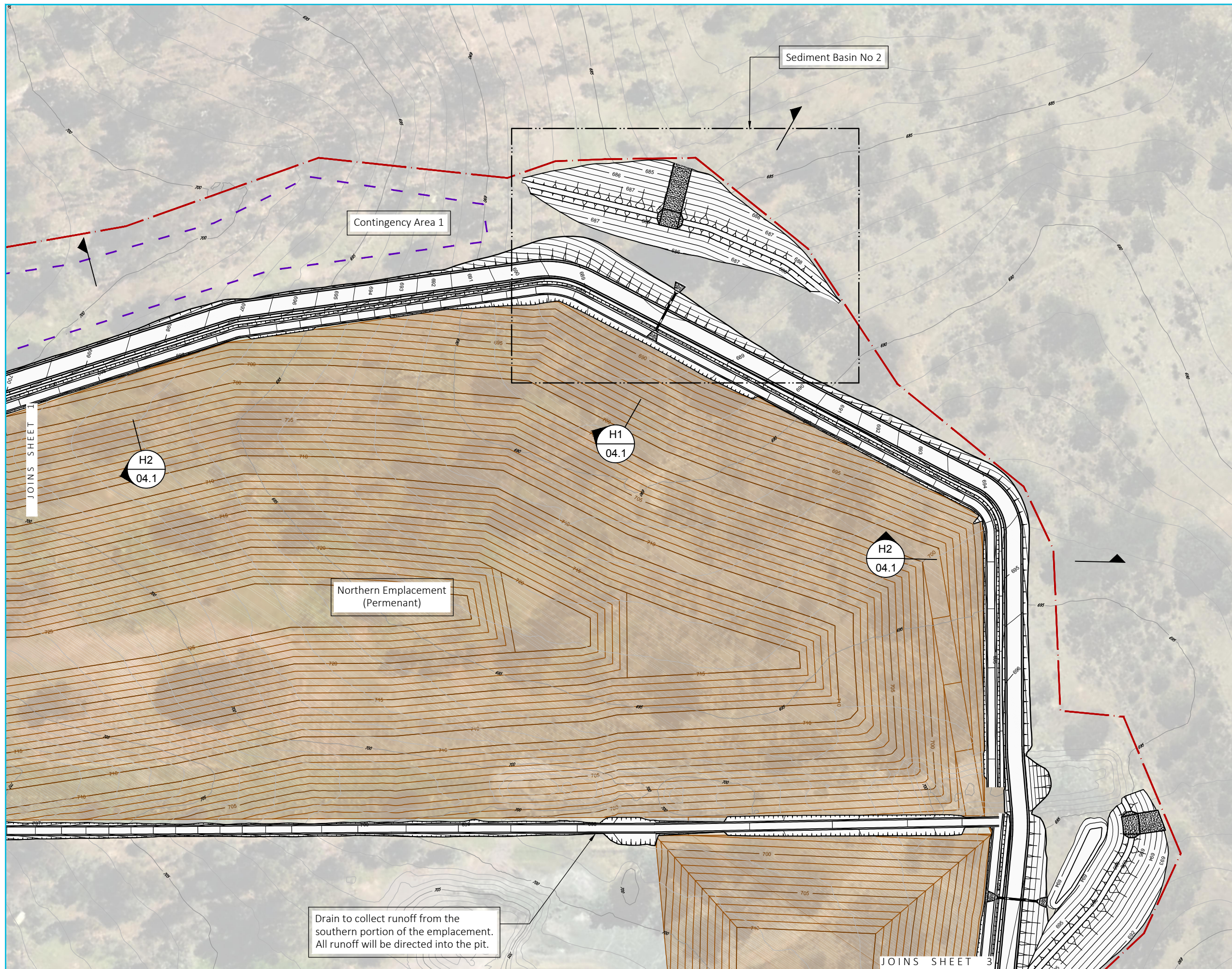
- Legend**
- Project Disturbance Boundary — · —
  - Contingency Area - - -
  - Emplacement Areas

JOINS SHEET 2

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

General Arrangement Plan  
Sheet 1  
Boral Mugga Quarry  
Overburden Expansion  
Figure 02-1



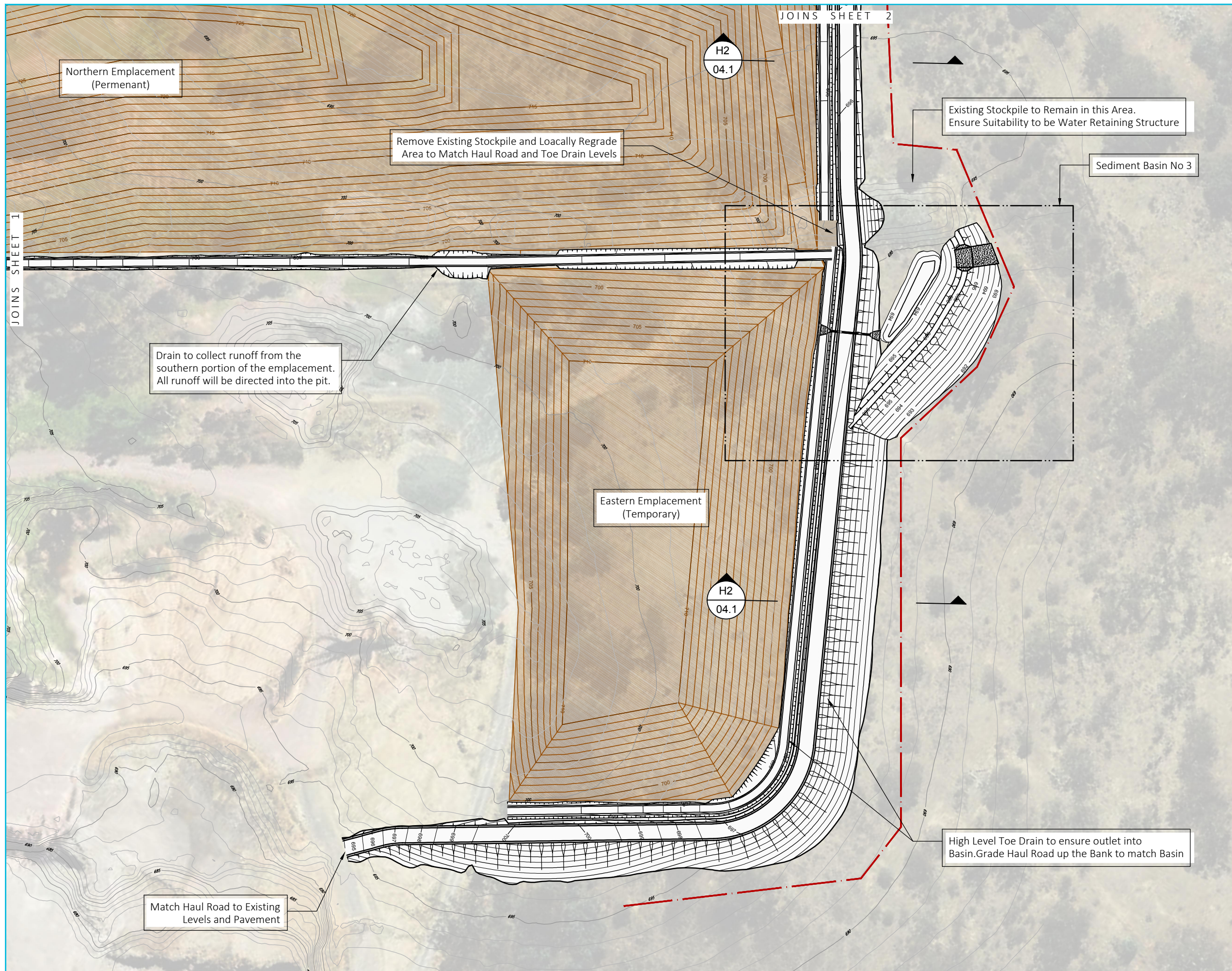


- Legend**
- Project Disturbance Boundary - - -
  - Contingency Area - - -
  - Emplacement Areas

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

General Arrangement Plan  
Sheet 2  
Boral Mugga Quarry  
Overburden Expansion  
Figure 02-2





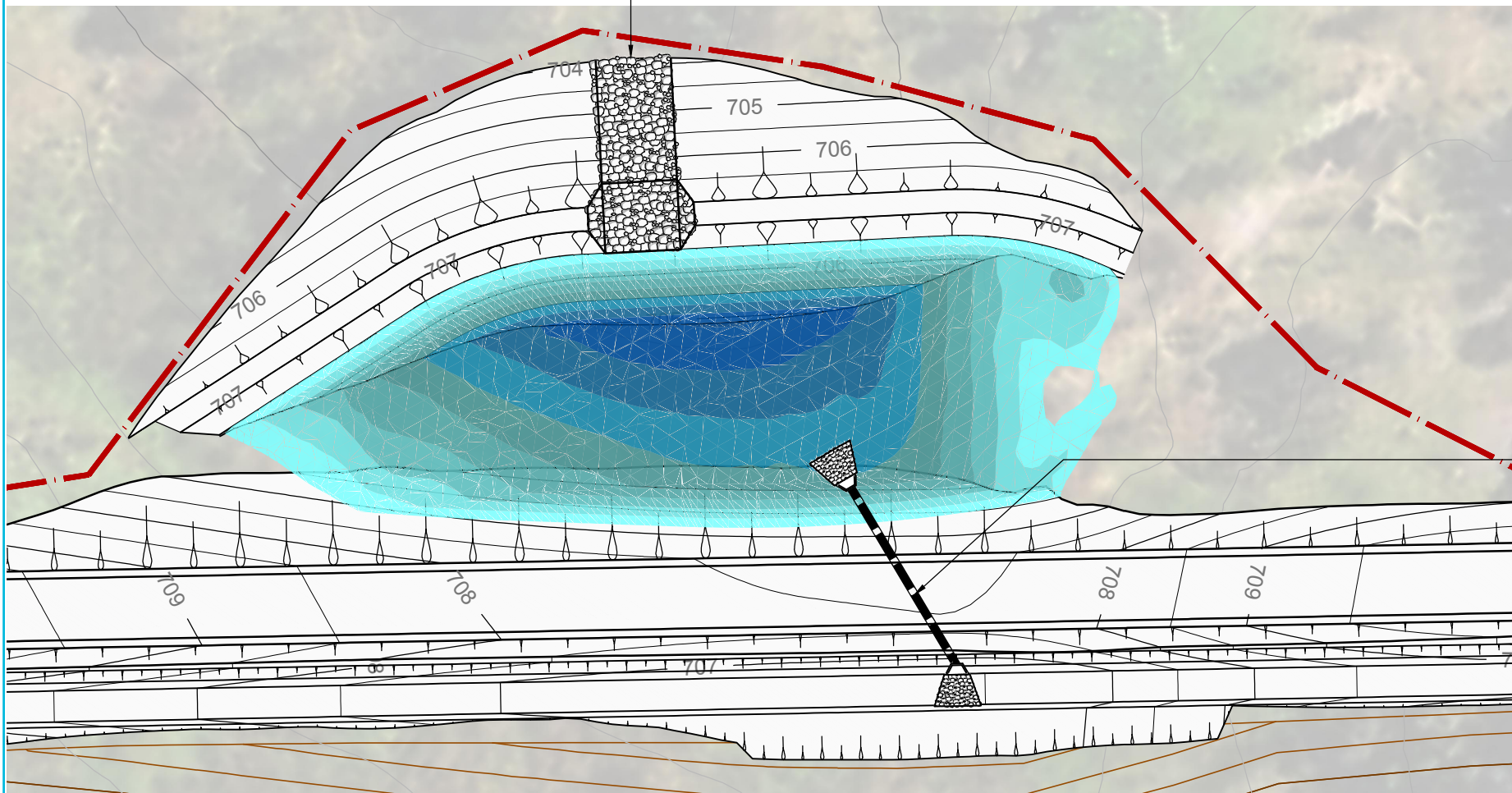
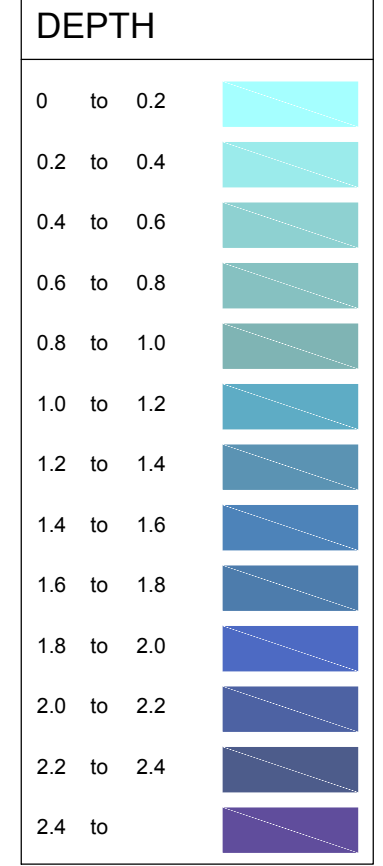
- Legend**
- Project Disturbance Boundary - - -
  - Contingency Area - - -
  - Emplacement Areas

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

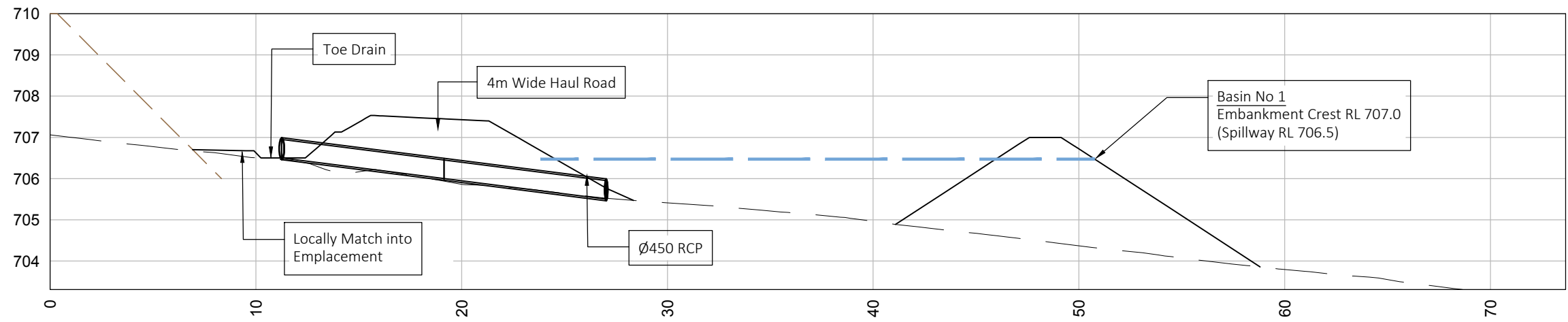
General Arrangement Plan  
Sheet 3  
Boral Mugga Quarry  
Overburden Expansion  
Figure 02-3



Height	Delta Ht	Vol to Height	Delta Vol	Plan Area	Delta Area	Slope Area	Delta Area
706.500	0.500	624.369	345.619	841.315	295.536	858.551	304.297
706.000	0.500	278.751	210.137	545.778	262.559	554.253	268.182
705.500	0.500	68.614	67.662	283.220	262.778	286.072	265.407
705.000	0.500	0.952	0.952	20.442	20.442	20.664	20.664
704.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000

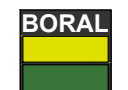


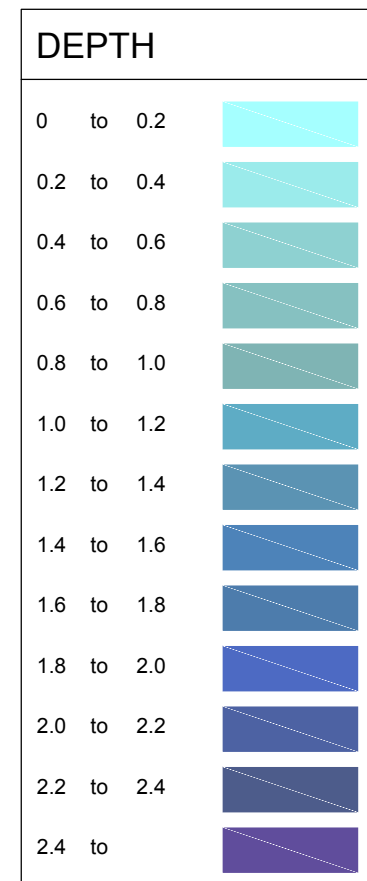
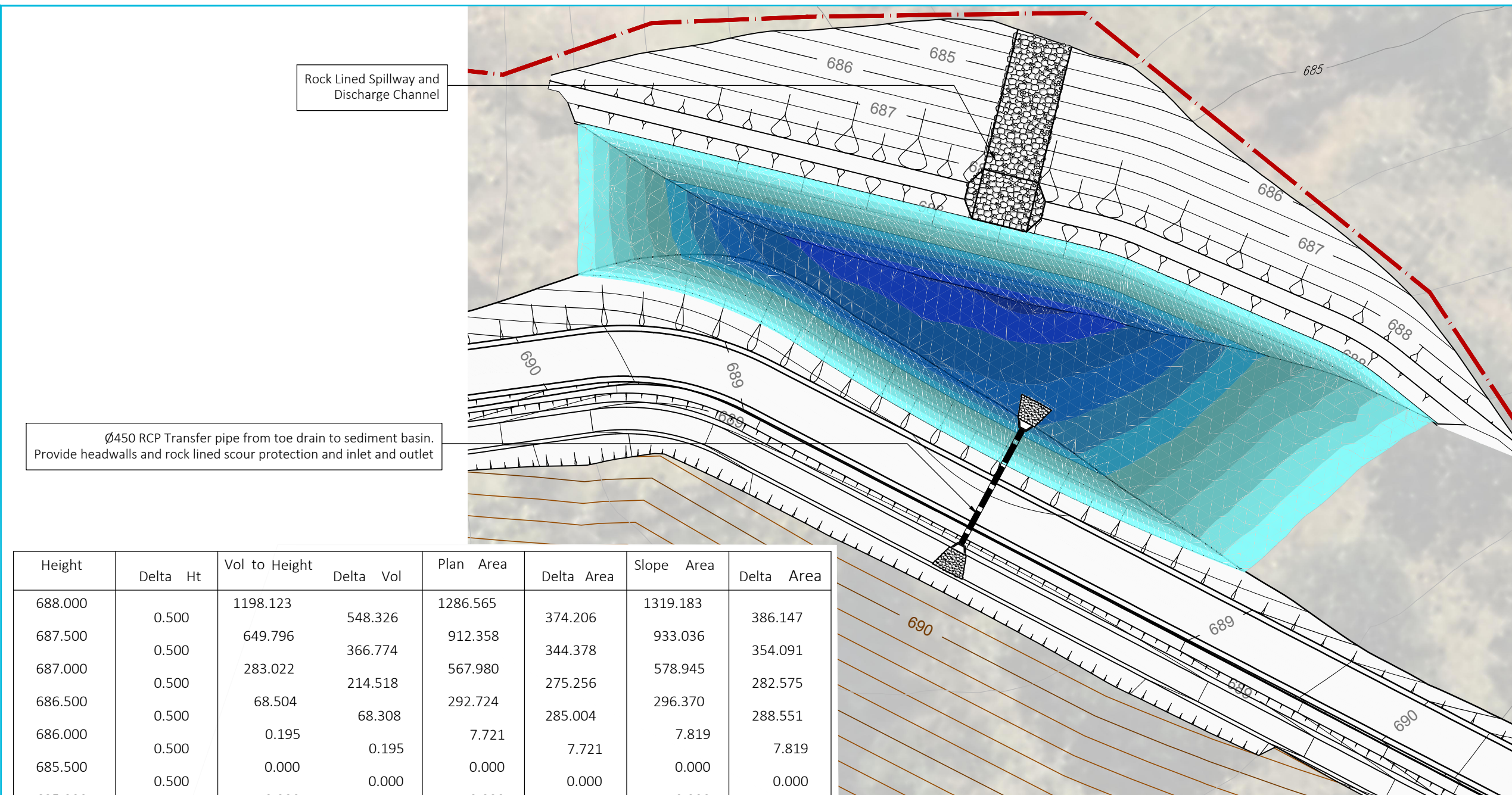
Ø450 RCP transfer pipe from toe drain to sediment basin. Provide headwalls and rock lined scour protection and inlet and outlet.



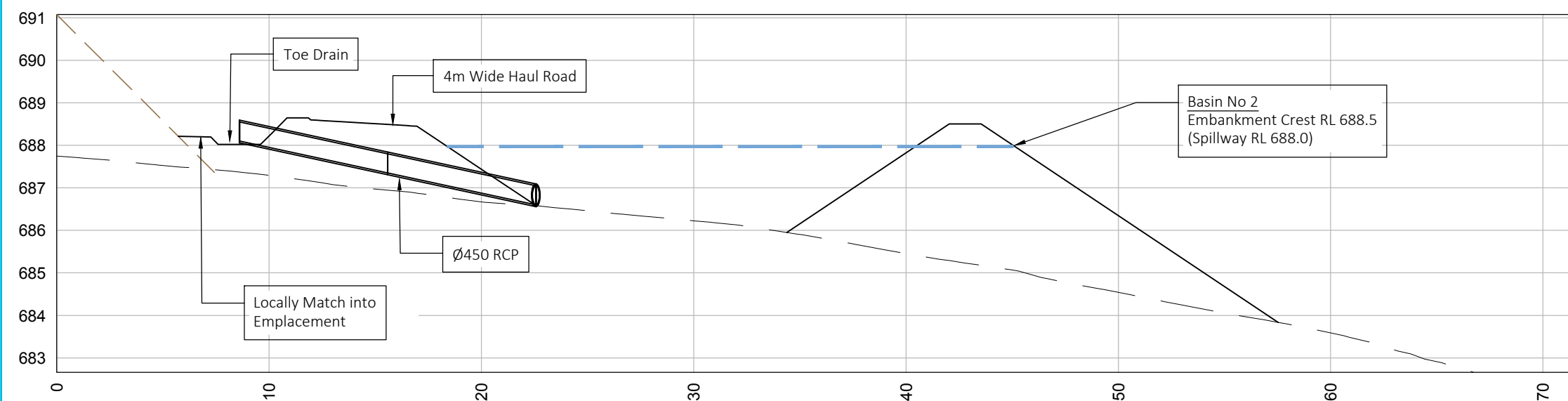
PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

Sediment Basin No 1  
Detail Plan  
Boral Mugga Quarry  
Overburden Expansion  
Figure 03-1





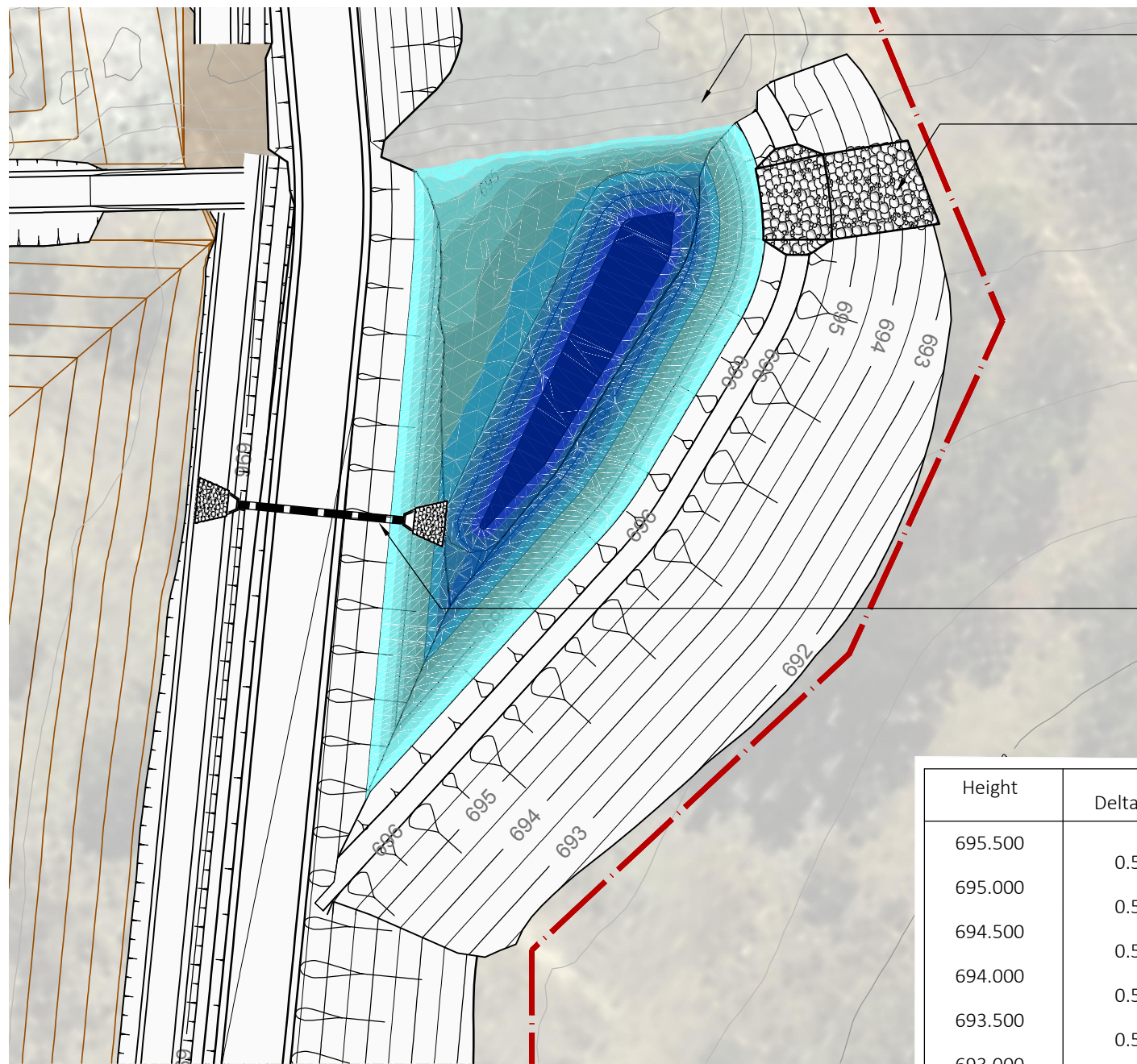
Height	Delta Ht	Vol to Height	Delta Vol	Plan Area	Delta Area	Slope Area	Delta Area
688.000	0.500	1198.123	548.326	1286.565	374.206	1319.183	386.147
687.500	0.500	649.796	366.774	912.358	344.378	933.036	354.091
687.000	0.500	283.022	214.518	567.980	275.256	578.945	282.575
686.500	0.500	68.504	68.308	292.724	285.004	296.370	288.551
686.000	0.500	0.195	0.195	7.721	7.721	7.819	7.819
685.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000
685.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000



PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

Sediment Basin No 2  
Detail Plan  
Boral Mugga Quarry  
Overburden Expansion  
Figure 03-2

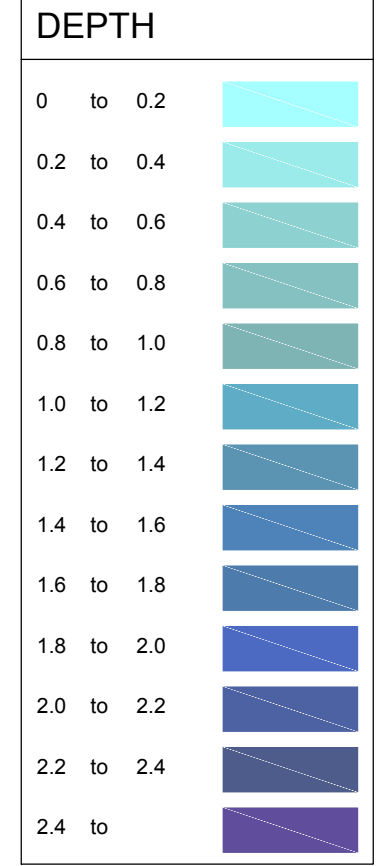




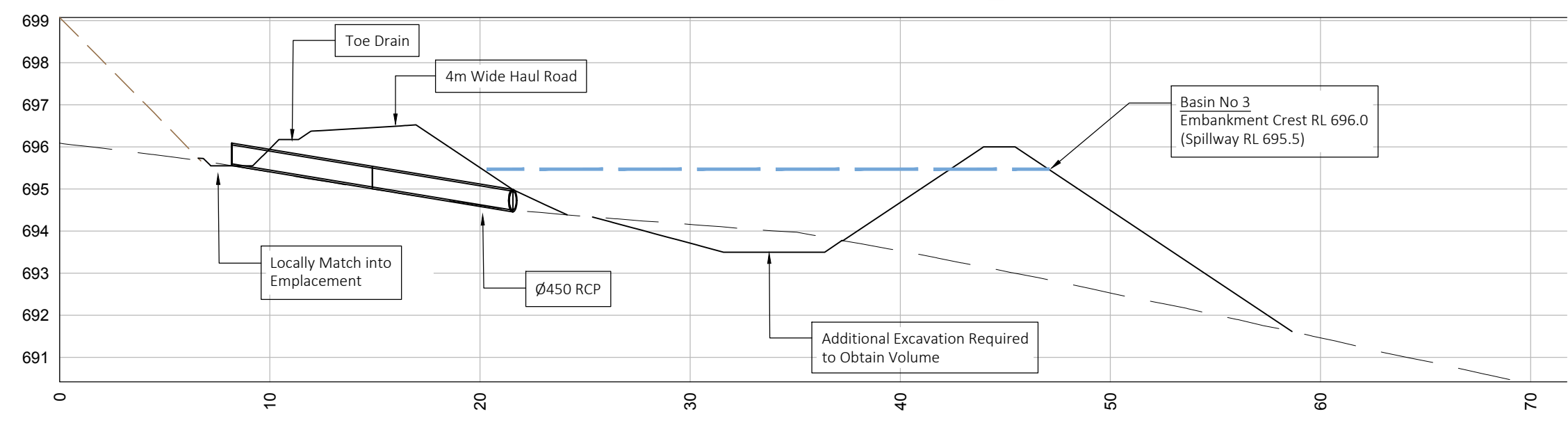
Utilise Existing Embankment to for Edge of Basin

Rock Lined Spillway and Discharge Channel

Ø450 RCP Transfer pipe from toe drain to sediment basin. Provide headwalls and rock lined scour protection and inlet and outlet.

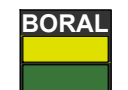


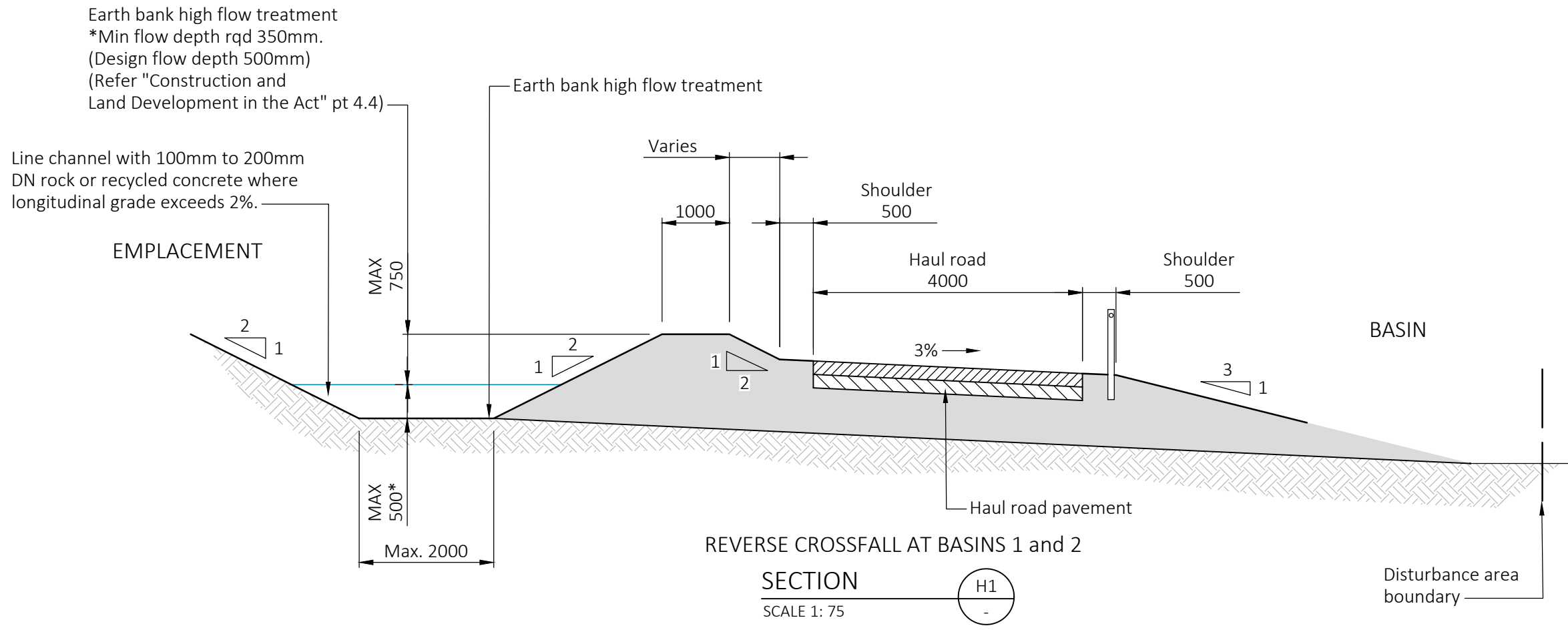
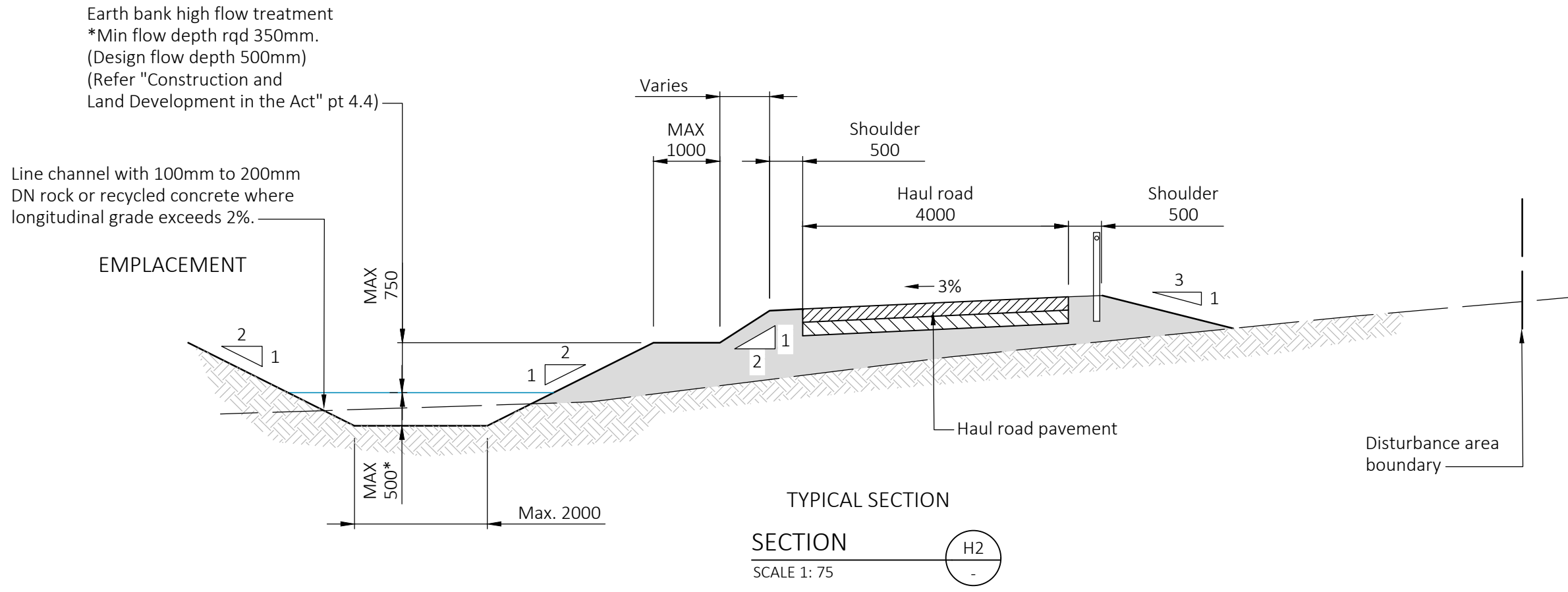
Height	Delta Ht	Vol to Height	Delta Vol	Plan Area	Delta Area	Slope Area	Delta Area
695.500	0.500	625.057	278.033	635.472	157.108	661.965	166.742
695.000	0.500	347.024	193.810	478.363	191.165	495.223	198.013
694.500	0.500	153.214	102.788	287.198	142.601	297.210	148.097
694.000	0.500	50.426	50.426	144.597	144.597	149.113	149.113
693.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000
693.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000



PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

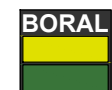
Sediment Basin No 3  
Detail Plan  
Boral Mugga Quarry  
Overburden Expansion  
Figure 03-3





PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

Typical Sections  
Haul Road - Sheet 1  
Boral Mugga Quarry  
Overburden Expansion  
Figure 04-1







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Appendix E

# Environmental authorisation

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## AUSTRALIAN CAPITAL TERRITORY

### ENVIRONMENTAL AUTHORISATION UNDER THE ENVIRONMENT PROTECTION ACT 1997

**NOTE:** This is a variation of the original environmental Authorisation dated 8 January 2004 and subsequent variations dated 15 June 2010, 19 December 2011, and 28 May 2015.

The Environment Protection Authority (the Authority), pursuant to section 49(1)(a) of the *Environment Protection Act 1997* (the Act), hereby authorises:

Name: **Boral Resources (Country) Pty Ltd**  
ACN: **000 187 002**  
ABN: **51 000 187 002**  
Street: **Mugga Lane**  
Block: **2031**  
District: **Jerrabomberra**  
Postcode: **2619**

to conduct the following activity/activities:

- the production of concrete or concrete products at a facility designed to produce more than 7,000 m<sup>3</sup> of concrete per year;
- the operation of equipment designed to extract more than 30,000t per year of material (other than ground water) from land outside a waterway;
- the operation of a facility for the crushing, grinding or separating of materials (including sand, gravel, rock, minerals, slag, road base, concrete, bricks, tiles, asphaltic material, metal or timber) into different sizes, if the processing facility is designed to produce more than 10,000t of processed materials per year;
- the acceptance of more than 100m<sup>3</sup> of soil for placement on land by a lessee or occupier of the land if the land is in—
  - (a) an area identified in the territory plan as land in any of the following zones: Broadacre; Rural; Hills, Ridges and Buffer Areas; River Corridors; Mountains and Bushlands; or
  - (b) a plantation forestry precinct, within the meaning of the territory plan; or
  - (c) an area identified in the national capital plan as any of the following: Broadacre Areas; Rural Areas; Hills, Ridges and Buffer Spaces; River Corridors; Mountains and Bushland

On: Block: 2031  
District: Jerrabomberra

subject to the conditions set out in Schedules 1, 2 and 3 attached, for an unlimited period or until earlier surrendered by Boral Resources (Country) Pty Ltd or cancelled or suspended by the Authority.

This is a **standard** environmental authorisation. This authorisation will be reviewed.

  
.....  
Environment Protection Authority

Dated this 30<sup>th</sup> day of October 2017

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## SCHEDULE 1: GENERAL CONDITIONS

### Definitions

For the purposes of this Authorisation the following terms are defined as:

**Authority:** means the ACT Environment Protection Authority.

**Compliance point:** The compliance point below refer to locations as indicated in Attachment A.

- (a) 385 Mugga Lane, Block 2224, District Jerrabomberra, around 50m up driveway on the left near the cement post, GPS location using MGA94 E693584, N6084776.
- (b) Opposite the entry of 214 Mugga Lane, Block 154, District Jerrabomberra, near the steel straining post on Block 2031, District Jerrabomberra, GPS location using MGA94 E693584, N6084776.

**Controlled Waste:** as defined in the National Environment Protection Measure (Movement of Controlled Waste between States and Territories) Measure.

**Operation:** operation includes crushing, grinding, separation of materials, loading and unloading, and delivery of materials.

**Plant and equipment:** includes drainage systems, infrastructure and pollution control equipment.

**Regulated Waste:** as defined in Schedule 1, Section 1.1A of the *Environment Protection Act 1997*.

**Residual Waste:** means waste material left over from the resource recovery/recycling operations and sent to an appropriately licensed facility for disposal.

**Settling Dam No 2:** is the dam as specified in the Environment Management Plan, August 2002, fig 3.1B as Settling Dam No 2.

**Site:** Block 2031, District Jerrabomberra.

**Stormwater System:** as defined in Schedule 1, Section 1.1 of the *Environment Protection Act 1997*.

**Waterway:** as defined in Schedule 1, Section 1.1 of the *Environment Protection Act 1997*.

**Working day:** a day other than a Saturday, or Sunday, a public holiday or a day that is a holiday for public servants.

### 1. Compliance with Environmental Authorisation

The Authorisation holder shall:

- (a) comply with any authorisation condition immediately where no time for compliance is stated;
- (b) notify the Authority in writing within 2 working days of becoming aware of:
  - i. any event that causes, or is likely to cause, any authorisation condition to be exceeded; or
  - ii. any monitoring data that show that a condition of the authorisation has been exceeded.

**2. Activities must be carried out to protect the environment**

2.1 All activities carried out on the site shall be carried out in such a manner that adverse impact on the environment is minimised.

**3. Maintenance of plant and equipment**

3.1 All plant and equipment installed or used in or on the site shall be maintained in a safe and good condition and in accordance with manufacturer's recommendations.

3.2 Records of all maintenance and repairs performed on pollution control equipment including drainage systems, interceptors, separators and infrastructure shall be kept on site for a period of 2 years and made available to the Authority on request.

**4. Environmental Practices**

4.1 The Authorisation holder shall minimise emissions to the environment by:

- (a) for the production of concrete adopt the practises set out in **Schedule 2**,
- (b) for all other activities adopt the practises set out in **Schedule 3**,

**5. Compliance with Australian Standards, Industry Codes of Practice and Policies**

5.1 The Authorisation holder shall comply with the provisions of the following Australian Standards, Guidelines, Industry Codes of Practice and Policies provided such provisions are not in conflict with the conditions in this Authorisation, and the provisions of any policies made by the Authority.

- Environment Protection Guidelines for Service Station Sites and Hydrocarbon Storage in the ACT.
- AS 1940 - The Storage and Handling of Flammable and Combustible Liquids,
- AS 2187.2 - Explosives – Storage and use – Use of explosives
- AS 4282 - Control of the obtrusive effects of outdoor lighting
- AS 2436 - Guide to noise control and vibration control on construction, demolition and maintenance sites.
- AS 3580.1.1 - Methods for sampling and analysis of ambient air - Guide to siting air monitoring equipment; and
- AS 3580.10.1 - Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric method.
- AS/NZS 5667.1 - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.
- Environment Protection Guidelines for Construction and Land Development in the ACT.
- Environment Protection Policies prepared under the *Environment Protection Act 1997*.

**6. Fuel Storage**

6.1 Where there are fuel storage tanks on the site the Authorisation holder shall ensure the tanks and associated pipe work are maintained in good condition. The proposed method of demonstrating the integrity of the tanks and associated pipe

should be incorporated into the Authorisation holders Environment Management Plan required under section 17 of this Schedule.

- 6.2 Further to the provisions of clause 6.1, special requirements are applied to the abandonment of any aboveground or underground tanks and should the need arise, the Authorisation holder agrees to contact the Authority and:

**Access Canberra**

**Dangerous Substances Licensing**

Telephone: 13 22 81

Email: [dangeroussubstances@act.gov.au](mailto:dangeroussubstances@act.gov.au)

Postal address: GPO Box 158 Canberra ACT 2601)

**7. Reporting of environmental harm**

- 7.1 In the event that an incident has caused, is causing or is likely to cause material or serious environmental harm, whether the harm occurs on or off the site, the Authorisation holder, their employee or agent shall report the incident to the Authority immediately after it becomes known to the Authorisation holder or to their employee or agent in accordance with clause 7.2.
- 7.2 The incident shall be reported to the Authority by telephoning Access Canberra on 132281 during and outside business hours.
- 7.3 The Authorisation holder shall notify the Authority in accordance with clause 7.2 immediately after becoming aware that land is contaminated in such a way as to present, or to be likely to present –
- a) a significant risk of harm to human health; or
  - b) a risk of material environmental harm or serious environmental harm.
- 7.4 The Authorisation holder shall keep a record of all other incidents in relation to pollution from, or on, the site. These records are to be provided, on request, to the Authority.
- 7.5 The Authorisation holder, their employee or agent is required to report an incident in writing and include:
- (a) incident or activity that has caused contamination or environmental harm;
  - (b) nature of contamination and chemicals of concern;
  - (c) area affected (on or off site);
  - (d) aspects of the environment affected; and
  - (e) any other relevant information.

The report may be provided by email to [environment.protection@act.gov.au](mailto:environment.protection@act.gov.au)

**8. Record of pollution complaints**

8.1 The Authorisation holder shall keep a record of all complaints received by its employees or its agents, in relation to pollution from, or on, the site. This record is to be provided, on request, to the Authority.

**9. Record of activity levels**

The Authorisation holder shall maintain the following records:

- (a) level of production of concrete in m<sup>3</sup>;
- (b) material extracted from land in tonnes;
- (c) amount of material processed by crushing, grinding or separating in tonnes; and
- (d) amount of residual waste generated from site operations.

**10. Records to be maintained**

10.1 The following records will be maintained and kept by the Authorisation holder for a period of five years:

- a) field sampling record sheets and chain-of-custody forms;
- b) results of monitoring of soils and groundwater;
- c) reconciliation records for all fuels, oils and hazardous materials and wastes utilised and stored on site;
- d) waste disposal certificates for any hazardous wastes disposed off-site.
- e) results of monitoring of Settling Dam No.2; and,
- f) results of monitoring of air emissions.

**11. Responsible employees**

11.1 The Authorisation holder shall authorise at least two senior employees or agents:

- a) to speak on behalf of the Authorisation holder; and
- b) to provide any information or document required under this Authorisation.

11.2 The Authorisation holder shall inform the Authority of the names and telephone numbers (including after hours numbers) of those persons within five (5) working days of this Authorisation coming into force. The details may be provided by email to [environment.protection@act.gov.au](mailto:environment.protection@act.gov.au).

11.3 The Authorisation holder shall inform the Authority of any change in the information provided under clause 11.2 within five (5) working days of the change. The details may be provided by email to [environment.protection@act.gov.au](mailto:environment.protection@act.gov.au).

11.4 Any person nominated by the Authorisation holder to meet the requirements of clause 11.2 shall be readily contactable on the person's nominated telephone numbers.

**12. Authorisation shall be kept on site**

12.1 A copy of this Authorisation shall be kept at the site and shall be available for inspection by any employee or agent of the Authorisation holder working at the site.

**13. Waste**

13.1 No waste material is to be incinerated on site.

13.2 The Authorisation holder shall use licensed waste transporters to transport "controlled/regulated wastes" as defined in the *Environment Protection Act 1997* and the *Environment Protection Regulation 2005*. Information on Controlled Waste handling and transport can be obtained from the Authority on 13 22 81.

13.3 The Authorisation holder shall not permit controlled or regulated waste to be transported from the facility to another State or Territory unless the Authorisation holder first obtains a Consignment Authorisation from the relevant agency in the destination jurisdiction. The waste must be then transported using an approved Waste Transport Certificate by a properly licensed Transporter to an appropriately licensed facility. Information on Controlled Waste handling and transport can be obtained by contacting the Authority on 13 22 81.

**14. Hazardous Materials**

14.1 The Authorisation holder shall store and manage hazardous materials in a manner that prevents adverse impacts on the environment. The handling and storage of hazardous materials should be addressed in the Environment Management Plan required under section 17 of this Schedule.

**15. Discharge of stormwater**

15.1 There should be no discharges to the stormwater system from the site without prior approval from the Authority. Approved stormwater discharges are only permitted from Settling Dam No.2.

**16. New designs and innovations**

16.1 The provisions of this Authorisation are not intended to limit the appropriate use of alternative materials, equipment, designs, or methods because they are not included.

**17. Environment Management Plan**

17.1 The Authorisation holder shall prepare and submit an Environment Management Plan (EMP) acceptable to the Authority within 3 months of the date of this Authorisation.

17.2 The EMP should identify all activities that may have an adverse impact on the environment or the potential to cause environmental harm, and detail the mechanisms employed to prevent or minimise the impact of these activities. If required, the ways in which the conduct of the activity will be altered to minimise or reduce the adverse environmental impact of the activity is to be detailed including a timetable for implementation.

17.3 The EMP, once accepted by the Authority is to be implemented. It will also form the basis for future authorisation conditions and environmental improvements.

17.4 Where a variation to the mechanisms employed to prevent or minimise the adverse environmental impacts of the activity or the way in which the activity is carried out as detailed in the endorsed EMP is proposed, the Authorisation holder must seek endorsement from the Authority for the variation. A revised EMP acceptable to the Authority must be submitted within 3 months of the endorsement of the variation.

17.5 A copy of the EMP must be kept on the site.

## 18. Monitoring Requirements

### 18.1 Stormwater Settling Dam Monitoring

- a) Settling Dam No.2 shall be monitored for the parameters and frequencies set out in Schedule 3 Table 3.2.

18.2 Air monitoring on the site shall be carried out in accordance with Schedule 3 Table 3.1, Conditions 2 and 3.

## 19. Water Quality Standards

19.1 Water quality in Settling Dam No.2 shall be managed with the object of being within the limits for the parameters listed at Schedule 3, Table 3.8.

## 20. Reporting Requirements

20.1 Monitoring results of the Settling Dam No.2 for discharge to the stormwater system must be forwarded to the Authority within 5 working days from receipt of results. The details may be provided by email to [environment.protection@act.gov.au](mailto:environment.protection@act.gov.au).

## 21. Sampling Requirements

21.1 All sample collection, analysis and associated paperwork under this Authorisation shall be conducted in accordance with Australian Standard/New Zealand Standard 5667.1:1998, *"Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples"*, and with the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation *Standard Methods for the Examination of Water and Wastewater*, 18<sup>th</sup> Edition, 1989, or other standards and methods agreed to by the Authority.

21.2 The sample collection shall be undertaken and documented by a suitably qualified person in accordance with clause 21.1. All required documentation shall be countersigned by a person authorised under clause 11.1 and shall be made available for inspection by the EPA. Sample analysis of parameters shall be conducted by a person employed as an analyst in any of the following organisations:

- (a) a Government laboratory;
- (b) an Australian university;
- (c) a laboratory where Authorisation parameters are accredited by the National Association of Testing Authorities; or
- (d) a laboratory approved by the Environment Protection Authority.

**22. Total Quantity to be Accepted**

22.1 The total quantity of permitted building demolition waste which may be stockpiled at the site must not exceed 30,000m<sup>3</sup> at any given time.

**SCHEDULE 2: PRODUCTION OF CONCRETE**

**TABLE 2.1: AIR POLLUTION**

Accessories/ Plant	Equipment/ Plant	Requirement
1	Plant yard area	To remove promptly the spillage of raw materials where dust is visibly originating from the spillage area
2	Sand and aggregate stockpiles	To contain stockpiles of aggregates in aggregate ground bins that enclose the stockpiles on at least three sides and to provide a wind shield.  Take practical measures to dampen aggregates during delivery or visible dust emissions.
3	In-ground receiving bins	To shield the bin on two sides by shrouds or wing walls 0.5 m high extending the full length of the bin (for drive over delivery).  Water sprays fitted and operated during deliveries where practical.
4	Conveyor belts and raw Materials transfer points	To roof all conveyor belts and enclose them on at least on one side.  Equip conveyor belts with spill trays where appropriate. Install water sprays at raw materials transfer points where appropriate.
5	Overhead bins	To either totally or partially enclose overhead storage bins at the top where appropriate.  To enclose swivel chute area and transfer point from conveyor and rubber shunting where appropriate.
6	Truck loading point	Either install water sprays in the perimeter of the hopper set to start when a batch of concrete is discharged from the hopper or provide an effective means of dust extraction.
7	Aggregate weigh bins	To shroud on three sides and roof the weigh hoppers in the case of front-end loader plants where appropriate.  To partially or totally enclose from the base of the overhead bin walls down to the aggregate weigh bin where appropriate.
8	Silo discharge system	Silo discharge valve to be air-open spring close type for all new operations and replacements.
9	Silo overfill protection	To fit the silo with a high level sensor alarm and an automatic delivery shut down switch.
10	Silo dust control	To use Fabric and Filter Dust Control (FFDC) technology. maintain dust control according to manufacturers recommendations.

**TABLE 2.2: WATER POLLUTION**

	Requirement
1	To dispose of wastewater and concrete waste in a settlement pit which is designed to ensure that no discharge of wash-out water to the environment takes place.
2	To store the first 10 mm of rain collected as stormwater run off from the yard area for treatment. Upon collection of this volume stormwater may bypass the holding pit. Water from this should be drained into a secondary pit and may be reused.
3	Collection pits should be cleaned out regularly to maintain capacity. Waste removed should not be allowed to drain to the stormwater system.
4	Every effort should be made to recycle/reuse wastewater and the concrete waste.

**TABLE 2.3: NOISE EMISSION**

	Requirement
1	To locate noisy equipment in an area most distant from the nearest residences.
2	To use self-cleaning weigh hoppers on all new operations and replacement
3	To enclose air compressors where appropriate.
4	To fit all pressure-operated controls and valves with suitable silencers where appropriate.
5	To seal and maintain access roads in good condition.
6	To pave the plant site with concrete or bitumen and maintaining this in a good condition.
7	To have access road to the plant remote from residential allotments where possible.
8	To fit high efficiency mufflers to truck and mixer engines to manufacturers specifications.
9	To ensure vehicle clean-up work using jack hammers or impact chipping hammers is carried out on site remote from residences where possible.

### SCHEDULE 3: EXTRACTION OF MATERIAL, CRUSHING, GRINDING OR SEPERATING OF MATERIALS, AND PLACEMENT OF SOIL

**TABLE 3.1: AIR POLLUTION**

		<b>Requirement</b>
1	Limits of Particulate matter	The operations at the site shall be managed to ensure that emissions of particulate matter resulting from activities does not exceed the mass deposition of insoluble particulates of 4g/m <sup>2</sup> /month (12 month rolling average) at any of the compliance points detailed in Schedule 1.
2	Particulate matter	For the purpose of assessment of particular matter, particular matter shall be measured at the compliance points on a monthly basis. The assessment period shall be the start of each calendar month to the last day of the month.
3	Particulate matter monitoring	For the purpose of assessment, monitoring shall be carried out in accordance with the following Australian Standards and by a person or body possessing appropriate qualifications and experience to perform the required measurements: 1) Australian Standard AS 3580.1.1:2007 <i>Methods for sampling and analysis of ambient air-Guide to sitting air monitoring equipment; and</i> 2) Australian Standard AS 3580.1.1:2003 <i>Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric method.</i>
4	Trafficked areas	Pave, seal or otherwise treat and maintain all trafficked areas within site to prevent or minimise the generation of airborne dust.
5	Movement of materials	Water sprays fitted and operated during deliveries where practical.  Take practical measures to prevent or minimise airborne dust.
6	Crushing and Screening	Take practical measures to prevent or minimise airborne dust.
7	Stockpiles	Take practical measures to prevent or minimise airborne dust.
8	In-ground receiving bins	To contain stockpiles of aggregates in aggregate ground bins that enclose the stockpiles on at least three sides and to provide a wind shield.
9	Movement of materials	Water sprays fitted and operated during deliveries where practical.  Take practical measures to prevent or minimise airborne dust.

**TABLE 3.2: WATER POLLUTION**

	<b>Requirement</b>
1	Manage the water catchment on the property so that pollutants and sediment are retained on site.
2	<p>Only permit controlled discharges to the stormwater system in such a manner that the following do not exceed the limits set in Schedule 3, Table 3.8.</p> <p><b>The following to be sampled before every discharge:</b>                      Dissolved Oxygen                      Oil and Grease                      pH                      Suspended solids</p> <p><b>The following to be sampled every fifth discharge:</b>                      Arsenic                      Cadmium                      Chromium                      Copper                      Lead                      Zinc</p>
3	Ensure that no discharge from the site causes erosion of the channels or banks leading to a waterway.
4	Stabilise all embankments and soil stockpile areas using vegetative or other appropriate means, or as directed by the Authority.
5	Notify the Authority in accordance with Schedule 1, Section 15 prior to any controlled discharge.

**TABLE 3.3: NOISE POLLUTION**

	<b>Requirement</b>
1	Only permit blasting on the site between the hours of 8 am to 5 pm Monday to Friday, excluding Public Holidays.
2	The airblast overpressure level from blasting operations in or on the site must not exceed 120dB (Lin Peak) at any time, at any point on the boundary of the site adjacent to the closest residential boundary.
3	The ground vibration peak particle velocity from blasting operations carried out in or on the site must not exceed 10mm/s at any time, at any point on the boundary of the site adjacent to the closest residential boundary.

**TABLE 3.4: NOISE EMISSION**

Requirement	
1	Shall manage the operations at the site so that noise levels do not exceed the following levels at any point on the boundary of the site
	Mon – Saturday                      7 am to 6 pm 45dB(A)
	Sunday and Public Holidays 9 am to 6 pm 45dB(A)
	At any other time                      35dB(A)

**TABLE 3.5: ACCEPTANCE OF MATERIAL**

Requirement	
1	Only accept the following material for processing;  <b>Permitted</b> Building and Demolition Waste as defined in Table 1 of the “ACT’s <i>Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes (June 2000)</i> ”; Virgin excavated natural material (VENM) as defined in Table 1 of the “ACT’s <i>Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes (June 2000)</i> ”; and Metals
2	<b>Not Permitted</b> Material sourced from a contaminated site; Green Waste; Electronic Waste; Tyres; and Waste types or streams as defined in Tables 2, 3, 4 and 5 of the “ACT’s <i>Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes (June 2000)</i> ”.
3	Residual waste is to be classified using the “ACT’s <i>Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes (June 2000)</i> ” and separately stored and removed from the site within six (6) months or a longer time frame approved in writing by the Authority.
4	Residual waste removed must be taken to a facility approved to accept such waste and documentary evidence of the disposal kept by the Authorisation Holder as set out in Schedule 1, Section 10.

5	<p>Records of all material obtained shall be kept on site for a period of 2 years and made available to the Authority on request.</p> <p>These records are to include:</p> <p><b>Material Accepted</b>                      The date and time of delivery.                      The source and supplier of the material                      Clients contact details                      Type and quantity of material                      Area within the site to which the material was directed.</p>
6	<p>The supplier of material is to provide certification that the material is not contaminated, prior to acceptance by the Authorisation Holder.</p>

**TABLE 3.6: ACCEPTANCE OF LIQUID WASTE**

<b>Requirement</b>	
1	<p>Only accept the following liquid waste material;</p> <p><b>Permitted</b>                      Material in the form of drilling mud and/ or muddy waters from drilling operations.</p>
2	<p><b>Not Permitted</b></p> <p>Material sourced from a contaminated site and Waste types or streams as defined in Table 5 of the "ACT's Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes (June 2000)".</p>
3	<p>All material is to be placed in a dedicated acceptance area/ drying pad.</p>
4	<p>All liquid from the material which leaves the acceptance area/ drying pad is to be directed to the on site sediment retention pond(s)</p>
5	<p>Any beneficial reuse of the silt from the sediment retention pond(s) will require prior written approval by the Authority.</p>
6	<p>Records of all material obtained shall be kept on site for a period of 2 years and made available to the Authority on request.</p> <p>These records are to include:</p> <p><b>Material Accepted</b>                      The date and time of delivery.                      The source and supplier of the material                      Clients contact details                      Type and quantity of material                      Area within the site to which the material was directed.</p> <p>The supplier of material is to provide certification that the material is not contaminated, prior to acceptance by the Authorisation holder.</p>

**TABLE 3.7: ACCEPTED MATERIAL FOR PERMANENT PLACEMENT ON SITE**

Requirement	
1	<p>Only accept the following material for placement on site.</p> <p><b>Permitted</b> Virgin excavated natural material (VENM) (eg clay, gravel, sand, soil or rock) as detailed in Table 1 of the "ACT's Environmental Standards: Assessment and Classification of Liquid and Non-liquid Wastes (June 2000)."</p>
2	<p>The supplier of material is to provide certification that the material is not contaminated, prior to acceptance by the Authorisation holder.</p>
3	<p>Records of all fill obtained shall be kept on site for a period of 2 years and made available to the Authority on request.</p> <p>These records are to include:</p> <ul style="list-style-type: none"> <li>• Source of the material (including Block, Section and Street Address);</li> <li>• Type of material;</li> <li>• Quantity of the material; and</li> <li>• Who delivered the material.</li> </ul>

**TABLE 3.8: WATER PARAMETERS**

Parameter - Water	Criteria
Dissolved Oxygen	≥4mg/L
Oil and Grease, above 10,000mg/L= visible	Not visible
pH	6.5-8.5
Suspended Solids	<25 mg/L
Faecal coliforms	≤150/100mL
Arsenic (Total)	≤50µg/L
Cadmium (Total)	≤0.2µg/L
Chromium (Total)	≤2µg/L
Copper (Total)	≤2µg/L
Lead (Total)	≤1µg/L
Nickel	≤25µg/L
Zinc (Total)	≤5µg/L

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Appendix F

## EPBC referral

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## Mugga Quarry Overburden Expansion Project

Commonwealth Referral | Protected Matters Report

Prepared for Boral Resources (Country) Pty Ltd | 24 January 2018





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## Mugga Quarry Overburden Expansion Project

Commonwealth Referral | Protected Matters Report

Prepared for Boral Resources (Country) Pty Ltd | 24 January 2018

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## Mugga Quarry Overburden Expansion Project

Final

Report J17174RP1 | Prepared for Boral Resources (Country) Pty Ltd | 24 January 2018

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Prepared by	<b>Katie Diver</b>	Approved by	Paul Gibbons
Position	Associate	Position	Principle Environmental Planner
Signature		Signature	
Date	24 January 2018	Date	24 January 2018

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This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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### Document Control

Version	Date	Prepared by	Reviewed by
V1	24/01/2018	Katie Diver	Paul Gibbons

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# 1 Introduction

## 1.1 Background

This document has been prepared as supplementary information to accompany the Commonwealth referral for the Mugga Quarry Overburden Expansion Project. Boral Resources (Country) Pty Ltd (Boral) currently operates a hard rock quarry at the Mugga site, which is in the Australian Capital Territory (ACT) (Figure 1 and 2 provided in the referral). Boral proposes to create a new permanent bund and temporary stockpile area to store quarried overburden and weathered rock material up to 620,000 m<sup>3</sup> from Mugga Quarry. The additional bund and stockpile areas will be located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road) (refer to Figure 3 provided in the referral).

With the exception of the proposed permanent bund and new temporary stockpile area (Figure 3 provided in the referral), the current Mugga Quarry operations described in the *Boral Lease Conditions for Mugga Quarry* will not change. As total production will not be increasing, there will not be any change to current operating hours, external traffic movements, groundwater management or employment.

As operations are proposed to be concentrated at a single area, noise, dust emissions and surface water may be intensified at this location. Therefore these emissions require assessment to determine compliance with applicable criteria and management during construction and operation of the permanent and temporary bund areas. Further, the placement of overburden will alter the existing site topography requiring an assessment of the visual impact on the rural character and visual backdrop of the locality. Ecology and cultural heritage assessments are also being undertaken to assess the proposals impacts and demonstrate management measures to minimise (as far as practicable) or offset impacts in accordance with legislative requirements.

An Assessment of Environmental Effects (AEE) is in preparation in accordance with the requirements of the Territory Plan 2008 (Territory Plan) for lodgement of a Development Application to the ACT Environment, Planning and Sustainable Development Directorate - Planning. In preparing the AEE, the relevant codes and statutory considerations are being addressed in accordance with the requirements of the ACT *Planning and Development Act 2007* (P&D Act) and the Territory Plan.

As the proposed area is within a noted critically endangered ecological community (CEEC), approval is also being sought under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (this referral).

## 1.2 The proposed action

The proposed action which is the subject of this referral is an extension to the quarry disturbance footprint to create a new permanent bund and temporary stockpile area to store quarried overburden and weathered rock material up to 620,000 m<sup>3</sup>. The extension is being proposed due to exploratory drilling in the approved extraction area that identified weathered rock that is not suitable more making high quality concrete and asphalt aggregates. This weathered material needs to be temporarily stockpiled to enable the continued extraction of higher quality rock underneath. The stockpiled weathered material will then be progressively blended into other quarry products over the remaining life of the quarry.

The proposed extension area encompasses a total of approximately 5.71 ha and is located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road), as shown on Figure 3 of the referral, with the final design layout to be informed by the environmental assessments referenced in this referral.

It is noted that the proposed action **does not include the activities** which are already approved under *Boral Lease Conditions for Mugga Quarry*.

### 1.3 This report

An environmental significance assessment has been prepared by Rowell (2017) that documents the methods and results of a biodiversity survey at the site. This information is attached at Section 2.14 of the referral.

The information provided within this document is intended to provide more detail on the results with a focus on MNES and provide an assessment of the likely impacts.

## 2 Results

### 2.1 Threatened ecological communities

The protected matters search (Appendix A) identified that the following threatened ecological communities have the potential to occur within 1 km of the proposed action:

- Natural Temperate Grassland of the South Eastern Highlands; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Of the communities predicted by the protected matters search tool, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland occurs in the project area (Rowell 2017). An assessment of the community in the project area against policy and statutory documents is provided in the following section.

#### 2.1.1 White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland

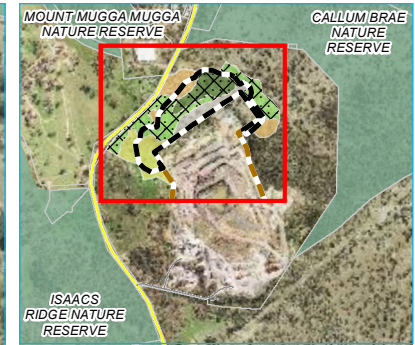
##### i Description of community at the site

Vegetation mapped within the site (Rowell 2017) comprises approximately 2.84 ha of Red Stringybark (*Eucalyptus macrorhyncha*) Tableland Grass/Shrub Forest, Yellow Box – Red Gum Grassy Woodland in very low, low and moderate condition (3.24, 6.24 and 2.50 ha, respectively) and 1.97 ha of cleared land containing isolated Red Box (*Eucalyptus polyanthemos*) trees, shown on Figure 2.1. The patches of Yellow Box – Red Gum Grassy Woodland in low and moderate condition meet the description of the community listed under the ACT *Nature Conservation Act 2014* (NC Act) and White Box Yellow Box Blakelys Red Gum Grassy Woodland and Derived Native Grasslands listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The community and its condition states in the proposed expansion area are described in Rowell (2017).

##### ii The community in the ACT

Woodland at Mugga Quarry and in the proposed expansion area is part of a 2,325 ha woodland area in the Callum Brae-Jerrabomberra Valley complex, which is one of the largest areas of contiguous woodland in the ACT region (ACT Government 2004). It includes 1,040 ha of Yellow Box – Red Gum Grassy Woodland community. Highly modified areas of woodland in the Mugga Lane East area, two major quarries (of which one comprises the project area) and the Mugga landfill form major discontinuities in this complex (ACT Government 2004).’ (page 65 and Figure 5.3a of Strategy).

Detailed mapping of the community has been conducted in the ACT (Maguire and Mulvaney 2011) to inform the publically available mapping provided by ACTMapi ([www.actmapi.gov.au](http://www.actmapi.gov.au)). The mapping was informed by detailed surveys across the ACT between 1995 and 2005 that assessed woodland structure and tree composition to delineate patches of the community into those meeting the description of Yellow Box – Red Gum Grassy Woodland listed under the NC Act and White Box Yellow Box Blakelys Red Gum Grassy Woodland and Derived Native Grasslands listed under the EPBC Act. Within a 10 km buffer of the project area, approximately 25,423 ha of White Box Yellow Box Blakelys Red Gum Grassy Woodland and Derived Native Grasslands occurs (Figure 2.1).



**KEY**

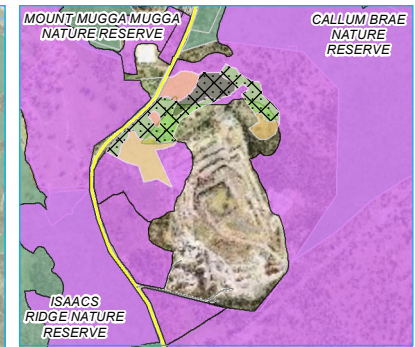
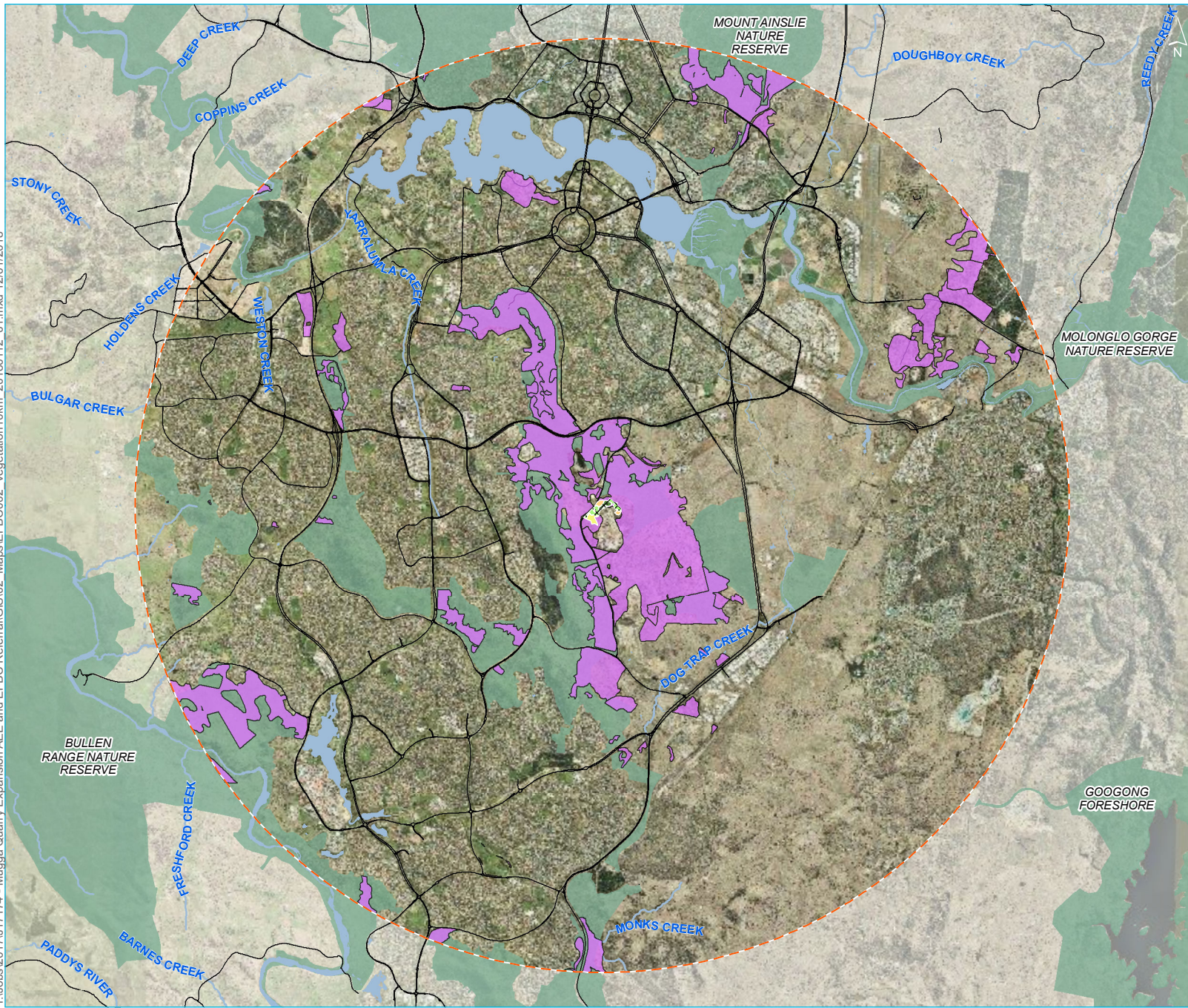
- Total disturbance area
- Final pit extent
- Block boundary
- Electricity transmission line
- Main road
- ACT reserve
- White Box-Yellow Box-Blakely's Red Gum
- Grassy Woodland and Derived Native Grassland (EPBC Act)
- Yellow Box - Red Gum Grassy Woodland (NC Act)
- Cleared area
- Native vegetation**
- Grass/shrub forest
- Yellow Box - Red Gum Grassy Woodland (very low condition)
- Yellow Box - Red Gum Grassy Woodland (low condition)
- Yellow Box - Red Gum Grassy Woodland (moderate condition)
- Red Box

Native vegetation & threatened ecological communities  
 Boral - Mugga Quarry overburden expansion  
 Commonwealth referral  
 Protected Matters Report

Figure 2.1



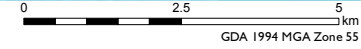
T:\Jobs\2017\117174 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02 Maps\EPBC002\_Vegetation\10km 20180112 01.mxd 12/01/2018



- KEY**
- 10 km buffer
  - Electricity transmission line
  - Main road
  - Watercourse
  - Waterbody
  - ACT reserve
  - X Yellow Box - Red Gum Grassy Woodland (NC Act)
  - White Box-Yellow Box-Blakely's Red Gum
  - Grassy Woodland and Derived Native Grassland (EPBC Act)
  - Box Gum Woodland (EPBC Act-listed)
  - Native vegetation**
  - Grass/shrub forest
  - Yellow Box - Red Gum Grassy Woodland (very low condition)
  - Yellow Box - Red Gum Grassy Woodland (low condition)
  - Yellow Box - Red Gum Grassy Woodland (moderate condition)

White Box Yellow Box Blakely's Red Gum Woodland and Mugga Quarry Overburden Expansion Project Commonwealth Referral Protected Matters Report Figure 2.2

Source: EMM (2018); actmap1 (2016); LPI (2015)



### iii Commonwealth listing advice

The Commonwealth Listing Advice on White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (TSSC 2006) provides a general description of the community and describes its current status. White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland occurs on the western slopes and tablelands of the Great Dividing Range, from southern Queensland, though NSW and central Victoria. Much of the community's original distribution has been cleared for agriculture, and remaining areas are subject to grazing and pasture improvement impacts. Consequently, remaining patches of the community have a disturbed understorey with mature trees, or occur as areas with a highly diverse understorey, sometimes without a canopy (ie derived native grasslands) (TSSC 2006).

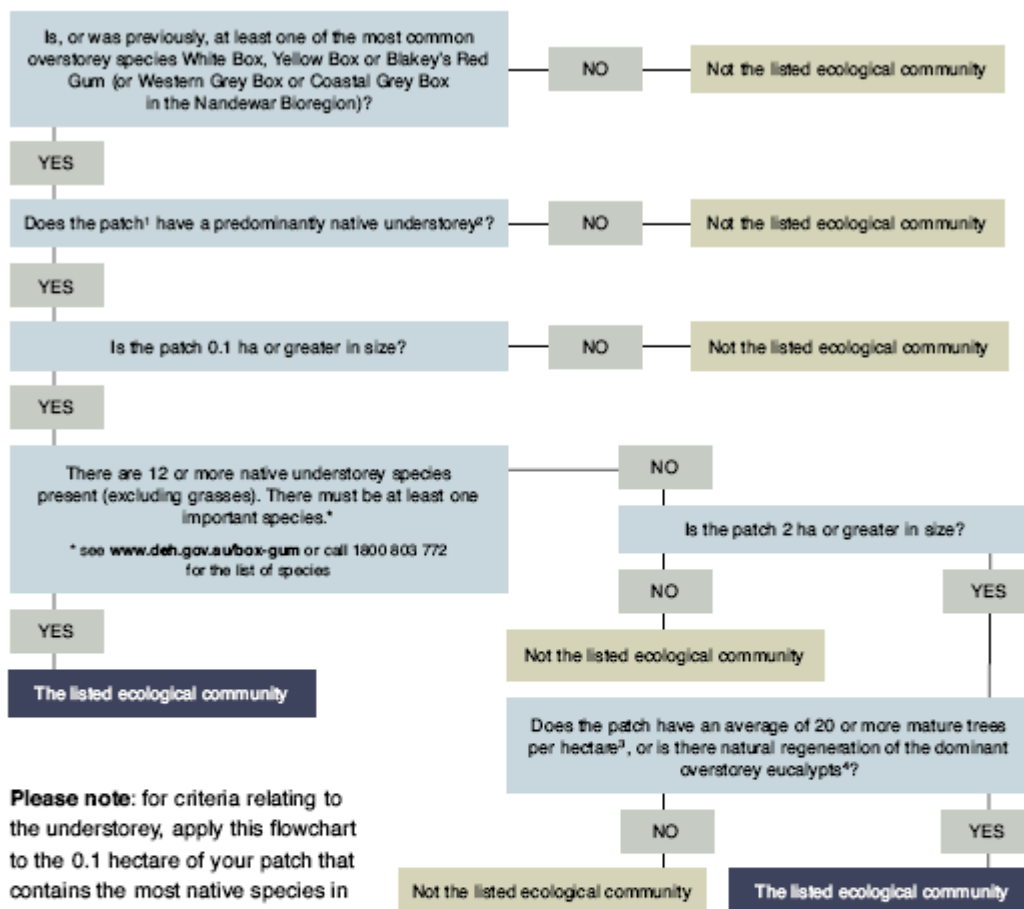
The ACT, in which the project is located, contains the largest remaining remnants of the community that are in good condition and are connected. This is likely reflective of the significantly lower levels of stock grazing than occurs across the remaining distribution of the community, given the system of lease-hold title in the ACT. The community is estimated to be 66% cleared in the ACT, compared with 94% in NSW and Victoria, and 67% in Queensland (TSSC 2006).

The community is characterised by the dominance (or prior dominance) of White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and/or Blakely's Red Gum (*E. blakelyi*) trees. White Box does not typically occur in the Canberra region, and therefore stands of the community are dominated by Yellow Box or Blakely's Red Gum. Tree cover in the community is generally discontinuous, consisting of widely-spaced trees of moderate height. In optimum condition, the community contains a sparse shrub layer and a diverse understorey of native grasses and forbs (TSSC 2006). In order for an area to be included in the listed ecological community, a patch must have a predominantly native understorey (TSSC 2006).

### iv Policy statement

EPBC Act Policy Statement 3.5 White Box Yellow Box Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands (DEH 2006) provides a flowchart to assist in determining if patches are included in the listed community (Plate 2.1).

The structure and diversity of the different condition classes shown on Figure 2.1 (ie very low condition, low condition and moderate condition) have been compared with the flowchart (Plate 2.1) to determine if they represent the listed community (Table 2.1). It has been determined that polygons in low and moderate condition represent the listed community as they are dominated by representative canopy species, have a patch size greater than 0.1 ha and contain 12 or more understorey species, excluding grasses. Therefore, they form part of a single patch. The polygon in low condition does not represent the listed community as it has a predominantly exotic understorey, the nearest tree to the adjacent low condition polygon is greater than 75 m away, few mature canopy trees remain, less than 12 understorey species (excluding grasses) are present, and canopy regeneration is absent. Therefore, the very low condition polygon forms part of a separate and discontinuous patch to the other polygons.



- <sup>1</sup> Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and is not, included within any individual patch. The patch is the larger of:
  - an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
  - the area over which the understorey is predominantly native.
 Patches must be assessed at a scale of 0.1 ha (1000m<sup>2</sup>) or greater.
- <sup>2</sup> A predominantly native ground layer is one where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species. The best time of the year to determine this is late autumn when the annual species have died back and have not yet started to regrow. (At other times of the year, you can determine whether something is perennial or not if it is difficult to pull out of the soil. Annual species pull out very easily.)
- <sup>3</sup> Mature trees are trees with a circumference of at least 125 cm at 130 cm above the ground.
- <sup>4</sup> Natural regeneration of the dominant overstorey eucalypts when there are mature trees plus regenerating trees of at least 15 cm circumference at 130 cm above the ground.

Plate 2.1 Flowchart to determine presence of the listed community (or otherwise)

**Table 2.1 Assessment to determine presence (or otherwise) of the listed community**

Patch	Moderate condition	Low condition	Very low condition
Is, or was previously at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum (or Western Grey Box or Coastal Grey Box in the Nandewar Bioregion)?	Yes. The polygons in moderate condition are dominated by Yellow Box and Blakely's Red Gum trees.	Yes. The polygons in low condition are dominated by Yellow Box and Blakely's Red Gum trees.	Yes. The polygons in very low condition are contain some Yellow Box and Blakely's Red Gum trees.
Does the patch <sup>1</sup> have a predominantly native understorey? <sup>2</sup>	Yes. Patches have a predominantly native understorey and trees are spaced at less than 75 m from each other.	Yes. Patches have a predominantly native understorey and trees are spaced at less than 75 m from each other.	No. The polygon has a predominantly exotic understorey and the nearest tree is located greater than 75 m (ie 78 m) from trees in the adjacent low condition patch.
Is the patch 0.1 ha or greater in size?	Yes. The polygon is 2.50 ha, which is part of a larger patch connecting to the community in low condition that is 6.24 ha.	Yes. The polygon is 6.24 ha, which is part of a larger patch connecting to the community in moderate condition that is 2.50 ha.	Yes. The polygon is 3.24 ha. It forms part of a separate patch to the low and moderate condition polygons.
Are there 12 or more native understorey species present (excluding grasses)? There must be at least one important species.	Yes. The patch contains mature trees with mixed-age overstorey regeneration. The groundlayer has 20 native species including 15 forbs, of which 5 were important species.	Yes. The patch contains mature trees with overstorey regeneration. The groundlayer has 16 native species and more than one important species.	No. Few mature trees remain, overstorey regeneration is absent. Thirteen native understorey species were present but these comprised 9 grasses and three forbs and no important species were present.
Is the patch 2 ha or greater in size?	Yes. The polygon is 2.50 ha, which is part of a larger patch connecting to the community in low condition that is 6.24 ha.	Yes. The polygon is 6.24 ha, which is part of a larger patch connecting to the community in moderate condition that is 2.50 ha.	Yes. The polygon is 3.24 ha. It forms part of a separate patch to the low and moderate condition polygons.
Does that patch have an average of 20 or more mature trees per hectare <sup>3</sup> , or is there natural regeneration of the overstorey eucalypts? <sup>4</sup>	Yes. Greater than 20 mature trees per hectare and natural regeneration of overstorey eucalypts are present.	Yes. Greater than 20 mature trees per hectare and natural regeneration of overstorey eucalypts are present.	No. The patch does not have greater than 20 mature trees per hectare and natural overstorey regeneration is absent.
Conclusion	Represents the listed community.	Represents the listed community.	Does not represent the listed community.

v **Recovery plan**

The National Recovery Plan for White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (DECCW 2010). The plan has describes the listed community as a woodland or derived native grassland, characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, that is dominated by White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and/or Blakely's Red Gum (*E. blakelyi*). To be considered part of the listed community, remnants must also:

- Have a predominantly native understorey (ie more than 50% of the perennial groundlayer must comprise native species); and

- be 0.1 ha or greater in size and contain 12 or more native understorey species (excluding grasses), including one or more identified important species; or
- be 2 ha or greater in size and have either natural regeneration of the overstorey species or an average of 20 or more mature trees per ha.

The criteria described above are the same as that presented in EPBC Act Policy Statement 3.5 (DEH 2006). Using these criteria, polygons in low and moderate condition represent the community (Figure 2.1), while polygons in very low condition do not.

The recovery plan states that it is difficult to define habitat critical to the survival of the community as it occurs over such a wide distribution where it has been cleared, fragmented and degraded to the point where its medium and long-term survival is threatened. The recovery plan states that in very broad terms, habitat critical to the survival of the listed community is that which occurs on the moderate to highly fertile soils of the western slopes of NSW and Queensland, northern slopes of Victoria, and the tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT. It also states that given the highly fragmented and degraded state of the community, all patches that meet the minimum condition criteria described above should be considered critical to the survival of the community. The recovery plan also states that further work to assist recovery of the ecological community is required to identify those areas important to the conservation and maintenance of landscape connectivity.

The polygons identified as very low condition (Figure 2.1 and Section iv above) do not meet the description of the listed community, and therefore do not comprise habitat critical to the survival of the community. As the polygons in low and moderate condition represent the listed community, they can be broadly defined as habitat critical to the survival of the community. However, their importance to the survival of the community should be interpreted in the context of the continuity and condition of surrounded woodland patches protected by nature reserves.

Woodland at Mugga Quarry and in the project area is part of a 2,325 ha woodland area in the Callum Brae-Jerrabomberra Valley complex, which is one of the largest areas of contiguous woodland in the ACT region (ACT Government 2004). It includes 1,040 ha of Yellow Box – Red Gum Grassy Woodland community. Highly modified areas of woodland in the Mugga Lane East area, two major quarries (of which one comprises the project area) and the Mugga landfill form major discontinuities in this complex (ACT Government 2004).’ (page 65 and Figure 5.3a of Strategy). The recovery plan states that further work is needed to identify those areas important to the community’s conservation. Using the advice from ACT Government (2004), the 1,040 ha occurrence within the 2,325 ha woodland complex comprises habitat critical to the survival of the listed community, and degraded woodland in the Mugga area (which includes the project area) forms a major discontinuity in the woodland complex, and therefore does not comprise habitat critical to the survival of the woodland complex or the listed community.

## 2.2 EPBC Act listed threatened species

The protected matters search (Appendix A) identified that 28 listed species may occur within 1 km of the project area, comprising 10 plant, 7 bird, 2 frog, 4 mammal, 2 reptile, 2 fish and 1 insect species. The likelihood that each species predicted by the protected matters search would occur in the project area was assessed (based upon the presence/absence of recent records and the presence of suitable habitat (refer to fauna habitat description in Rowell 2017).

The assessment is provided in Table 3.1. Only one species, namely the Superb Parrot, has potential to occur in the project area. An assessment of the species habitat in the project area against policy and statutory documents is provided in the following section.

**Table 2.2 Listed threatened fauna and flora likelihood of occurrence**

Listed species	Conservation status	Habitat	Likelihood of occurrence
Trailing Hop Bush ( <i>Dodonaea procumbens</i> )	V	The Trailing Hop-bush is widely but patchily distributed across south-eastern Australia, where it occurs in New South Wales, Victoria and South Australia. The species is not known from the ACT.	None, as the species is not known to occur in the ACT.
Black Gum ( <i>Eucalyptus aggregata</i> )	V	Black Gum is found in the NSW Central and Southern Tablelands, with small isolated populations in Victoria and the ACT. It grows in the lowest parts of the landscape on alluvial soils on poorly drained flats.	None as suitable habitat is absent from the project area.
Basalt Peppercress ( <i>Lepidium hyssopifolium</i> )	E	The Basalt Pepper-cress is found in an extensive, but patchy distribution from south-eastern NSW, through Victoria to eastern parts of Tasmania. The species is not known from the ACT.	None, as the species is not known to occur in the ACT.
Hoary Sunray ( <i>Leucochrysum albicans</i> var. <i>tricolor</i> )	E	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass. This species has not been recorded in the locality and was not recorded within the proposed extension area during targeted surveys.	Potentially suitable habitat, however the species was not recorded during targeted surveys during a time when the species was readily detectable.
Omeo's Storksbill ( <i>Pelargonium</i> sp. <i>Striatellum</i> )	E	Known from 4 populations in NSW and one population in Victoria. Not known to occur in the ACT.	None, as the species is not known to occur in the ACT.
Pale Pomaderris ( <i>Pomaderris pallida</i> )	V	The Pale Pomaderris is currently known from the ACT, southern NSW and eastern Victoria. In the ACT, this species is scattered along the Cotter, Paddys and Murrumbidgee Rivers and through the Molonglo Gorge. Grows on the plateau edge and steep upper slopes and cliffs of river valleys.	None as suitable habitat is absent from the project area.
Tarengo Leek Orchid ( <i>Prasophyllum petilum</i> )	E	Only known from Hall in the ACT and four populations in NSW.	None, as the species is not known to occur in the southern ACT.
Button Wrinklewort ( <i>Rutidosia leptorhynchoides</i> )	E	Known from Goulburn, the Canberra – Queanbeyan area and Michelago and Victoria. Occurs in Box Gum Woodland and Derived Native Grassland and Natural Temperate Grassland.	None as the species is highly sensitive to grazing, and the site is heavily grazed.

**Table 2.2 Listed threatened fauna and flora likelihood of occurrence**

Listed species	Conservation status	Habitat	Likelihood of occurrence
Small Purple Pea ( <i>Swainsona recta</i> )	E	The species occurs in the ACT, the central slopes of NSW and in the Mt Chiltern area of Victoria and is associated with Box Gum Woodland.	None as the species is highly sensitive to grazing, and the site is heavily grazed.
Austral Toadflax ( <i>Thesium australe</i> )	V	The species occurs in New South Wales, the Australian Capital Territory, Queensland and Victoria. Only known from Kambah Pool in the ACT.	None as the species is highly sensitive to grazing, and the site is heavily grazed.
Regent Honeyeater ( <i>Anthochaera phrygia</i> )	CE	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark ( <i>E. sideroxylon</i> ), Yellow Box ( <i>E. melliodora</i> ), Blakely's Red Gum ( <i>E. blakelyi</i> ), White Box ( <i>E. albens</i> ) and Swamp Mahogany ( <i>E. robusta</i> ). Also utilises: <i>Eucalyptus microcarpa</i> , <i>E. punctata</i> , <i>E. polyanthemos</i> , <i>E. moluccana</i> , <i>E. crebra</i> , <i>E. caleyi</i> , <i>C. maculata</i> , <i>E. mckieana</i> , <i>E. macrorhyncha</i> , <i>E. laevopinea</i> , and <i>Angophora floribunda</i> . (Rough barked apple). The species is rarely recorded in the Act, with the most recent records at Coolemon Ridge Nature Reserve in 2008 and Jerrabomberra Wetlands Reserve in 2015.	Low potential. Although suitable habitat is present, the species is rarely recorded in the ACT.
Curlew Sandpiper ( <i>Calidris ferruginea</i> )	CE	This species generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	None as suitable habitat is absent from the project area.

**Table 2.2 Listed threatened fauna and flora likelihood of occurrence**

Listed species	Conservation status	Habitat	Likelihood of occurrence
Painted Honeyeater ( <i>Grantiella picta</i> )	V	The species inhabits mistletoes in eucalypt forests/woodlands, riparian woodlands of black box and river red gum, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris, and trees on farmland or gardens. The species exhibits seasonal north-south movements governed principally by the fruiting of mistletoe, with many birds moving after breeding to semi-arid regions such as north-eastern South Australia, central and western Queensland, and central Northern Territory. The species has not been recorded within the locality.	None as suitable habitat is absent from the project area.
Swift Parrot ( <i>Lathamus discolor</i> )	CE	Migrating in the autumn and winter months to south-eastern Australia. In NSW, mostly occurs on the coast and south west slopes in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany ( <i>Eucalyptus robusta</i> ), Spotted Gum ( <i>Corymbia maculata</i> ), Red Bloodwood ( <i>C. gummifera</i> ), Mugga Ironbark ( <i>E. sideroxylon</i> ), and White Box ( <i>E. albens</i> ). The species has not been recorded within the locality.	None as suitable habitat is absent from the project area.
Eastern Curlew ( <i>Numenius madagascariensis</i> )	CE	This species generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. This species has not been recorded within the locality and there is no suitable habitat within the proposed extension area.	None as suitable habitat is absent from the project area.

**Table 2.2 Listed threatened fauna and flora likelihood of occurrence**

Listed species	Conservation status	Habitat	Likelihood of occurrence
Superb Parrot ( <i>Polytelis swainsonii</i> )	V	The Superb Parrot mainly inhabits forests and woodlands dominated by eucalypts, especially River Red Gums ( <i>Eucalyptus camaldulensis</i> ) and box eucalypts such as Yellow Box ( <i>Eucalyptus melliodora</i> ) or Grey Box ( <i>E. microcarpa</i> ).	Potential to occur given the presence of Yellow Box trees with hollows. Not recorded during targeted surveys during the breeding season.
Australian Painted Snipe ( <i>Rostratula australis</i> )	E	The species inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans.	None as suitable habitat is absent from the project area.
Green and Golden Bell Frog ( <i>Litoria aurea</i> )	V	Occurs along the east coast of Australia where it inhabits marshes, dams and stream sides, particularly those containing bulrushes and spikerushes. Not known from the ACT.	None as suitable habitat is absent from the project area.
Yellow-spotted Tree Frog ( <i>Litoria castanea</i> )	E	The southern population of the species occurs between Canberra ACT and Bombala in NSW. Inhabits permanent ponds, swamps, lagoons, farm dams and river backwaters.	None as suitable habitat is absent from the project area.
Spotted-tail Quoll ( <i>Dasyurus maculatus</i> )	E	Has been recorded from a wide range of habitats, unlogged forest or forest that has been less disturbed by timber harvesting is preferable. Habitat requirements include suitable den sites such as hollow logs, tree hollows, rock outcrops or caves. Individuals require an abundance of food, such as birds and small mammals, and large areas of relatively intact vegetation through which to forage. Home ranges are estimated to be 620–2560 ha for males, and 90–650 ha for females. Recent records of species show that it is rarely recorded in the ACT and is generally from forested habitat with a complex understorey, west of the city.	None as suitable habitat is absent from the project area.

**Table 2.2 Listed threatened fauna and flora likelihood of occurrence**

Listed species	Conservation status	Habitat	Likelihood of occurrence
Greater Glider ( <i>Petauroides volans</i> )	V	The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows.	None as suitable forest habitat is absent from the project area.
Koala ( <i>Phascolarctos cinereus</i> )	V	This species inhabits eucalypt woodlands and forests and feeds on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. In the ACT, Koalas are thought to be present through the Brindabella Ranges (around Bushfold) and in the Orroral Valley and Tidbinbilla reserve, Namadgi National Park. k	None as Koalas are not known from the locality.
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	V	The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. This species has not been recorded within the locality and it is considered unlikely that the species would occur within the proposed extension area as there is a distinct lack of records for this species this far west (apart from outliers)	Low potential to occur as the site does not contain enough large eucalypts to provide sufficient feeding habitat.
Pink-tailed Worm Lizard ( <i>Aprasia parapulchella</i> )	V	Known from the Canberra/Queanbeyan region, with other populations in NSW. Inhabits open woodland areas with native grasses. Sites are typically well-drained with rocky outcrops or scattered and partially buried surface rocks.	None due to the paucity of suitable surface rocks.
Striped Legless Lizard ( <i>Delma impar</i> )	V	Occurs in the NSW and the ACT. Found mainly in natural temperate grassland in the ACT and derived native grassland within 2 km of natural temperate grassland.	None as suitable habitat is absent from the site.
Murray Cod ( <i>Maccullochella peelii</i> )	V	The Murray Cod utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW (including the ACT), to slow-flowing, turbid lowland rivers and billabongs.	None as suitable habitat is absent from the site.

**Table 2.2** Listed threatened fauna and flora likelihood of occurrence

Listed species	Conservation status	Habitat	Likelihood of occurrence
Macquarie Perch ( <i>Macquaria australasica</i> )	E	In the Australian Capital Territory, the Macquarie Perch is restricted to the Murrumbidgee, Paddys and Cotter Rivers.	None as suitable habitat is absent from the site.
Golden Sun Moth ( <i>Synemon plana</i> )	CE	Occurs primarily in Natural Temperate Grassland and adjacent exotic grasslands.	None as suitable habitat is absent from the site.

Notes 1. Sources: DoEE (2018), OEH (2018)

### 2.2.1 Superb Parrot

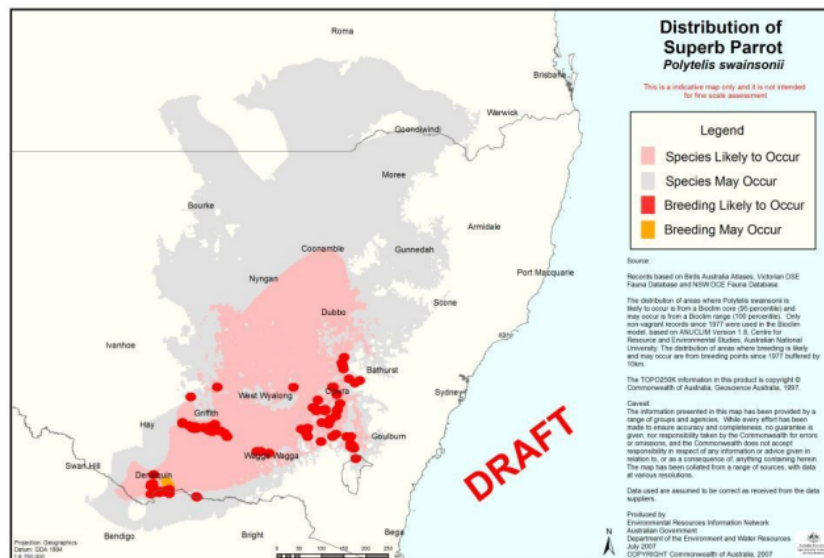
#### i Commonwealth conservation advice

The Commonwealth Conservation Advice for the Superb Parrot (TSSC 2016) describes the conservation status, distribution, biology/ecology and threats to the survival of the Superb Parrot. The Superb Parrot occurs west of the Great Dividing Range, in Canberra, Goulburn and west to Nyngan and Swan Hill. The Superb Parrot nests in large, living or dead trees with many hollow branches, typically near watercourses. In Canberra, they have also been recorded nesting in semi-urban environments where old trees have been retained. Following breeding, Superb Parrots disperse and forage on a variety woodland and other habitat types. Threats to the survival of the species comprise the loss and degradation of habitat, competition for nest hollows, road kill, illegal collection of wild birds, Psittacine beak and feather disease and climate change.

Superb Parrots are sparsely distributed in the ACT during the breeding season, when they nest in hollows in large eucalypts (ACT Government 2004). There are records of small numbers in the Callum Brae Nature Reserve in 2016 and 2017, and in Garran and Red Hill to the north from 2015 to 2017 (eBird, Canberra Nature Map). Low and moderate condition Yellow Box – Red Gum Grassy Woodland in the project area is of sufficient quality, size and connectivity to provide potential feeding habitat and/or nest sites for the Superb Parrot.

#### ii Recovery plan

The National Recovery Plan for the Superb Parrot (Baker-Gabb 2011) details the species biology, ecology, distribution, populations, habitat and threats. The recovery plan describes the species as nomadic, resident, dispersive and migratory, making regular seasonal movements between breeding and non-breeding areas, in response to changes in food availability. When making local foraging movements, the species usually moves through wooded corridors, rarely crossing large areas of open ground.



**Plate 2.2 Breeding range of the Superb Parrot (Baker-Gabb 2011)**

The breeding range of the Superb Parrot is concentrated on the NSW South Western Slopes and Riverina bioregions. The three main breeding areas (see Plate 2.2) comprise:

- the area bounded by Molong, Rye Park, Yass, Coolac, Cootamundra and Young;
- along the Murrumbidgee River between Wagga Wagg and Toganmain Sation to Goolgowi; and
- along the Murray and Edward Rivers, east of Barmah and Millewa State Forest to south of Taylors Bridge.

The total population of the Superb Parrot has been estimated at 5,000 to 8,000 birds, 6,500 of which comprise adults. Recent population information indicates the following nest data:

- Victoria: 30-40 nest trees in the Barmah region;
- NSW:
  - 136 nest trees in Cuba State Forest and the Edward River;
  - 106 nest trees on the South-western Slopes; and
  - 11 nest trees in Cowra.
- ACT: 8 nests in the Canberra district.

The recovery plan (Baker-Gabb 2011) defines habitat critical to the survival of the Superb Parrot as breeding habitat that comprises riverine forests in the Riverina and Box-Gum Woodlands on the tablelands and slopes. Tree species typically selected for nesting on the slopes and tablelands comprise River Red Gum (*E. camaldulensis*), Blakely’s Red Gum, Apple Box (*E. bridgesiana*), Grey Box (*E. microcarpa*), White Box and Red Box (*E. polyanthemos*). Of the species described above, Blakely’s Red Gum and Apple Box occur in the project area and surrounds. The species has been observed in small numbers in Callum Brae Nature Reserve (north of the project area) in 2016 and 2017, and in Garran and Red Hill to the north from 2015 to 2017 (eBird, Canberra Nature Map).

These nature reserves form part of the 2,325 ha woodland complex in the Callum Brae-Jerrabomberra Valley complex, which is one of the largest areas of contiguous woodland in the ACT region (ACT Government 2004), to which vegetation in the Mugga area (including the project area) forms a major discontinuity. As Superb Parrots have been observed during the breeding season in reserves in the woodland complex, this area is likely to comprise breeding habitat critical to the survival of the species. As vegetation in the Mugga area (including the project area) forms a major discontinuity to the woodland complex in terms of vegetation condition, and targeted surveys were completed during the breeding season that did not record the species, it is unlikely to represent habitat critical to the survival of the species.

Foraging habitat critical to the survival of the species is defined by the recovery plan (Baker-Gabb 2011) as Boree Woodlands between the Murrumbidgee and Murray Rivers, River Red Gum Forest, Box-Pine Woodland and White Cypress Pine Woodland. These vegetation types do not occur in the project area, and therefore it does not comprise foraging habitat critical to the survival of the community.



## 3 Nature and extent of likely impact

### 3.1 Avoidance, minimisation and mitigation

The following alternatives have been considered for the emplacement of overburden and weathered rock:

- Emplacement within the Mugga 1 pit – Boral is already planning to emplace approximately 270,000 cubic metres of overburden and weathered rock within the pit, for possible processing or relocation. Total overburden material in-pit emplacement is not considered viable as it would begin to sterilise approved resource and shorten the lifespan of the quarry;
- Emplacement within the disused Mugga 2 quarry pit – inquiries are being made with the ACT Government to determine whether this is a possibility and whether it would be commercially viable. However, based on haulage costs, even without a tipping fee, it is not attractive from a commercial perspective. Emplacement within the Mugga 2 pit would also negate later re-use and blending of the weathered rock material;
- Emplacement at another Boral quarry – the closest Boral Quarry is at Hall Quarry at Jera NSW, approximately 55 kilometres to the north. Hall Quarry does not have development approval to receive overburden from external sites, and the cost involved in trucking material over such a long distance is not commercially viable. It would also negate later re-use and blending of the weathered rock material; and
- Emplacement out of pit on adjoining quarry land – this has been considered the most viable solution from a commercial perspective, given it's the shortest haulage distance. It also means the weathered rock material can be later blended and re-used, instead of simply being applied to land. The vegetation surveys, topography and stormwater capture requirements have further refined the design of the emplacement to minimise its environmental footprint.

To determine the final overburden emplacement the design process investigated different on-site layouts which combined environmental impacts and Boral's project objectives as outlined below.

The original design proposed all overburden material placement outside the quarry pit on surface requiring up to 12.17 hectares (ha) of White Box-Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland (Box Gum Grassy Woodland) to be removed (refer Figure 7 provided in Section 4.3 of referral).

Given potential ecological impacts and following Pre-EPBC Referral discussions, the following measures to reduce impacts were considered:

- ecological assessment of significance;
- final Mugga Quarry pit extent;
- topography and site contours;
- surface water sedimentation dam locations;
- original overburden design contours; and

- proposed alternative overburden area.

The outcome of the above is an alternative overburden placement design that includes both in pit and on surface emplacement (refer Figure 7 provided in Section 4.3 of referral) requiring total vegetation clearance of 9.16 ha, comprising:

- 1.76 ha of cleared vegetation;
- 0.76 ha of Red Stringybark Tableland Grass/Shrub Forest;
- 2.47 ha Yellow Box – Red Gum Grassy Woodland (moderate condition);
- 2.57 ha Yellow Box – Red Gum Grassy Woodland (low condition); and
- 1.6 ha Yellow Box – Red Gum Grassy Woodland (very low condition).

Of the 9.16 ha of vegetation to be cleared, 5.04 ha represents White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland, comprising the patches in moderate and low condition.

The final design minimises environmental impacts whilst maintaining constructability and the capacity to meet Boral's operational efficiencies required for the project.

Mugga Quarry operates under an environmental management plan (EMP) – the EMP details the performance criteria (where relevant), mitigation and management and environmental performance monitoring. A summary of the management measures include:

- air quality management;
- operational noise management;
- product transportation;
- surface water management;
- hydrocarbon/spill management;
- biodiversity management;
- visual amenity management;
- heritage management;
- waste management and product handling; and
- contaminated land management.

Boral's EMP will be updated to include the proposed action.

The following measures will be added to Boral's EMP, and implemented during the project to further minimise biodiversity impacts:

- the loss of hollow bearing trees will be minimised where possible;

- trees will be felled outside the Spring woodland bird breeding season;
- the trunks and large branches from trees felled will be placed amongst the remaining woodland on the lease area; and
- a program of native tree and shrub planting will be undertaken to screen or cover the dumped material and that the scale of planting more than matches the loss of saplings and shrubs.

## 3.2 Residual direct and indirect impacts

### 3.2.1 Overview

The primary direct impact of the proposed action is clearing of vegetation within the proposed extension area and potential loss of habitat.

The proposed action has the potential for indirect impacts on retained vegetation and, therefore, habitats in and adjacent to the disturbance boundaries, including:

- increased noise and dust levels; and
- changes in hydrology.

Direct and indirect impacts are detailed below.

### 3.2.2 Direct impacts

Direct impacts comprise the removal of approximately 5.04 ha of White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grasslands and Superb Parrot habitat for the project. Assessments of significance have been provided for the listed community and species in the following sections.

#### i White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grasslands

Table 3.1 provides an assessment of significance for the removal of up to 5.04 ha of White Box-Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland for the proposed action, in accordance with the relevant assessment criteria for critically endangered ecological communities (DoE 2013).

**Table 3.1 Assessment of significance for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland**

Criteria	Discussion
<b>1. Reduce the extent of an ecological community</b>	Approximately 5.04 ha of the listed community will be removed as a result of the project. The listed community has also been mapped within the immediate vicinity of the proposed extension area, using regional vegetation mapping (Macguire and Mulvaney 2011). Within the vicinity of the proposed extension area, 25, 423 ha of EPBC Act listed Box – Gum Grassy Woodland occurs within a 10 km radius of the project (Figure 2.2). Accordingly, the project would result in a minor reduction (0.02%) in extent of the CEEC within a 10 km radius of the project.
<b>2. Fragment or increase fragmentation</b>	The proposed extension will not fragment the listed community. Connectivity will be maintained in retained patches of the listed community that comprise a vegetated corridor to the north of the site, connecting with native vegetation in Mugga Mugga and Callum Brae Nature Reserves.

**Table 3.1 Assessment of significance for White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland**

<b>Criteria</b>	<b>Discussion</b>
<b>3. Adversely affect critical habitat</b>	<p>A national recovery plan has been developed (DECCW 2010) for this community, which states that all areas of the listed community which meet the minimum condition criteria outlined in Section 3 of the plan, should be considered critical to the survival of this listed ecological community. This is defined as a canopy dominated or co-dominated by White Box (<i>Eucalyptus albens</i>), Yellow Box (<i>E. melliodora</i>) or Blakelys Red Gum (<i>E. blakelyi</i>), have a predominantly native understorey (ie more than 50% of the perennial native groundcover) with a patch size greater than 0.1 ha and must contain 12 or more understorey species, with at least one important species. If the patch does not meet the above criteria, it must be part of a patch greater than 2 ha in size and have an average of 20 or more mature trees per ha or natural regeneration of the canopy eucalypts.</p> <p>Approximately 5.04 ha of vegetation in the proposed extension area meets the above criteria. According to the ACT mapping (Macguire and Mulvaney 2011), there is 25, 423 ha of the listed community that provides critical habitat for the community within a 10 km radius of the project. The project would only reduce the extent of critical habitat in the locality by 0.02%, and therefore would not adversely affect critical habitat.</p>
<b>4. Modify or destroy abiotic factors necessary for survival</b>	<p>The listed community occurs directly adjacent to the existing quarry. Abiotic factors do not appear to have adversely affected retained areas of the listed community, with no detectable changes between the community directly adjacent or further away from the quarry boundary. No material changes in surface hydrology are expected to occur (Section 3.2.3ii). Accordingly, the project will not destroy abiotic factors necessary for the listed community’s survival.</p>
<b>5. Cause a substantial change in species composition</b>	<p>The project will remove 5.04 ha of habitat for the listed community within the proposed extension area. Consequently, there will be no residual functionality of the CEEC in the proposed extension area. Any areas of CEEC outside of the disturbance footprint would not be significantly impacted by indirect means and their functionality is likely to continue unchanged.</p>
<b>6. Cause a substantial reduction in quality or integrity</b>	<p>The project will remove all habitats within the disturbance footprint; consequently, there will be no residual risk within the proposed extension area. Areas outside of the proposed extension area have been subjected to the indirect impacts of vehicle movements for a long period of time, e.g the potential importation of invasive species or increased dust levels. This does not appear to have significantly impacted the CEEC to date. The majority of weed species within the CEEC are exotic pasture species associated with previous agricultural land uses rather than the quarry operation. Any indirect impacts from the quarry are anticipated to be negligible.</p>
<b>7. Interfere with recovery</b>	<p>A national recovery plan has been developed (DECCW 2010), with the objective to promote the recovery and minimise the risk of extinction of the ecological community through:</p> <ul style="list-style-type: none"> <li>• achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;</li> <li>• increasing protection of sites in good condition;</li> <li>• increasing landscape function of the ecological community through management and restoration of degraded sites;</li> <li>• increasing transitional areas around remnants and linkages between remnants; and</li> <li>• bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.</li> </ul> <p>The clearance of up to 5.04 ha of the CEEC will directly contravene Point 1, by reducing the extent of the listed community. The area to be removed is part of a 2,325 ha woodland area in the Callum Brae-Jerrabomberra Valley complex, which is one of the largest areas of contiguous woodland in the ACT region (ACT Government 2004). It includes 1,040 ha of the listed community. Highly modified areas of woodland in the Mugga Lane East area, two major quarries and the Mugga landfill form major discontinuities in this complex (ACT Government 2004).’ (page 65 and Figure 5.3a of Strategy). Accordingly, removal of this patch would not interfere with recovery of the listed community.</p>
<b>Conclusion</b>	<p>Although 5.04 ha of the listed community identified within the project area meets the minimum critical habitat criteria, as per the National Recovery Plan (DECCW 2010), the project will not adversely affect critical habitat or significantly reduce the extent of the community as only 0.02% of its extent within the locality will be removed.</p>

Table 3.2 provides an assessment of significance for the removal of up to 5.04 ha of potential Superb Parrot habitat, in accordance with the relevant assessment criteria for vulnerable species (DoE 2013).

**Table 3.2 Assessment of significance for the Superb Parrot**

<b>Criteria</b>	<b>Discussion</b>
<b>1. Long-term decrease of an important population</b>	Important populations have not been defined in the recovery plan for the Swift Parrot (Baker-Gabb 2011). A single population of the species exists, and therefore the project cannot lead to the decrease of an important population.
<b>2. Reduce occupancy area for important population</b>	Important populations have not been defined in the recovery plan for the Swift Parrot (Baker-Gabb 2011). A single population of the species exists, and therefore the project cannot reduce the area of occupancy of an important population.
<b>3. Fragment an important population</b>	Important populations have not been defined in the recovery plan for the Swift Parrot (Baker-Gabb 2011). A single population of the species exists, and therefore the project cannot fragment an important population.
<b>4. Adversely affect habitat critical to survival</b>	<p>Habitat critical to the survival of the species has been defined by the recovery plan (Baker-Gabb 2011) as breeding habitat that comprises riverine forests in the Riverina and Box Gum Woodlands on the tablelands and slopes and foraging habitat comprising Boree Woodlands between the Murrumbidgee and Murray Rivers, River Red Gum Forest, Box-Pine Woodland and White Cypress Pine Woodland.</p> <p>As Superb Parrots have been observed during the breeding season in reserves in the 2,325 ha Callum Brae – Jerrabombera Valley woodland complex, this area is likely to comprise breeding habitat critical to the survival of the species. As vegetation in the Mugga area (including the project area) forms a major discontinuity to the woodland complex in terms of vegetation condition, and targeted surveys were completed during the breeding season that did not record the species, it is unlikely to represent habitat critical to the survival of the species. In addition, the project area does not contain the vegetation types listed as critical foraging habitat for the species.</p>
<b>5. Disrupt breeding cycle</b>	Breeding has been observed in Callum Brae Nature Reserve, north of the project area. Targeted surveys were completed in the project area during the breeding season that did not record the species. Accordingly, clearing of this habitat would not disrupt the breeding cycle of the species.
<b>6. Modify, destroy, remove, isolate or degrade habitat</b>	The project will remove 5.04 ha of potential habitat for the Superb Parrot. The species has not been observed in the area. The habitat to be removed is adjacent to a 2,325 ha woodland complex where the species is known to occur and breed. Accordingly, removal of this habitat is unlikely to adversely impact the species.
<b>7. Result in invasive species</b>	Soil disturbance for the project has potential to result in the spread of invasive weeds to retained areas of vegetation and potential habitat. Weed control will be completed as part of Boral's environmental management plan in areas of retained native vegetation and habitat to minimise this risk.
<b>8. Introduce disease</b>	Superb Parrots may be susceptible to Beak and Feather disease. Disease outbreaks usually occur in wild animal populations where significant stresses arise. The clearance of potential habitat is unlikely to cause significant stress such that a disease outbreak would occur.
<b>9. Interfere with recovery</b>	Recovery actions for the Superb Parrot aim to determine population trends, increase knowledge of the species ecological requirements, develop and implement threat abatement strategies and increase community involvement and awareness of the recovery program (Baker-Gabb 2011). As recovery actions are focused on increasing knowledge of the species, the project will not interfere with recovery.
<b>Conclusion</b>	The clearance of 5.04 ha of potential Superb Parrot habitat will not result in a significant impact on the species important populations will not be adversely affected, the area to be removed does not represent habitat critical to the survival of the species and the project will not interfere with recovery.

### 3.2.3 Indirect impacts

#### i Increased noise and dust levels

Without management, the proposed action could result in increased noise and dust levels. A noise and air quality study will be completed for the proposed action that will make recommendations to minimise noise and dust impacts on native vegetation and fauna habitat to be retained. These measures will be included in revised versions of Boral's existing noise management and air quality management plans for the site.

#### ii Changed hydrology

Existing hydrology is described in the attachment provided at Section 3.2.1 of the referral. Changes to surface flow regimes can occur due to the realignment of existing catchment boundaries and due to harvesting runoff that has been captured in the sedimentation dams. The proposed emplacement design will seek to minimise the realignment of catchment boundaries, hence no material redistribution of surface flows is expected. However, it is noted that the upper portion of the Area 3 catchment (Figure 6 provided at Section 3.2.1 of referral) will be removed as the quarry pit progresses to its approved extraction limit.

The sedimentation basins will be designed and operated in accordance with the guideline titled Environment Protection Guidelines for Construction and Land Development in ACT (EPA 2011), which recommends the following design and management practices:

- the basins will be sized to capture the initial 150 m<sup>3</sup> of runoff per hectare (ha) of disturbance area. This is equivalent to 15 mm of runoff. Accounting for soil losses, approximately 30 to 50mm of rainfall is expected to be required to produce 15mm of runoff; and
- following rainfall, the basins will be dewatered to 20% capacity to provide capacity to capture the next runoff event.

As the sedimentation basins will capture the initial 15 mm of runoff from each rainfall event it is expected that the frequency of stream flows in the immediate receiving waters will reduce. The magnitude of this change will progressively diminish in downstream sections of waterways as the contributing catchment area increases.

The proposed sedimentation dams will be designed, constructed and operated in accordance the guideline titled Environment Protection Guidelines for Construction and Land Development in ACT (EPA 2011) and are therefore expected to provide effective sedimentation treatment.

Boral will implement a surface water monitoring program. If monitoring identifies that the sedimentation dams are not providing effective treatment during overflow conditions, the following additional measures can be implemented to reduce water quality risks:

- gypsum (or chemical flocculants such as alum) can be applied to the basin water bodies to improve sedimentation rates; and
- water from the dams can be dewatered to the open pit where it will be temporarily stored and used for process water make.

## 4 Conclusion

The proposed action will result in the clearance of 9.16 ha of vegetation, comprising 5.04 ha of White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grasslands and potential Superb Parrot habitat. Assessments of significance have been completed for the listed species and community. The proposed action will not result in a significant impact for the listed species or community.



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## Appendix A

### Protected Matters Search Tool Results

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# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 11/01/18 14:02:51

[Summary](#)

[Details](#)

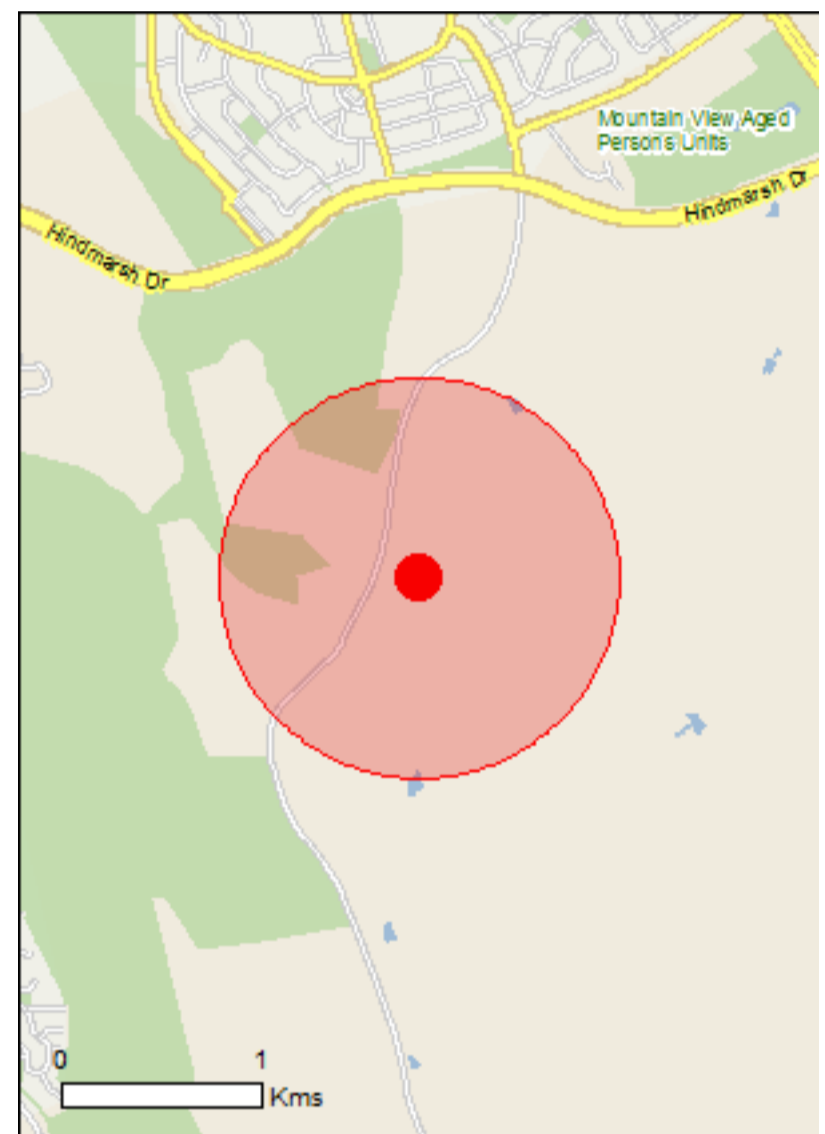
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

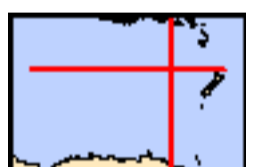
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 1.0Km](#)



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	None
<a href="#">Wetlands of International Importance:</a>	4
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Area:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	2
<a href="#">Listed Threatened Species:</a>	28
<a href="#">Listed Migratory Species:</a>	13

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

<a href="#">Commonwealth Land:</a>	None
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	19
<a href="#">Whales and Other Cetaceans:</a>	None
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Commonwealth Reserves Marine:</a>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<a href="#">State and Territory Reserves:</a>	2
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	33
<a href="#">Nationally Important Wetlands:</a>	None
<a href="#">Key Ecological Features (Marine)</a>	None

# Details

## Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[ Resource Information ]
Name	Proximity
<a href="#">Banrock station wetland complex</a>	800 - 900km upstream
<a href="#">Hattah-kulkyne lakes</a>	600 - 700km upstream
<a href="#">Riverland</a>	700 - 800km upstream
<a href="#">The coorong, and lakes alexandrina and albert wetland</a>	800 - 900km upstream

## Listed Threatened Ecological Communities [ Resource Information ]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
<a href="#">Natural Temperate Grassland of the South Eastern Highlands</a>	Critically Endangered	Community likely to occur within area
<a href="#">White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</a>	Critically Endangered	Community likely to occur within area

## Listed Threatened Species [ Resource Information ]

Name	Status	Type of Presence
<b>Birds</b>		
<a href="#">Anthochaera phrygia</a> Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Grantiella picta</a> Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Lathamus discolor</a> Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Polytelis swainsonii</a> Superb Parrot [738]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Rostratula australis</a> Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
<b>Fish</b>		
<a href="#">Maccullochella peelii</a> Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
<a href="#">Macquaria australasica</a> Macquarie Perch [66632]	Endangered	Species or species

Name	Status	Type of Presence
<b>Frogs</b>		
<a href="#">Litoria aurea</a> Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
<a href="#">Litoria castanea</a> Yellow-spotted Tree Frog, Yellow-spotted Bell Frog [1848]	Endangered	Species or species habitat may occur within area
<b>Insects</b>		
<a href="#">Synemon plana</a> Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
<b>Mammals</b>		
<a href="#">Dasyurus maculatus maculatus (SE mainland population)</a> Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
<a href="#">Petauroides volans</a> Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
<a href="#">Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)</a> Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
<a href="#">Pteropus poliocephalus</a> Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<b>Plants</b>		
<a href="#">Dodonaea procumbens</a> Trailing Hop-bush [12149]	Vulnerable	Species or species habitat may occur within area
<a href="#">Eucalyptus aggregata</a> Black Gum [20890]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Lepidium hyssopifolium</a> Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat may occur within area
<a href="#">Leucochrysum albicans var. tricolor</a> Hoary Sunray, Grassland Paper-daisy [56204]	Endangered	Species or species habitat likely to occur within area
<a href="#">Pelargonium sp. Striatellum (G.W.Carr 10345)</a> Omeo Stork's-bill [84065]	Endangered	Species or species habitat may occur within area
<a href="#">Pomaderris pallida</a> Pale Pomaderris [13684]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Prasophyllum petilum</a> Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
<a href="#">Rutidosis leptorrhynchoides</a> Button Wrinklewort [7384]	Endangered	Species or species habitat likely to occur within area
<a href="#">Swainsona recta</a> Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat likely to occur within area
<a href="#">Thesium australe</a> Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence area
<b>Reptiles</b>		
<a href="#">Aprasia parapulchella</a> Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Delma impar</a> Striped Legless Lizard [1649]	Vulnerable	Species or species habitat likely to occur within area
<b>Listed Migratory Species</b>		<b>[ Resource Information ]</b>
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
<b>Migratory Marine Birds</b>		
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<b>Migratory Terrestrial Species</b>		
<a href="#">Hirundapus caudacutus</a> White-throated Needletail [682]		Species or species habitat known to occur within area
<a href="#">Monarcha melanopsis</a> Black-faced Monarch [609]		Species or species habitat known to occur within area
<a href="#">Motacilla flava</a> Yellow Wagtail [644]		Species or species habitat may occur within area
<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher [612]		Species or species habitat known to occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat likely to occur within area
<b>Migratory Wetlands Species</b>		
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat may occur within area
<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Pandion haliaetus</a> Osprey [952]		Species or species habitat may occur within area

## Other Matters Protected by the EPBC Act

Listed Marine Species		[ <a href="#">Resource Information</a> ]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
<b>Birds</b>		
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat may occur within area
<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
<a href="#">Hirundapus caudacutus</a> White-throated Needletail [682]		Species or species habitat known to occur within area
<a href="#">Lathamus discolor</a> Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Monarcha melanopsis</a> Black-faced Monarch [609]		Species or species habitat known to occur within area
<a href="#">Motacilla flava</a> Yellow Wagtail [644]		Species or species habitat may occur within area
<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher [612]		Species or species habitat known to occur within area
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within

Name	Threatened	Type of Presence area
<a href="#">Pandion haliaetus</a> Osprey [952]		Species or species habitat may occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat likely to occur within area
<a href="#">Rostratula benghalensis (sensu lato)</a> Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

## Extra Information

State and Territory Reserves	[ Resource Information ]
Name	State
Callum Brae	ACT
Mt Mugga Mugga	ACT

Invasive Species	[ Resource Information ]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.	

Name	Status	Type of Presence
<b>Birds</b>		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
<i>Sturnus vulgaris</i> Common Starling [389]		Species or species habitat likely to occur within area
<i>Turdus merula</i> Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
<b>Mammals</b>		
<i>Bos taurus</i> Domestic Cattle [16]		Species or species habitat likely to occur within area
<i>Canis lupus familiaris</i> Domestic Dog [82654]		Species or species habitat likely to occur within area
<i>Felis catus</i> Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
<i>Lepus capensis</i> Brown Hare [127]		Species or species habitat likely to occur within area
<i>Mus musculus</i> House Mouse [120]		Species or species habitat likely to occur within area
<i>Oryctolagus cuniculus</i> Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
<i>Rattus norvegicus</i> Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
<i>Rattus rattus</i> Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
<i>Sus scrofa</i> Pig [6]		Species or species habitat likely to occur within area
<i>Vulpes vulpes</i> Red Fox, Fox [18]		Species or species habitat likely to occur within area
<b>Plants</b>		
<i>Alternanthera philoxeroides</i> Alligator Weed [11620]		Species or species habitat likely to occur within area
<i>Cytisus scoparius</i> Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
<i>Genista</i> sp. X <i>Genista monspessulana</i> Broom [67538]		Species or species habitat may occur within area
<i>Lycium ferocissimum</i> African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
<i>Nassella neesiana</i> Chilean Needle grass [67699]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
<p>Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]</p>		Species or species habitat likely to occur within area
<p>Opuntia spp. Prickly Pears [82753]</p>		Species or species habitat likely to occur within area
<p>Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]</p>		Species or species habitat may occur within area
<p>Rubus fruticosus aggregate Blackberry, European Blackberry [68406]</p>		Species or species habitat likely to occur within area
<p>Salix spp. except S.babylonica, S.x calodendron &amp; S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]</p>		Species or species habitat likely to occur within area
<p>Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]</p>		Species or species habitat likely to occur within area
<p>Ulex europaeus Gorse, Furze [7693]</p>		Species or species habitat likely to occur within area

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-35.35886 149.13425

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.



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Appendix G

# PD assessment

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## Mugga Quarry Overburden Expansion Project

EPBC Act Referral (EPBC 2018/8151) | Preliminary Documentation

Prepared for Boral Resources (Country) Pty Ltd | 15 February 2019

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## Mugga Quarry Overburden Expansion Project

Final

Report J17174RP1 | Prepared for Boral Resources (Country) Pty Ltd | 18 October 2018

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Prepared by Nathan Garvey  
Cassandra Kottaras

Approved by Paul Gibbons

Position Associate Director – Ecology  
Ecologist

Position Associate Director

Signature



Signature



Date 15/02/2019

Date 15/02/2019

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This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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### Document Control

Version	Date	Prepared by	Reviewed by
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# 1 Introduction

Boral Resources (Country) Pty Ltd (Boral), a wholly owned subsidiary of Boral Limited, proposes to establish a new permanent bund and temporary stockpile area to store quarried overburden and weathered rock material from its Mugga Quarry operations (the project) at 321 Mugga Lane, Symonston (the site).

The project is required to enable the ongoing extraction operations of the quarry and supply of aggregates and quarry products to the construction market within the Australian Capital Territory (ACT) and surrounding New South Wales (NSW) regional areas.

The site in its regional and local context can be seen in Figure 1.1 and Figure 1.2.

## 1.1 Assessment background

EMM Consulting Pty Ltd (EMM) was engaged by Boral to prepare an ecology assessment for the project and a referral of the proposed action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in February 2018 (EPBC 2018/8151).

A referral decision was received on 20 March 2018, with the proposed action deemed a controlled action due to the potential for a significant impact to listed threatened species and communities. In particular, the Department of the Environment and Energy (DoEE) highlighted impacts to White box-yellow box-Blakely's red gum grassy woodland and derived native grassland critically endangered ecological community (CEEC, hereafter referred to as Box Gum Woodland) and habitat for the Superb Parrot (*Polytelis swainsonii*). The proposed action is to be assessed by preliminary documentation (PD), and preliminary documentation requirements were issued.

EMM has prepared this preliminary documentation assessment to address the specific requirements provided by DoEE and incorporates all information used to prepare the original referral. This assessment will also be used to support an Environmental Impact Statement (EIS) currently being prepared by EMM for assessment by Environment, Planning and Sustainable Development Directorate under the ACT *Planning and Development Act 2007*.

## 1.2 Scope and purpose of this report

This preliminary documentation has been prepared to fulfil the requirements of the assessment approach and provide further information in relation to the following species and community:

- White box-yellow box-Blakely's red gum grassy woodland and derived native grassland ecological CEEC; and
- Superb Parrot (*Polytelis swainsonii*).

The preliminary documentation requirements provided by DoEE set out a number of requirements. Table 1.1 provides a summary of these requirements and where they have been addressed in this assessment.

**Table 1.1 Preliminary documentation requirements**

Requirements	Where addressed
The document must make reference to all relevant standards, policies and other guidance material published by the Department.	Section 1.3
Names, roles and qualifications (where relevant) of all persons involved in preparing the preliminary documentation must be provided.	This documentation has been prepared by Nathan Garvey and Cassandra Kottaras. Nathan is Associate Director at EMM Consulting and has over 15 years' experience in biodiversity assessment and approvals across south-eastern Australia. He has a Bachelor of Science and Graduate Diploma (Biological Science) and is a Certified Environmental Practitioner (CEnvP). Cass is an Ecologist at EMM Consulting. Cass has a Bachelor of Science.
<i>White box yellow box Blakely's red gum grassy woodland and derived native grassland</i>	
Further evidence required on:	
<ul style="list-style-type: none"> <li>• information on management of edge effects, including Asset Protection Zone (APZ) specifications;</li> <li>• areas of impact, APZs and 30 metre notional buffer mapped and tabulated; and</li> <li>• proposals to offset residual significant impacts.</li> </ul>	Section 4.1.2 – no APZs are required Section 4.1.2 Section 5
<i>Superb Parrot (Polytelis swainsonii)</i>	
Further evidence required on:	
<ul style="list-style-type: none"> <li>• proposals to offset residual significant impacts; and</li> <li>• clarify the number of hollow hearing trees to be removed from within the project's development footprint.</li> </ul>	Offsets not required as there is no residual significant impact – see Section 3.2 Section 3.2.4 (ii)
Occurrence of species and/or communities at the site following relevant survey standards. Survey methodology must be described and results appended to the preliminary documentation.	Section 3
Direct and indirect impacts of the proposed action must be considered, in relation to the specific needs and characteristics of relevant listed threatened species and communities.	
In particular:	
<ul style="list-style-type: none"> <li>• clearing (direct impact) associated with the development; and</li> <li>• edge effects (indirect impacts) on retained listed threatened ecological communities or species habitat arising from development activities, including but not necessarily limited to noise and light disturbance, weed invasion, spread of root rot fungus <i>Phytophthora cinnamomi</i>, altered fire regime and altered hydrology (in terms of quality and quantity).</li> </ul>	Section 4.1.1 Section 4.1.2
Avoidance and mitigation measures must be discussed in terms of their expected effectiveness and cost	Section 4.2
Significant residual impacts on any listed threatened species or community must be offset in accordance with the Department's EPBC Environmental Offsets Policy 2012 and offset assessment guide.	Section 5

**Table 1.1 Preliminary documentation requirements**

Requirements	Where addressed
<p>Must provide information about the expected economic and social impacts of the proposed action. This should, but not necessarily be limited to, the following:</p> <ul style="list-style-type: none"> <li>• consideration of both costs and benefits;</li> <li>• consideration of different scales of impact where relevant; and</li> <li>• specific dollar or other numerical values where relevant.</li> </ul>	Section 6
<p>Must provide details of any proceedings under a Commonwealth, state or territory law for the protection of the environment, or the conservation and sustainable use of natural resources, against the person proposing to take the action (or if the person is a corporation, its executive officers). Additionally details of the corporation’s environmental policy and planning framework must be provided.</p>	Section 6

This assessment report is restricted to addressing the preliminary documentation requirements.

### 1.3 Project description

The proposed action, which is the subject of this preliminary documentation assessment, involves the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 cubic metres (m<sup>3</sup>) of quarried overburden and weathered rock material from Mugga Quarry.

The additional bund and emplacement areas will be located north and east of the quarry’s existing operations between the pit face and Mugga Lane (public road) and resides within an extractive industry lease area of 106.4 hectares (ha).

The site has a long history of supporting construction materials manufacturing and contains four Boral operations, namely an asphalt plant, a concrete batching plant, a recycling facility and the hard rock quarry that is associated with the proposed emplacement area.

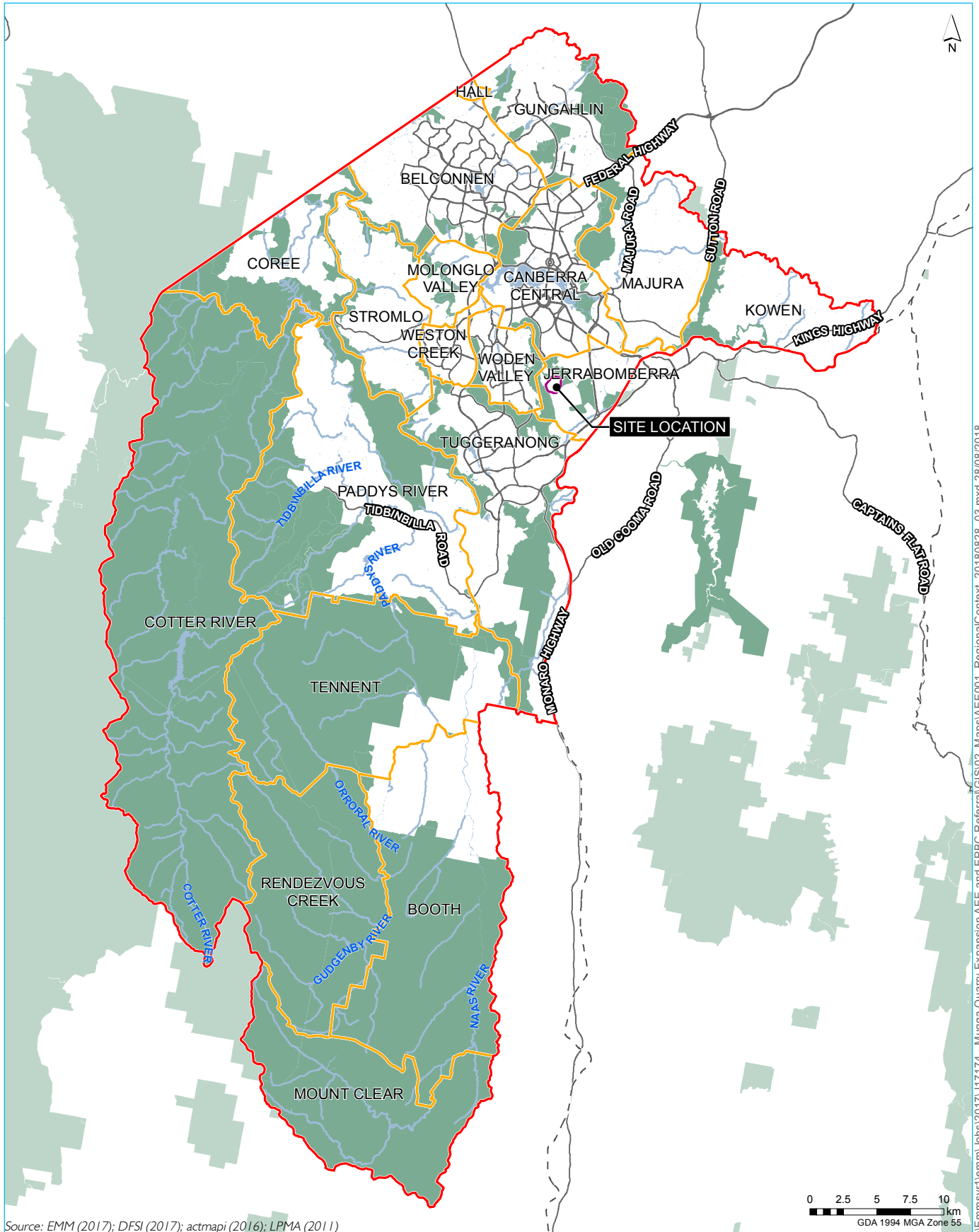
The additional emplacement area is proposed due to exploratory drilling within the approved extraction area identified weathered rock that is not suitable for making high quality concrete and asphalt aggregates. This material needs to be stockpiled to enable the continued extraction of higher quality rock underneath.

It is worth noting that while the overburden emplacement area has not changed since the referral documentation was prepared, the approved disturbance boundary has been reviewed and refined to align with Boral’s approved Mugga Quarry pit and bund footprint sourced from their March 1999 approved Mugga Quarry Preliminary Assessment – Lease Renewal Report. This revised approved pit and bund extent’ is shown in Figure 1.2. This has resulted in a reduction in the ‘Total disturbance area’ from 9.16 ha to 7.28 ha, a reduction of 1.88 ha. The ‘Total disturbance area’ is located north and east of the quarry’s existing operations between the pit face and Mugga Lane (public road), as shown in Figure 1.2.

It is noted that the proposed action **does not include the activities** which are already approved under *Boral Lease Conditions for Mugga Quarry*.

## 1.4 Assessment guidelines and standards

This preliminary documentation assessment has been prepared with reference to the relevant guidelines and standards outlined in Section 7 (References).



**KEY**

- Site location - 321 Mugga Lane, Symonston
- ACT boundary
- District boundary
- Railway
- Main road
- Watercourse
- Waterbody
- ACT reserve
- NPWS reserve

**Location of the Mugga Quarry**

Boral - Mugga Quarry overburden expansion  
Preliminary documentation (PD) report

Figure 1.1



**KEY**

- |   |                               |                |
|---|-------------------------------|----------------|
| Site location - 321 Mugga Lane, Symonston   | Asphalt plant                 | Local Road     |
| Total disturbance area                      | Concrete batching plant       | Block boundary |
| Approved pit extent                         | Quarry                        | ACT reserve    |
| Emplacement contours (Boral)                | Recycling facility            |                |
| Proposed eastern emplacement contours (EMM) | Electricity transmission line |                |
|   | Main road                     |                |

Location of the overburden emplacement area at the Mugga Quarry

Boral - Mugga Quarry overburden expansion Preliminary documentation (PD) report

Figure 1.2



\\emmsvr1\emms\jobs\2017\171774 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02\_Maps\EPBC005\_CurrentSite\_20180828\_07.mxd 28/08/2018

## 2 Consultation

This chapter of the preliminary documentation assessment provides an overview of the stakeholder engagement undertaken by EMM in relation to the project. The objectives for stakeholder consultation include:

- to inform stakeholders about the project;
- to identify and address any potential issues (where required) prior to submitting the referral;
- to address any stakeholder concerns and discuss how these concerns have been considered during the assessment process; and
- to gain valuable feedback on the actions direct and indirect impacts and the proposed management measures and offsetting to improve the projects operations and performance.

### 2.1 Preliminary consultation

Key stakeholders consulted on the project to date include:

- ACT Environment, Planning and Sustainable Development Directorate (EPSDD);
- The ACT Conservator; and
- Commonwealth Department of Environment and Energy (DoEE).

### 2.2 Consultation with government

On 21 May 2018, in separate meetings, EMM and Boral consulted with representatives from the EPSDD and the DoEE in relation to the project. The purpose of the preliminary consultation was to:

- provide an overview of the project to establish a new permanent bund and temporary stockpile area to store quarried overburden and weathered work material up to 620,000 m<sup>3</sup>;
- discuss the proposed ecology assessment approach to meeting DoEEs PD requirements;
- discuss the proposed mechanism for fulfilling and delivering the offset;
- providing an update on the cultural heritage assessment and proposed submission of a Statement of Heritage Effect application to ACT Heritage Council for approval under s61H of the *Heritage Act 2004*; and
- discuss the impact assessment pathway for the project given DoEEs controlled action determination.

The following key outcomes were noted during the preliminary consultation:

- EPSDD advised that the project would be assessed via Impact Assessment Pathway (ie EIS) and Boral to prepare an EIS scoping document;
- the EIS could use the PD assessment (this report) to support the EIS; and

- DoEE will consider offsets determined in accordance with the ACT Environmental Offsets Policy (ACT Government 2015a) in determining the impacts and offset requirements for the proposed action.

Further consultation has been undertaken with both DoEE and the ACT Conservator on 14 August 2018 in relation to the offsets for the proposed action. DoEE and the Conservator have indicated they will consider offset sites in NSW that satisfy the requirements of the EPBC Act Offsets Policy.

## 3 Identification of matters of national environmental significance

### 3.1 White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland

#### 3.1.1 Description and characteristics of the ecological community

The Commonwealth Listing Advice on Box Gum Woodland (TSSC 2006) provides a general description of the community and describes its current status. Box Gum Woodland occurs on the western slopes and tablelands of the Great Dividing Range, from southern Queensland, through New South Wales (NSW) and central Victoria. Much of the community's original distribution has been cleared for agriculture, and remaining areas are subject to grazing and pasture improvement impacts. Consequently, remaining patches of the community have a disturbed understorey with mature trees, or occur as areas with a highly diverse understorey, sometimes without a canopy (ie derived native grasslands) (TSSC 2006).

The ACT, in which the project is located, contains the largest remaining remnants of the community that are in good condition and are connected. This is likely reflective of the significantly lower levels of stock grazing than occurs across the remaining distribution of the community, given the system of lease-hold title in the ACT. The community is estimated to be 66% cleared in the ACT, compared with 94% in NSW and Victoria, and 67% in Queensland (TSSC 2006).

The community is characterised by the dominance (or prior dominance) of White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and/or Blakely's Red Gum (*E. blakelyi*) trees. White Box does not typically occur in the Canberra region, and therefore stands of the community are dominated by Yellow Box or Blakely's Red Gum. Tree cover in the community is generally discontinuous, consisting of widely-spaced trees of moderate height. In optimum condition, the community contains a sparse shrub layer and a diverse understorey of native grasses and forbs (TSSC 2006). In order for an area to be included in the listed ecological community, a patch must have a predominantly native understorey (TSSC 2006).

#### 3.1.2 Conservation status and advice

##### i National legal status

The White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community is listed as critically endangered under the EPBC Act and endangered under the *Nature Conservation Act 2014*.

##### ii Threatening process

Key threatening processes to the ecological community are defined under the EPBC Act (DECCW 2010) as:

- historical and on-going threats;
- land clearing;
- land use for agricultural and horticultural development, rural residential, urban development and mining;
- grazing regimes and pasture management;

- firewood collection and tidying up;
- changed fire regimes;
- increased soil nutrients and use of chemicals;
- mowing or slashing regimes;
- weed invasion;
- climate change;
- soil acidification;
- introduced pests;
- disease; and
- collection/removal of native flora.

### iii National recovery plan

The main objective of the National Recover Plan for White Box – Yellow Box – Blakeley’s Red Gum Grassy Woodland and Derived Native Grassland (DECCW 2010) is to promote the recovery and minimise the risk of extinction of the critically endangered ecological community. The priority protection and restoration actions include (DECCW 2010):

- achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- increasing protection of sites in good condition;
- increasing landscape function of the ecological community through management and restoration of the degraded sites;
- increasing transitional areas around the remnants and linkages between remnants; and
- bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

The recovery plan states that the community can occur either as a woodland or derived native grassland, including a dominance or prior dominance of White Box and/or Yellow Box and/or Blakely’s Red Gum. It also states to be considered part of the listed community, remnants must also:

- have predominantly native understorey (ie more than 50% of the perennial ground layer must comprise native species); and
- be 0.1 ha or greater in size and contain 12 or more native understorey species (excluding grasses), including one or more identified important species; or
- be 2 ha or greater in size and have either natural regeneration of the overstorey species or an average of 20 or more mature trees per ha.

The recovery plan states that it is difficult to define habitat critical to the survival of the community as it occurs over such a wide distribution where it has been cleared, fragmented and degraded to the point where its medium and long-term survival is threatened. The recovery plan states that in very broad terms, habitat critical to the survival of the listed community is that which occurs on the moderate to highly fertile soils of the western slopes of NSW and Queensland, northern slopes of Victoria, and the tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT. It also states that given the highly fragmented and degraded state of the community, all patches that meet the minimum condition criteria described above should be considered critical to the survival of the community. The recovery plan also states that further work to assist recovery of the ecological community is required to identify those areas important to the conservation and maintenance of landscape connectivity.

### 3.1.3 Survey methodology

Initial field surveys were conducted by Alison Rowell on 2, 3, 7 and 8 November 2017. The winter and early spring had been dry and the site was heavily grazed by kangaroos and rabbits, but by early November there had been sufficient plant growth for vegetation survey. The site was traversed, and vegetation communities were mapped in accordance with the ACT list. A list of species present was made for each vegetation type (Rowells 2017). Recorded vegetation types were stratified into vegetation zones based on condition. Low condition vegetation was recorded separately from moderate to good condition vegetation, and the zones were mapped using a GPS and aerial photographs. Vegetation zones were assessed against the minimum threshold criteria for the Commonwealth and ACT listed communities Box Gum Woodland and Yellow Box/Red Gum Grassy Woodland. Vegetation condition was assessed using the method outlined in the ACT Environmental Offsets Calculator Assessment Methodology (ACT Government 2015a). This includes assessment of site value by measuring condition attributes in a 20 x 20 metre quadrant and 50 metre transect. Two plot/transects were completed within the study area (see Table 3.7).

On 9 July 2018, Capital Ecology completed additional field surveys. The purpose of these additional field surveys was to collect additional data to address preliminary documentation and offsetting requirements. Additional vegetation mapping was undertaken to map areas up to 50 m outside the disturbance area, and to verify and revise previous vegetation mapping where necessary. Additional plots/transects were undertaken in accordance with the ACT Environmental Offsets Calculator Assessment Methodology (ACT Government 2015a) to ensure the minimum number of plots/transects were completed for each vegetation zone, with four additional plot/transects completed (see Table 3.7).

**Table 3.1 Plots/transects completed in each vegetation zone (see Figure 3.1)**

Vegetation zone	Plots/transects completed (Rowell 2017)	Plots/transects completed (Capital Ecology 2018)	Total number of plots/transects
Yellow Box - Red Gum Grassy Woodland (very low condition)	0	1 (CE3)	1
Yellow Box - Red Gum Grassy Woodland (low condition)	1 (AR2)	1 (CE1)	2
Yellow Box - Red Gum Grassy Woodland (moderate condition)	1 (AR1)	1 (CE2)	2
Red Stringybark Tableland Grass/Shrub Forest	0	1 (CE4)	1

Notes: 1. Type any additional notes or Sources.  
2. Or simply delete these lines of text if not required.

### 3.1.4 Survey results

#### i Description of vegetation at the Mugga Quarry

Vegetation mapped within the study area comprises a combination of Yellow Box - Red Gum Grassy Woodland and Red Stringybark (*Eucalyptus macrorhyncha*) Tableland Grass/Shrub Forest.

Throughout the study area, vegetation was found to be in moderate to poor condition, with various degrees of vegetation clearing and disturbance, mostly associated with the former layout of fences and heavy grazing from Kangaroos (*Macropus giganteus*) and Rabbits (*Oryctolagus cuniculus*). Some older trees supporting hollows are present, with remaining trees generally less than 50 years old. Regeneration of trees includes young saplings, with regeneration appearing to be recent. Exotic species including Ryegrass, Phalaris and Subterranean Clover occurred across the site, reflecting previous pasture improvement and stock grazing.

Although there were many native species present in parts of the understorey, there were few grazing-sensitive species (few lilies and daisies, no native orchids or legumes etc). No threatened plant species were found, and their absence in the survey and the condition of the vegetation suggested that none are likely to be present on the site. Native shrubs were also rare, and most of the mid-storey native species were in two fenced plantations.

#### ii Vegetation mapping

Two vegetation communities have been mapped within the study area:

- Yellow Box - Red Gum Grassy Woodland; and
- Red Stringybark Tableland Grass/Shrub Forest.


Vegetation communities were stratified into vegetation zones based on broad condition state. This stratification resulted in four vegetation zones being identified across the study area

**Table 3.2** Vegetation communities and vegetation zones in the study area

Vegetation community	Condition
Yellow Box - Red Gum Grassy Woodland	Very low
Yellow Box - Red Gum Grassy Woodland	Low
Yellow Box - Red Gum Grassy Woodland	Moderate
Red Stringybark Tableland Grass/Shrub Forest	–

A description of each vegetation zone, including extent within the study area and impact area and alignment with Commonwealth and ACT listed communities Box Gum Woodland and Yellow Box/Red Gum Grassy Woodland is provided below.


**Table 3.3 Yellow Box - Red Gum Grassy Woodland (very low)**

<b>Vegetation community</b>	Yellow Box - Red Gum Grassy Woodland
<b>Condition</b>	Very low
<b>Extent in the study area</b>	3.71 ha
<b>Extent in the disturbance area</b>	1.25 ha
<b>Description</b>	<p>The overstorey consists of scattered Yellow Box (<i>E.melliodora</i>). No midstorey is evident. The understorey is predominantly exotic and showed evidence of previous pasture improvement and possibly ploughing. Native groundcover includes grasses such as Purple Wiregrass (<i>Aristida ramosa</i>), <i>Austrostipa bigeniculata</i>, Speargrass (<i>Austrostipa scabra</i>), Red Grass (<i>Bothriochloa macra</i>), Weeping Grass (<i>Microlaena stipoides</i>), Hairy Panic (<i>Panicum effusum</i>) and Wallaby Grass (<i>Rytidosperma</i> sp.), as well as forbs including <i>Carex inversa</i>, Spurgewort (<i>Chamaesyce drummondii</i>), Blushing Bindweed (<i>Convolvulus erubescens</i>), Native Geranium (<i>Geranium solanderi</i>) and Swamp Dock (<i>Rumex brownii</i>).</p> <p>Exotic species dominate the groundcover and include Sheep Sorrel (<i>Acetosella vulgaris</i>), Hairgrass (<i>Aira</i> sp.), Quaking Grass (<i>Briza maxima</i>), Soft Brome (<i>Bromus hordeaceus</i>), Common Centaury (<i>Centaureum erythraea</i>), Paterson's Curse (<i>Echium plantagineum</i>), Vipers Bugloss (<i>Echium vulgare</i>), Goosegrass (<i>Galium aparine</i>), Barley Grass (<i>Hordeum</i> sp.), Wimmera Ryegrass (<i>Lolium rigidum</i>), Serrated Tussock (<i>Nassella trichotoma</i>), Phalaris (<i>Phalaris aquatic</i>), Plantain (<i>Plantago lanceolata</i>), Narrow-leaved Clover (<i>Trifolium angustifolium</i>), Great Mullein (<i>Verbascum Thapsus</i>) and Fescue (<i>Vulpia</i> sp.).</p> <p>This vegetation zone is in very low condition. Few mature trees remain and there is no eucalypt regeneration occurring. The groundcover is predominantly exotic as a result of past land use practices.</p>
<b>TEC status<sup>1,2</sup></b>	<p>EPBC Act: not TEC</p> <p>Whilst Yellow Box and Blakely's Red Gum are the most common species in this vegetation zone, the vegetation zone does not have a predominantly native understorey, with 74% exotic cover and just 6% native groundcover recorded during the plots/transects.</p> <p>NC Act: not TEC</p> <p>The vegetation community in this vegetation zone is dominated by exotic species and is considered degraded beyond recovery.</p>
<b>Photo (plot CE3 – photo courtesy of Capital Ecology)</b>	

Notes: 1. EPBC Act status has been determined using condition thresholds outlined in DEH (2006).

2. NC Act status has been determined using key characteristics outlined in Section 3.4.2 of ACT Government 2004.


**Table 3.4 Yellow Box - Red Gum Grassy Woodland (low)**

<b>Vegetation community</b>	Yellow Box - Red Gum Grassy Woodland
<b>Condition</b>	Low
<b>Extent in the study area</b>	6.45 ha
<b>Extent in the disturbance area</b>	2.34 ha
<b>Description</b>	<p>The overstorey consists of scattered Yellow Box and Blakely's Red Gum (<i>E.blakelyi</i>). A sparse midstorey is present, consisting Silver Wattle (<i>Acacia dealbata</i>), <i>Cassinia quinquefaria</i> and Native Raspberry (<i>Rubus parvifolius</i>).</p> <p>Native groundcover includes grasses such as Purple Wiregrass, <i>Austrostipa bigeniculata</i>, Speargrass, Red Grass, Windmill Grass (<i>Chloris truncata</i>), Wheatgrass (<i>Elymus scaber</i>), Weeping Grass, Hairy Panic and Wallaby Grass, as well as forbs including <i>Acaena ovina</i>, <i>Cheilanthes sieberi</i>, Climbing Saltbush (<i>Einadia nutans</i>), <i>Carex inversa</i>, Spurgewort, Blushing Bindweed, Common Everlasting (<i>Chrysocephalum apiculatum</i>), Clusted Everlasting (<i>Chrysocephalum semipapposum</i>), Native Geranium, Forest Goodenia (<i>Goodenia hederacea</i>), Small St. John's Wort (<i>Hypericum gramineum</i>), <i>Oxalis perennans</i>, Swamp Dock and New Holland Daisy (<i>Vittadinia</i> spp.).</p> <p>Exotic species co-dominate the groundcover in some areas and include Hairgrass, Soft Brome, Common Centaury, Paterson's Curse, Serrated Tussock, <i>Oxalis</i> sp., Phalaris, Plantain, Haresfoot Clover (<i>Trifolium arvense</i>) and Twiggy Mullein (<i>Verbascum virgatum</i>).</p> <p>This vegetation zone is in low condition. Few mature trees remain, but some regeneration is evident. The groundcover contains a mix of native and exotic species</p>
<b>TEC status<sup>1,2</sup></b>	<p>EPBC Act: Yellow Box – Red Gum Grassy Woodland and Derived Grasslands CEEC</p> <p>Yellow Box and Blakely's Red Gum are the most common species in this vegetation zone. Whilst the understorey is mixed, in some areas it is predominantly native, and has a patch size of greater than 0.1 ha. There are more than 12 native understorey species present and important species are present.</p> <p>NC Act: Yellow Box–Red Gum Grassy Woodland EEC</p> <p>Yellow Box and Blakely's Red Gum contribute more than 40% of the crown cover A species rich native understorey is present.</p>
<b>Photo (plot CE1 – photo courtesy of Capital Ecology)</b>	

Notes: 1. EPBC Act status has been determined using condition thresholds outlined in DEH (2006).


2. NC Act status has been determined using key characteristics outlined in Section 3.4.2 of ACT Government 2004.

**Table 3.5 Yellow Box - Red Gum Grassy Woodland (moderate)**

<b>Vegetation community</b>	Yellow Box - Red Gum Grassy Woodland
<b>Condition</b>	Moderate
<b>Extent in the study area</b>	3.20 ha
<b>Extent in the disturbance area</b>	2.39 ha
<b>Description</b>	<p>The overstorey consists of scattered Yellow Box and Blakely's Red Gum. A sparse midstorey is present, consisting Silver Wattle, <i>Cassinia quinquefaria</i> and Native Raspberry.</p> <p>Native species dominate the groundcover, and include grasses such as Purple Wiregrass, <i>Auroloma bigeniculata</i>, Speargrass, Red Grass, Windmill Grass, Wheatgrass, Weeping Grass, Hairy Panic and Wallaby Grass, as well as forbs including <i>Acaena ovina</i>, <i>Cheilanthes sieberi</i>, Climbing Saltbush, <i>Carex inversa</i>, Spurge, Blushing Bindweed, Common Everlasting, Clusted Everlasting, Native Geranium, Forest Goodenia, Small St. John's Wort, <i>Oxalis perennans</i>, Swamp Dock and New Holland Daisy.</p> <p>Exotic species are less dominant in this vegetation zone and include species such as Hairgrass, Soft Brome, Common Centaury, Paterson's Curse, Serrated Tussock, <i>Oxalis</i> sp., Phalaris, Plantain, Haresfoot Clover, Twiggy Mullein.</p> <p>This vegetation zone is in moderate condition. A greater number of mature trees occur and regeneration is evident. The groundcover contains a mix of native and exotic species, but native species occur at higher cover and there is a higher species diversity.</p>
<b>TEC status<sup>1,2</sup></b>	<p>EPBC Act: Yellow Box – Red Gum Grassy Woodland and Derived Grasslands CEEC</p> <p>Yellow Box and Blakely's Red Gum are the most common species in this vegetation zone. The understorey is predominantly native, and has a patch size of greater than 0.1 ha. There are more than 12 native understorey species present and important species are present.</p> <p>NC Act: Yellow Box–Red Gum Grassy Woodland EEC</p> <p>Yellow Box and Blakely's Red Gum contribute more than 40% of the crown cover A species rich native understorey is present.</p>
<b>Photo (plot CE2 – photo courtesy of Capital Ecology)</b>	

Notes: 1. EPBC Act status has been determined using condition thresholds outlined in DEH (2006).  
2. NC Act status has been determined using key characteristics outlined in Section 3.4.2 of ACT Government 2004.

**Table 3.6 Red Stringybark Tableland Grass/Shrub Forest**

<b>Vegetation community</b>	Red Stringybark Tableland Grass/Shrub Forest
<b>Condition</b>	–
<b>Extent in the study area</b>	3.23 ha
<b>Extent in the disturbance area</b>	0.80 ha
<b>Description</b>	<p>The overstorey consists of a moderate cover of Inland Scribbly Gum (<i>E.rossii</i>) and Red Box (<i>E.polyanthemus</i>). A sparse midstorey is present, consisting of Cootamundra Wattle (<i>Acacia baileyana</i>), Silver Wattle, Hickory Wattle (<i>Acacia implexa</i>), <i>Cassinia quinquefaria</i> and Native Raspberry.</p> <p>There is a sparse cover of native species in the groundcover, and include grasses such as Purple Wiregrass and Wallaby Grass, as well as forbs including <i>Cheilanthes sieberi</i>, Clusted Everlasting, Climbing Saltbush, Forest Goodenia, Stinking Pennywort (<i>Hydrocotyle laxiflora</i>), Many-flowered Mat-rush (<i>Lomandra multiflora</i>), Cotton Fireweed (<i>Senecio quadridentatus</i>), Australian Bluebell (<i>Wahlenbergia stricta</i>) and Sticky Everlasting (<i>Xerochrysum viscosum</i>).</p> <p>Exotic species are sparse, with only St John’s Wort (<i>Hypericum perforatum</i>) recorded.</p> <p>This vegetation zone is in good condition. Mature trees are present and regeneration is evident. The groundcover is largely native with minimal cover of exotic species.</p>
<b>TEC status</b>	<p>EPBC Act: Not listed</p> <p>Does not align with any EPBC Act listed communities.</p> <p>NC Act: Not listed</p> <p>Does not align with any NC Act listed communities.</p>
<b>Photo (plot CE4 – photo courtesy of Capital Ecology)</b>	

Yellow Box - Red Gum Grassy Woodland in low and moderate condition was found to align with the Box Gum Woodland CEEC under the EPBC Act and Yellow Box–Red Gum Grassy Woodland EEC under the NC Act. Only these two vegetation zones require further assessment. Yellow Box - Red Gum Grassy Woodland in very low condition and Red Stringybark Tableland Grass/Shrub Forest are not considered further.

**iii Plot/transect results**

The data collected for each plot/transect is provided in Table 3.7 below. The locations of each plot/transect are shown in Figure 3.1.

**Table 3.7** Vegetation plot/transect data (see Figure 3.1)

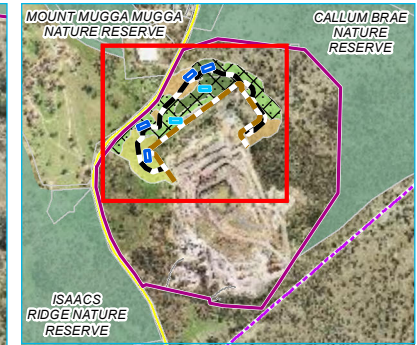
Parameter	Box Gum Woodland (low)		Box Gum Woodland (moderate)		Yellow Box - Red Gum Grassy Woodland (very low)	Red Stringybark Tableland Grass/Shrub Forest
	Plot/transect 2 (AR2)	Plot/transect 1 (CE1)	Plot/transect 1 (AR1)	Plot/transect 2 (CE2)	Plot/transect 3 (CE3)	Plot/transect 4 (CE4)
Native plant species richness in 20x20 m plot	16	6	22	7	2	10
Native overstorey (%) cover in 50 m transect	0	10	13	7	6	24
Native mid-storey (%) cover in 50 m transect	0	1.5	2	1.5	0	7.5
Native groundcover (grasses) in 50 m transect	23	56	20	50	6	14
Native groundcover (shrubs) in 50 m transect	0	0	14	0	0	0
Native groundcover (other) in 50 m transect	2	4	32	8	0	10
Exotic plant cover in 50 m transect	19	28	22	16	74	0
Number of large trees in 20x50 m plot	0	3	4	4	1	3
Overstorey regeneration in whole zone	E. blakelyi	E. melliodora E. blakelyi	E. melliodora E. blakelyi	E. melliodora E. blakelyi E. polyanthemos	E. melliodora	E. rossii E. polyanthemos
Total length of fallen logs in 20x50 m plot	2	18	49	22	15	20

Data for low condition was inputted into the calculator for the ACT Offset Policy (ACT Government 2015a) to determine site value scores.

**Table 3.8** Site value scores for Box Gum Woodland vegetation zones in the study area

<b>Vegetation zone</b>	<b>Site value score</b>
Yellow Box - Red Gum Grassy Woodland (low)	45
Yellow Box - Red Gum Grassy Woodland (moderate)	64

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- KEY**
- Site location - 321 Mugga Lane, Symonston
  - Total disturbance area
  - Approved pit extent
  - Block boundary
  - Electricity transmission line
  - Main road
  - ACT reserve
  - Plot location (Capital Ecology, 2018)
  - Plot location (Rowell, 2018)
  - White Box-Yellow Box-Blakely's Red Gum
  - Grassy Woodland and Derived Native Grassland (EPBC Act)
  - Box Gum Woodland (EPBC Act)
  - Cleared area
  - Native vegetation**
  - Grass/Shrub Forest
  - Yellow Box - Red Gum Grassy Woodland (low condition)
  - Yellow Box - Red Gum Grassy Woodland (very low condition)
  - Yellow Box - Red Gum Grassy Woodland (moderate condition)

Native vegetation & threatened ecological communities, including flora survey effort

Boral - Mugga Quarry overburden expansion  
Preliminary documentation (PD) report  
Figure 3.1



Source: EMM (2018); Boral (2018); Capital Ecology (2018); Rowell (2018); actmap (2016); LPI (2015)

0 100 200  
m  
GDA 1994 MGA Zone 55

## 3.2 Superb Parrot

### 3.2.1 Ecology and characteristics of the species

The Superb Parrot is a large bright green parrot with a narrow tail (OEH 2017). Males are identified by bright yellow foreheads and throats with a red crescent between the yellow and green. Females have slightly duller green bodies with a washed light blue face (OEH 2017).

The Commonwealth Conservation Advice for the Superb Parrot (TSSC 2016) describes the conservation status, distribution, biology/ecology and threats to the survival of the Superb Parrot. The Superb Parrot occurs west of the Great Dividing Range, in Canberra, Goulburn and west to Nyngan and Swan Hill. Three main breeding areas are recognised as:

- an area of the south-west slopes bounded by Molong, Rye Park, Yass, Coolac, Cootamundra and Young (NSW);
- along the Murrumbidgee River, between Wagga Wagga and Toganmain Station, and farther north at Goolgowi (NSW); and
- along the Murray and Edward Rivers, from east of Barmah and Millewa State Forest to south of Taylors Bridge (NSW and Victoria).

The species is known to breed in the Canberra region, in urban areas where large trees have been retained. This has been the subject of large amounts of study in recent years (Rayner et al. 2015).

### 3.2.2 Conservation status and advice

#### i National legal status

The Superb Parrot is listed as vulnerable under the EPBC Act and NC Act.

#### ii Threatening process

The Superb Parrot has a number of key threatening processes impacting on their biology and ecology (DoEE 2018) including:

- habitat clearing and degradation;
- grazing;
- hydrological changes;
- competition for nest sites;
- poisoning; and
- beak and feather disease.

#### iii National recovery plan

The National Recovery Plan for the Superb Parrot (Baker-Gabb 2011) defines habitat critical to the survival of the Superb Parrot as breeding habitat that comprises riverine forests in the Riverina and Box-Gum

Woodlands on the tablelands and slopes. Tree species typically selected for nesting on the slopes and tablelands comprise River Red Gum (*E. camaldulensis*), Blakely's Red Gum, Apple Box (*E. bridgesiana*), Grey Box (*E. microcarpa*), White Box and Red Box. Of the species described above, Blakely's Red Gum and Apple Box occur in the project area and surrounds. The species has been observed in small numbers in Callum Brae Nature Reserve (north of the project area) in 2016 and 2017, and in Garran and Red Hill to the north from 2015 to 2017 (eBird, Canberra Nature Map).

These nature reserves form part of the 2,325 ha woodland complex in the Callum Brae-Jerrabomberra Valley complex, which is one of the largest areas of contiguous woodland in the ACT region (ACT Government 2004), to which vegetation in the Mugga area (including the project area) forms a major discontinuity.

Foraging habitat critical to the survival of the species is defined by the recovery plan (Baker-Gabb 2011) as Boree Woodlands between the Murrumbidgee and Murray Rivers, River Red Gum Forest, Box-Pine Woodland and White Cypress Pine Woodland. These vegetation types do not occur in the project area, and therefore it does not comprise foraging habitat critical to the survival of the community.

### 3.2.3 Survey methodology

Initial field surveys were undertaken between 2 and 8 November 2017 by Alison Rowell. These surveys included three x 2 ha/20 minute bird surveys, as well as some mapping of hollow-bearing trees. An incidental bird list was also kept.

Additional field surveys were undertaken by Capital Ecology on 9 and 16 July 2018 to identify potential Superb Parrot breeding habitat. Comprehensive surveys were undertaken to identify and record all hollow-bearing trees within the study area. The following attributes were recorded for each tree:

- tree number (a unique identifying number allocated to the tree);
- species name;
- alive or dead;
- diameter at breast height (DBH) of the tree using a DBH tape;
- approximate height (m) of the tree measured with a clinometers;
- approximate height of hollow (m from ground); and
- approximate entrance diameter of hollow (to nearest 5 cm increment).

Survey effort is presented in Figure 3.2.

### 3.2.4 Survey results

#### i Bird surveys

The Superb Parrot was not recorded on site during field surveys.

ii Hollow-bearing tree surveys

The study area and surrounding land supports a large number of old woodland eucalypts, of which a substantial portion contains hollows characteristically suitable for the Superb Parrot (Rayner et al. 2015). Sixty-three hollow bearing trees were recorded within the study area, with 19 recorded within the direct impact area. The locations of these trees are presented Figure 3.2, with data presented in Table 3.9.

**Table 3.9** Hollow-bearing tree data (bold data indicates suitability for nesting by the Superb Parrot)

Tree Number	Species	Tree			Hollow Characteristics		
		Alive/ Dead	DBH (cm)	Height (m)	Height (m) + Entrance Diameter (cm)		
1	<i>E. melliodora</i>	Alive	<b>129</b>	20	8m, 15cm	9m, 10cm	5m, 30cm
2	<i>E. melliodora</i>	Alive	<b>92</b>	15	6m, 10cm		
3	<i>E. melliodora</i>	Dead	<b>86</b>	5	4m, 40cm		
4	<i>E. melliodora</i>	Alive	<b>92</b>	20	6m, 20cm		
5	<i>E. melliodora</i>	Dead	<b>86</b>	8	5m, 5cm		
6	<i>E. melliodora</i>	Dead	70	20	9m, 10cm	7m, 10cm	
7	<i>E. melliodora</i>	Alive	75	20	1m, 15cm	6m, 10cm	
8	<i>E. blakelyi</i>	Alive	100	15	5m, 10cm		
9	<i>E. blakelyi</i>	Alive	77	15	6m, 15cm		
10	<i>E. blakelyi</i>	Alive	99	22	9m, 10cm		
11	<i>E. blakelyi</i>	Alive	96	20	8m, 15cm	6m, 10cm	
12	<i>E. blakelyi</i>	Alive	98	8	4m, 20cm		
13	<i>E. rossii</i>	Alive	78	12	5m, 10cm	5m, 10cm	
14	<i>E. blakelyi</i>	Alive	60	10	2m, 20cm		
15	<i>E. polyanthemos</i>	Alive	65	12	3m, 20cm	4m, 10cm	
16	<i>E. polyanthemos</i>	Alive	82	12	6m, 5cm		
17	<i>E. rossii</i>	Alive	55	10	4m, 25cm	6m, 10cm	
18	<i>E. rossii</i>	Alive	94	8	5m, 30cm	6m, 10cm	4m, 15cm
19	<i>E. rossii</i>	Alive	86	10	2m, 50cm	4m, 10cm	
20	<i>E. rossii</i>	Alive	69	9	3m, 15cm	4m, 15cm	4m, 30cm

**Table 3.9** Hollow-bearing tree data (**bold data indicates suitability for nesting by the Superb Parrot**)

Tree Number	Species	Tree			Hollow Characteristics		
		Alive/ Dead	DBH (cm)	Height (m)	Height (m) + Entrance Diameter (cm)		
21	<i>E. rossii</i>	Alive	104	10	5m, 30cm	6m, 20cm	5m, 20cm
22	<i>E. rossii</i>	Alive	84	9	4m, 25cm	4m, 20cm	5m, 30cm
23	<i>E. rossii</i>	Alive	70	8	4m, 10cm		
24	<i>E. rossii</i>	Alive	54	10	5m, 10cm		
25	<i>E. polyanthemos</i>	Alive	67	8	4m, 30cm	5m, 20cm	
26	<i>E. rossii</i>	Dead	60	8	4m, 40cm		
<b>27</b>	<i>E. blakelyi</i>	Alive	91	18	5m, 20cm	8m, 15cm	10m, 10cm
<b>28</b>	<i>E. rossii</i>	Alive	81	15	5m, 10cm	4m, 10cm	8m, 5cm
29	<i>E. rossii</i>	Alive	76	8	3m, 10cm		
30	<i>E. blakelyi</i>	Alive	67	10	3m, 10cm		
<b>31</b>	<i>E. rossii</i>	Alive	105	12	3m, 20cm	4m, 5cm	5m, 10cm
32	<i>E. rossii</i>	Alive	141	18	10m, 35cm		
<b>33</b>	<i>E. polyanthemos</i>	Alive	82	18	5m, 15cm	8m, 10cm	7m, 20cm
<b>34</b>	<i>E. rossii</i>	Alive	91	12	6m, 10cm		
35	<i>E. rossii</i>	Alive	82	15	2m, 10cm		
36	<i>E. rossii</i>	Alive	54	8	3m, 10cm		
37	<i>E. rossii</i>	Alive	51	8	2.5m, 10cm		
38	<i>E. rossii</i>	Alive	63	14	5m, 10cm	8m, 6cm	
39	<i>E. polyanthemos</i>	Alive	54	12	4m, 15cm	5m, 15cm	
40	<i>E. rossii</i>	Dead	72	12	6m, 25cm		
41	<i>E. rossii</i>	Alive	68	10	3m, 10cm		
42	<i>E. rossii</i>	Alive	70	12	3m, 12cm		
43	<i>E. rossii</i>	Dead	87	7	6m,	5m,	

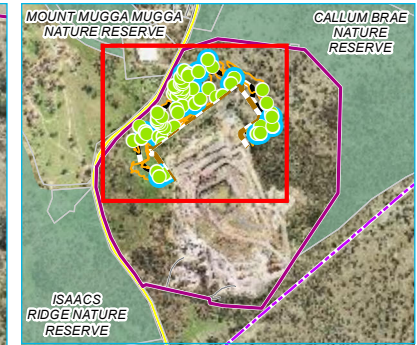
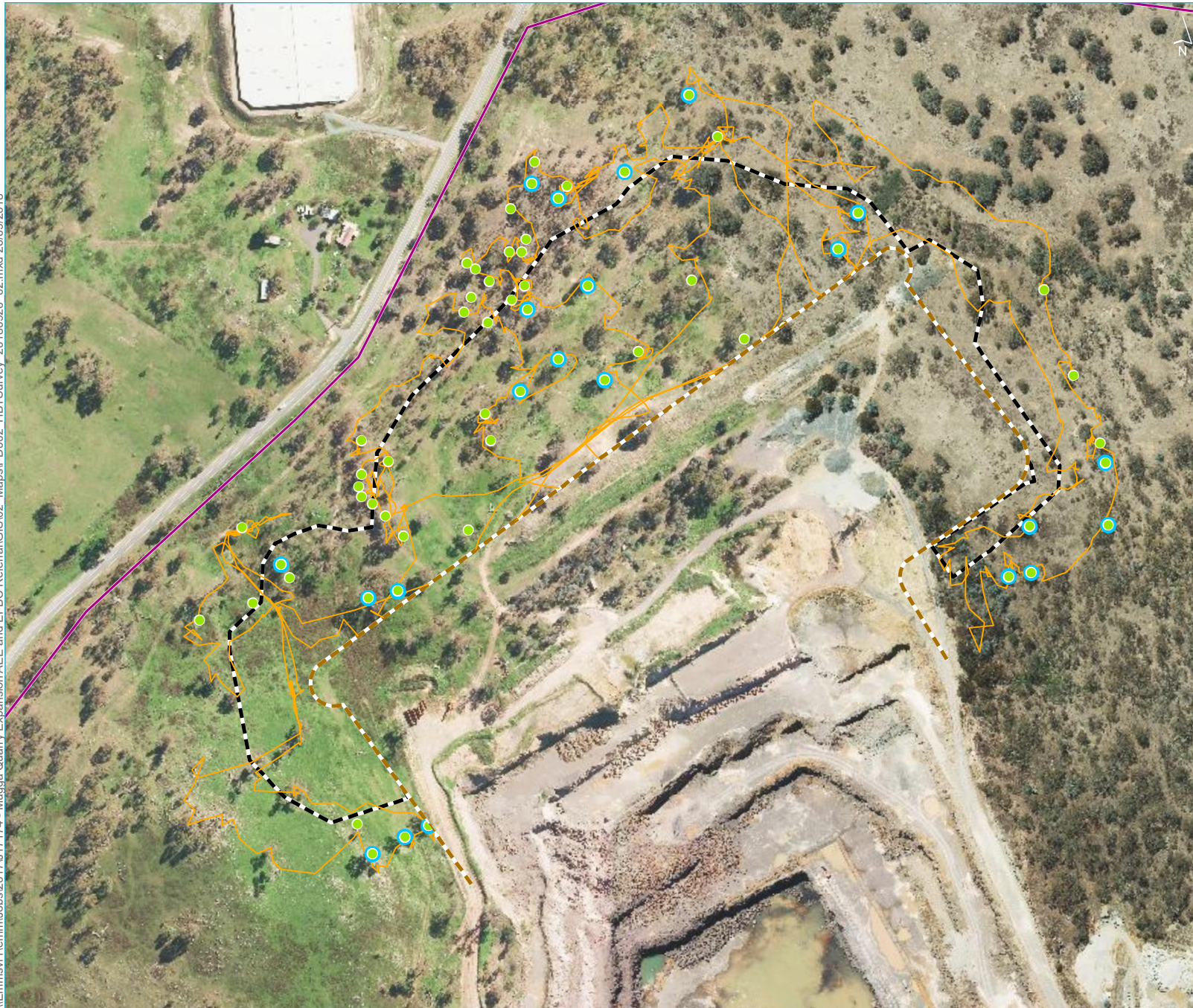
**Table 3.9** Hollow-bearing tree data (**bold data indicates suitability for nesting by the Superb Parrot**)

Tree Number	Species	Tree			Hollow Characteristics						
		Alive/ Dead	DBH (cm)	Height (m)	Height (m) + Entrance Diameter (cm)						
					30cm	26cm					
<b>44</b>	<i>E. rossii</i>	Alive	84	15	5m, 12cm	6m, 10cm	5m, 5cm	4m, 10cm	8m, 10cm	3m, 12cm	
45	<i>E. rossii</i>	Alive	116	12	4m, 30cm	5m, 25cm	6m, 10cm	6m, 10cm			
46	<i>E. rossii</i>	Alive	102	15	6m, 15cm						
<b>47</b>	<i>E. rossii</i>	Alive	52	15	5m, 10cm						
<b>48</b>	<i>E. blakelyi</i>	Alive	113	20	8m, 10cm	8m, 5cm	5m, 30cm	8m, 5cm			
49	<i>E. blakelyi</i>	Dead	61	12	5m, 10cm	6m, 15cm					
50	<i>E. blakelyi</i>	Alive	52, 40	10	3m, 5cm						
51	<i>E. blakelyi</i>	Alive	103	12	4m, 10cm	4m, 15cm					
52	<i>E. blakelyi</i>	Alive	101	20	15m, 15cm						
<b>53</b>	<i>E. blakelyi</i>	Alive	92	18	4m, 10cm	5m, 10cm	6m, 30cm	10m, 10cm			
<b>54</b>	<i>E. melliodora</i>	Alive	99	15	4m, 10cm	8m, 15cm	6m, 10cm	5m, 10cm	6m, 5cm		
<b>55</b>	<i>E. polyanthemos</i>	Alive	92	20	6m, 10cm	5m, 10cm					
<b>56</b>	<i>E. melliodora</i>	Alive	104	20	6m, 10cm	7m, 5cm	7m, 5cm				
<b>57</b>	<i>E. rossii</i>	Alive	140	20	8m, 40cm	6m, 10cm	7m, 40cm				
<b>58</b>	<i>E. rossii</i>	Alive	89	20	4m, 10cm	6m, 10cm					
<b>59</b>	<i>E. rossii</i>	Alive	89,75	20	5m, 10cm	5m, 15cm					
60	<i>E. rossii</i>	Alive	71	18	5m, 10cm						
<b>61</b>	<i>E. blakelyi</i>	Alive	172	22	7m, 15cm	6m, 10cm	6m, 20cm				
62	<i>E. blakelyi</i>	Alive	64	16	5m, 10cm						
63	<i>E. rossii</i>	Alive	135	15	3m, 20cm	4m, 10cm					

Characteristics of hollow-bearing trees used by the Superb Parrot in Northern Canberra (Rayner et al. 2015) were used as a guide to determine the suitability of hollow-bearing trees for breeding by the Superb Parrot within the study area. Based on these characteristics, 23 of the hollow-bearing trees

mapped within the study area have the characteristics of trees used by the Superb Parrot for nesting in northern Canberra, with just 10 of these located within the direct impact area.

It is important to recognise that the Superb Parrot is not known to nest south of the Molongolo River in the ACT, nor does it regularly visit sites in the Jerrabomberra Valley to forage. Consultation with the ACT Conservator indicates that the species is unlikely to breed in this part of the ACT (Michael Mulvaney, pers. comm. 2018.).



- KEY**
- Site location - 321 Mugga Lane, Symonston
  - Hollow-bearing tree location (Capital Ecology, 2018)
  - Superb Parrot habitat tree (Capital Ecology, 2018)
  - Survey transect
  - Electricity transmission line (refer to inset)
  - Approved pit extent
  - Total disturbance area

Hollow-bearing tree locations and survey effort

Boral - Mugga Quarry overburden expansion  
Preliminary documentation (PD) report  
Figure 3.2



## 4 Assessment of impacts

### 4.1 Impact assessment

#### 4.1.1 Direct impacts

The primary direct impact of the proposed action is clearing of vegetation for the purposes of the overburden emplacement area. This includes the removal of hollow-bearing trees.

#### 4.1.2 Indirect impacts

The proposed action has the potential for indirect impacts on retained vegetation and, therefore, habitats within the area of works and adjacent to the disturbance boundaries, including:

- increased noise and dust levels;
- changes in hydrology;
- weed invasion;
- spread of root rot fungus; and
- altered fire regime.

Potential indirect impacts are summarised below, with measures to minimise and mitigate indirect impacts outlined in Section 4.2.

##### i Increased noise and dust levels

Without management, the proposed action could result in increased noise and dust levels. A noise and air quality study has been completed for the proposed action. This assessment makes recommendations to minimise noise and dust impacts; this will reduce impacts to retained vegetation and fauna habitat. These measures will be included in revised versions of Boral's existing noise management and air quality management plans for the site.

It is important to note that total production will not be increasing, and there will not be any change to current operating hours, external traffic movements, groundwater management or employment. Boral has existing noise and dust control requirements which must be met.

Provided these recommendations are implemented, noise and dust impacts to biodiversity values of the site are expected to be minimal.

##### ii Changed hydrology

Hydrology, particularly surface water, has been assessed in the Mugga Quarry Overburden Expansion Project – Surface Water Assessment (EMM 2018b). This assessment looked at surface water impact arising from the proposed action, and provides a concept design for stormwater collection and treatment via sedimentation dams.

The sedimentation dams will be designed and operated in accordance with the guideline titled Environment Protection Guidelines for Construction and Land Development in ACT (EPA 2011), which recommends the following design and management practices:

- the basins will be sized to capture the initial 150 m<sup>3</sup> of runoff per ha of disturbance area. This is equivalent to 15 millimetres (mm) of runoff. Accounting for soil losses, approximately 30 to 50mm of rainfall is expected to be required to produce 15mm of runoff; and.
- following rainfall, the basins will be dewatered to 20% capacity to provide capacity to capture the next runoff event.

All basins are contained within the impact footprint, and have been assessed as a direct impact.

As the sedimentation basins will capture the initial 15 mm of runoff from each rainfall event it is expected that the frequency of stream flows in the immediate receiving waters will reduce. The magnitude of this change will progressively diminish in downstream sections of waterways as the contributing catchment area increases.

The proposed sedimentation dams will be designed, constructed and operated in accordance the relevant best practice guidelines and are expected to provide effective sedimentation treatment.

Boral will continue to implement a surface water monitoring program. If monitoring identifies that the sedimentation dams are not providing effective treatment during overflow conditions, the following additional measures can be implemented to reduce water quality risks:

- gypsum (or chemical flocculants such as alum) can be applied to the basin water bodies to improve sedimentation rates; and
- water from the dams can be dewatered to the open pit where it will be temporarily stored and used for process water make.

As a result, impacts to adjacent biodiversity values are predicted to be minimal.

As total production will not be increasing, no changes to groundwater regimes will result from the proposed action.

### iii Weed invasion

There is potential for increased weed invasion into retained vegetation adjacent to the overburden emplacement area. Potential for a reduction in the condition of retained vegetation has been accounted for in the assessment of the residual impact arising from the project, with reductions in groundcover scores and exotic cover scores assumed.

### iv Spread of root rot fungus

The proposed works are not expected to contribute any additional foot or vehicle movement. There it is highly unlikely this project will increase the possibility of the introduction of root rot fungus (*Phytophthora cinnamomi*) into the area.

#### v Altered fire regime

No asset protection zones (APZs) are required around the overburden emplacement area. Altered fire regimes will not be of concern in respect to the proposed action.

## 4.2 Measures to avoid and minimise impacts

In the design of the proposed action a variety of measures have been considered to try and avoid, minimise and mitigate impacts. These measures are summarised below.

The following alternatives were considered for the emplacement of overburden and weathered rock:

- emplacement within the Mugga 1 pit – Boral is already planning to emplace approximately 270,000 m<sup>3</sup> of overburden and weathered rock within the pit, for possible processing or relocation. Total overburden material in-pit emplacement is not considered viable as it would begin to sterilise approved resource and shorten the lifespan of the quarry;
- emplacement within the disused Mugga 2 quarry pit – inquiries are being made with the ACT Government to determine whether this is a possibility and whether it would be commercially viable. However, based on haulage costs, even without a tipping fee, it is not attractive from a commercial perspective. Emplacement within the Mugga 2 pit would also negate later re-use and blending of the weathered rock material;
- emplacement at another Boral quarry – the closest Boral Quarry is at Hall Quarry at Jeir NSW, approximately 55 km to the north. Hall Quarry does not have development approval to receive overburden from external sites, and the cost involved in trucking material over such a long distance is not commercially viable. It would also negate later re-use and blending of the weathered rock material; and
- emplacement out of pit on adjoining quarry land – this has been considered the most viable solution from a commercial perspective, given it's the shortest haulage distance. It also means the weathered rock material can be later blended and re-used, instead of simply being applied to land. The vegetation surveys, topography and stormwater capture requirements have further refined the design of the emplacement to minimise its environmental footprint.

To determine the final overburden emplacement the design process investigated different on-site layouts which combined environmental impacts and Boral's project objectives as outlined below. The original design proposed all overburden material placement outside the quarry pit on surface requiring up to 12.17 ha Box Gum Woodland to be removed. Given potential ecological impacts, and following discussions with DoEE prior to the referral of the proposed action, the following measures to reduce impacts were considered:

- ecological assessment of significance;
- final Mugga Quarry pit extent;
- topography and site contours;
- surface water sedimentation dam locations;
- original overburden design contours; and

- proposed alternative overburden area.

The outcome of the above is the alternative overburden placement design that includes both in-pit and out-of-pit emplacement. This design was used in the referral of the proposed action.

Further redesign of the overburden emplacement area has been considered following declaration of the proposed action as a controlled action. However, the revised design is constrained by topography, and would not support the required volume of overburden material. The final design minimises environmental impacts as far as practicable while maintaining constructability and the capacity to meet Boral's operational efficiencies required for the project.

Mugga Quarry operates under an environmental management plan (EMP) – the EMP details the performance criteria (where relevant), mitigation and management and environmental performance monitoring. A summary of the management measures include:

- air quality management;
- operational noise management;
- product transportation;
- surface water management;
- hydrocarbon/spill management;
- biodiversity management;
- visual amenity management;
- heritage management;
- waste management and product handling; and
- contaminated land management.

Boral's EMP will be updated to include the proposed action, including management of retained vegetation. The following measures will be added to Boral's EMP, and implemented during the project to further minimise biodiversity impacts:

- annual inspection of retained vegetation, with any weed infestations identified;
- treatment of any identified weed infestations using qualified bush regeneration contractors;
- the loss of hollow bearing trees will be minimised where possible;
- trees will be felled outside the spring woodland bird breeding season;
- the trunks and large branches from trees felled will be placed amongst the remaining woodland on the lease area; and
- a program of native tree and shrub planting will be undertaken to screen or cover the dumped material and that the scale of planting more than matches the loss of saplings and shrubs.

### 4.3 Residual impacts

Residual impacts, following consideration of all measures to avoid, minimise and mitigate impacts, have been calculated based on the design shown in Figure 4.1. The proposed action will include clearing of 4.19 ha of Box Gum Woodland and 10 hollow-bearing trees, suitable for nesting for the Superb Parrot. Direct impacts are outlined in Table 4.1.

**Table 4.1** Directs impacts (vegetation clearing) arising from the proposed action

<b>Vegetation zone</b>	<b>Clearing (ha)</b>
Yellow Box - Red Gum Grassy Woodland (low)	1.97
Yellow Box - Red Gum Grassy Woodland (moderate)	2.22
<b>TOTAL</b>	<b>4.19</b>

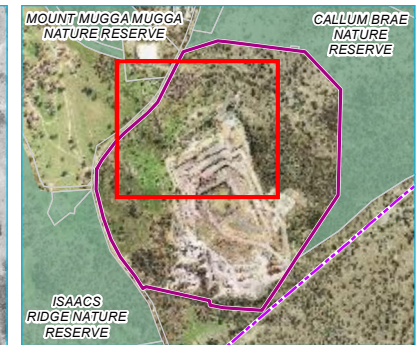
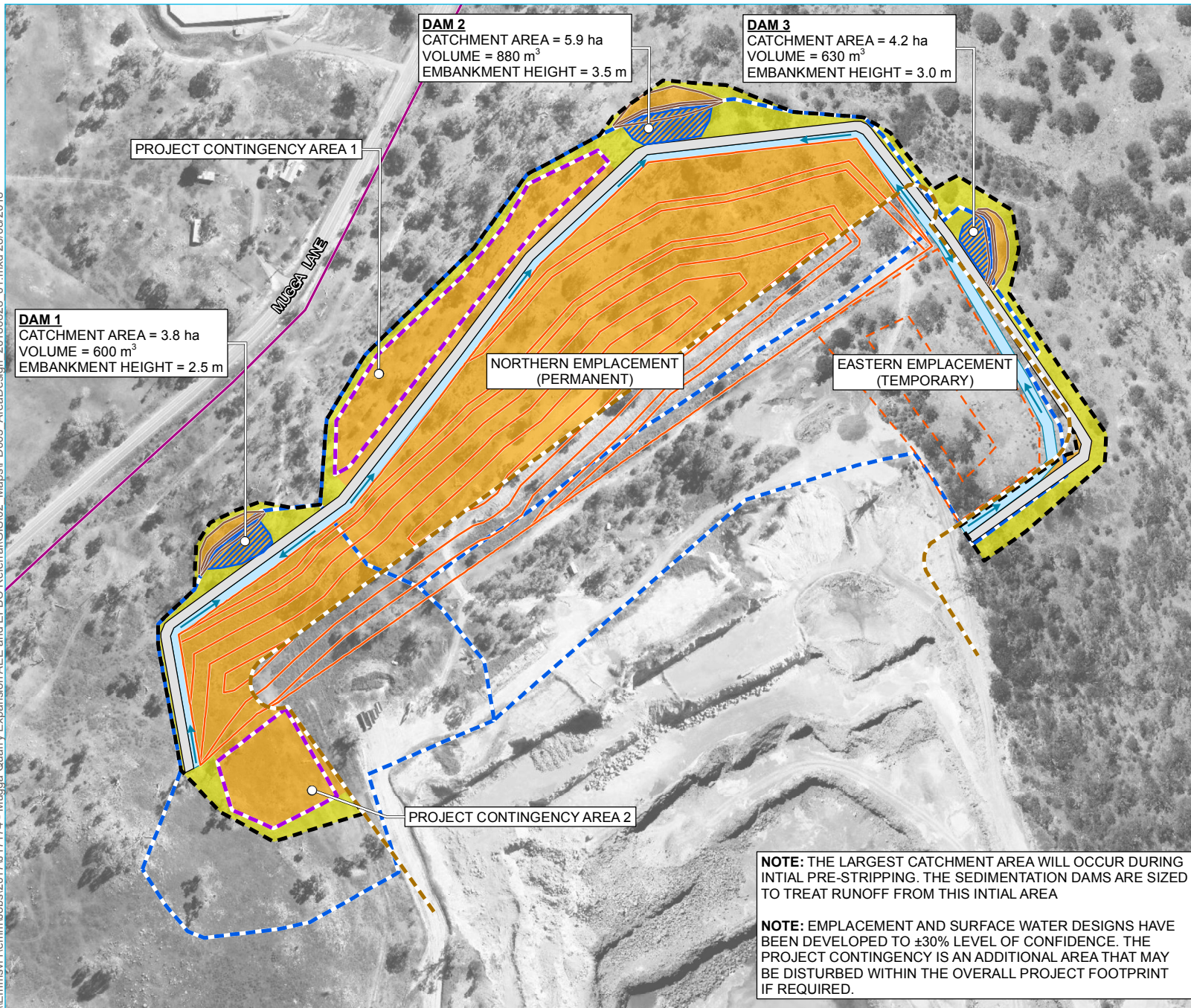
Indirect impacts have been calculated based on a buffer of between 5 – 30 m from the edge of the direct impact footprint. Indirect impacts will occur to a further 0.54 ha of Box Gum Woodland, and are summarised in Table 4.2.

**Table 4.2** Indirect impacts arising from the proposed action

<b>Vegetation zone</b>	<b>Clearing (ha)</b>
Yellow Box - Red Gum Grassy Woodland (low)	0.37
Yellow Box - Red Gum Grassy Woodland (moderate)	0.17
<b>TOTAL</b>	<b>0.54</b>

Credit requirements based on these residual impacts are summarised in Section 5.1.

\\E:\msvr1\emmm\Jobs\2017\17174 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02 Maps\PD003 AreaDesign\_20180828\_01.mxd 28/08/2018



- KEY**
- Site location - 321 Mugga Lane, Symonston
  - Emplacement contours (Boral)
  - Proposed eastern emplacement contours (EMM)
  - Dam embankment
  - Approved pit extent
  - Total disturbance area
  - Project contingency area
  - Sedimentation dam catchment area
  - Sedimentation dam
  - Perimeter road (6 m width, including batters)
  - Toe drain (5 m width, including batters)
  - Impact areas
    - Direct impact
    - Indirect impact

Overburden emplacement area design and impact footprint

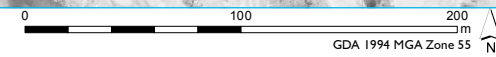
Boral - Mugga Quarry overburden expansion  
Preliminary documentation (PD) report  
Figure 4.1



**NOTE:** THE LARGEST CATCHMENT AREA WILL OCCUR DURING INITIAL PRE-STRIPPING. THE SEDIMENTATION DAMS ARE SIZED TO TREAT RUNOFF FROM THIS INITIAL AREA

**NOTE:** EMPLACEMENT AND SURFACE WATER DESIGNS HAVE BEEN DEVELOPED TO ±30% LEVEL OF CONFIDENCE. THE PROJECT CONTINGENCY IS AN ADDITIONAL AREA THAT MAY BE DISTURBED WITHIN THE OVERALL PROJECT FOOTPRINT IF REQUIRED.

Source: EMM (2018); Boral (2018); actmap1 (2016); LPI (2015)



GDA 1994 MGA Zone 55

## 5 Biodiversity offsets

### 5.1 ACT Environmental Offset Policy

Impacts of the proposed action, and offset requirements for residual impacts, have been assessed and calculated in accordance with the ACT Environmental Offset Policy (ACT Government 2015a). Inputs used in the ACT Environmental Offsets Calculator are presented in Appendix A.

The method used in the vegetation assessment is outlined in Section 3.1. For direct impacts, all values post impact were set to zero, indicating complete removal of all vegetation. For indirect impacts, groundcover (grasses), groundcover (other) and exotic plant cover scores were reduced, indicating some impact, but not set to zero as these areas will be managed in accordance with the Mugga Quarry EMP. Other values were retained at their current score. Site attribute scores for indirect impacts are shown in Table 5.1.

**Table 5.1 Management scores for each Box Gum Woodland vegetation zone**

Site attribute	Yellow Box - Red Gum Grassy Woodland (low)		Yellow Box - Red Gum Grassy Woodland (moderate)	
	Current score (0-3)	Score with development (0-3)	Current score (0-3)	Score with development (0-3)
Native plant species	1	1	1	1
Native over-storey cover	1	1	2	2
Native mid-storey cover	3	3	3	3
Native groundcover (grasses)	3	2	3	2
Native groundcover (shrubs)	3	3	1	1
Native groundcover (other)	1	1	2	1
Exotic plant cover	1	0	2	1
Number of trees with hollows	1	1	2	2
Overstorey regeneration	3	3	3	2
Total length of fallen logs	1	1	3	3

The residual impacts outlined in Section 4.3 will require 170 credits to offset. The credit report is provided Appendix B.

### 5.2 Project biodiversity offset strategy

EMM, on behalf of Boral, has undertaken an extensive search to locate like-for-like offsets that fulfil the requirements of the EPBC Act Environmental Offsets Policy (DSEWPaC 2012). A registered BioBank site in NSW will be used to meet the offset requirement outlined above. The site is located north-west of Crookwell in the Murrumbateman IBRA sub-region in the South East Highlands IBRA region.

The proposed offsets are like-for-like, will deliver 100% of the required offset and are composed of Box Gum Woodland that meets the conditions thresholds for Box Gum Woodland outlined in DEH (2006), as outlined below:

- vegetation in the proposed offset area contains the characteristic canopy species of Box Gum Woodland, namely Yellow Box (*E.melliodora*) and Blakely's Red Gum (*E. blakelyi*);

- vegetation at the proposed offset site has a predominantly native understorey, with more than 50% of the perennial vegetation cover comprised of native species, as determined using plot data collected in accordance with the NSW BioBanking Assessment Methodology (OEH 2014);
- the vegetation at the offset site is part of a patch greater than 0.1 ha; and
- the number of non-grassy native species and number of important species within the community exceeds the minimum number required to be considered part of the Box Gum Woodland CEEC (12 or more non-grassy native understorey species and at least one important species).

Following approval of the Mugga Quarry overburden emplacement project by DoEE and EPSSD, and prior to any impacts to biodiversity occurring, 170 credits will be purchased by Boral from the offset site and retired in accordance with the NSW BioBanking scheme.

The rules embedded in the Environmental Offsets Calculator associated with the ACT Environmental Offset Policy (ACT Government 2015a) “incorporate Commonwealth requirements and were largely based on the NSW Biobanking scheme” (ACT Government 2015b, p.4). The ACT Environmental Offsets Calculator states “The ACT Environmental Offsets Calculator is closely based on the NSW BioBanking Credit Calculator v1.1 . . . which was . . . adapted for ACT use. The major changes are the population of the tool with information on ACT vegetation and species and the basing of the assessment of Landscape Value on a spatial links analysis and consideration of past connectivity mapping across the ACT.” This indicates that the data used in the ACT Environmental Offsets Calculator provides more relevant local data for use in determining impacts and associated offsets.

In addition, the proposed offset site has been chosen as per the matters to be considered for offset sites in the ACT Environmental Offsets Policy (ACT Government 2015a) and has been endorsed by the ACT Conservator of Flora and Fauna (email 14 August 2018).

## 6 Economic and social matters

### 6.1 Economic and social matters

The Mugga Quarry site has a long history of supporting construction materials manufacturing and contains four Boral operations, namely an asphalt plant, a concrete batching plant, a recycling facility and the hard rock quarry that is associated with the proposed emplacement area.

The quarry is located in the central portion of the site and currently produces crushed rock products with a capacity to produce up to 1,000,000 tonnes per annum (tpa). The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities. The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00 am to 6:00 pm Monday to Saturday.

As total production of the quarry will not be increasing, there will be no change to current operating hours, external traffic movements, groundwater management or employment. No changes are proposed to the other operations at the site.

The project is predicted to cost \$3.75 million (inclusive of cost of purchasing credits), and will sustain employment for the workforce at the Mugga Quarry, currently 11 direct staff (full time equivalents) and 50 associated with the Boral concrete, asphalt, recycling and logistics operations, which rely on the quarry.

### 6.2 Boral's environmental history

Boral's Environmental Policy (2012) outlines the main objectives to minimise their environmental impact. Boral owns and operates a diverse range of businesses around the world within many different ecosystems and environments. Boral is committed to improving their environmental performance, setting a goal of zero harm and working to eliminate adverse environmental impacts. Where elimination is not possible, operations are aimed to sustain minimal harmful effects, possibly targeting better performance than environmental laws require.

Boral's main aims are to:

- reduce waste in all its forms, by application of LEAN manufacturing principles, leading to:
  - efficient use of energy, including reuse of waste energy;
  - conservation of water;
  - minimisation and recycling of waste production materials and energy;
  - prevention of pollution; and
  - effective use of virgin and recovered resources and supplemental materials;
- reduce greenhouse gas emissions from all processes, operations and facilities, including appropriate use of alternative fuels;
- protect and where practicable enhance biodiversity values at and around their facilities;

- openly and constructively engage with communities surrounding their operations;
- encourage and assist employees to enhance their environmental performance through communication and training;
- comply with environmental legislation, regulations, standards and codes of practice relevant to the particular business, as a minimum; and
- allocate sufficient resources to meet the commitments of this Policy.

Within recent years Boral has altered its portfolio to deliver better financial returns and respond to the changing world. Along with their strategy for change they have significantly reduced Boral's environmental footprint. Boral's carbon dioxide equivalent emissions today are 29% below emission levels in FY2012. For the past five years Boral have aimed to move away from the energy-intensive manufacturing towards lightweights, sustainable products.

In FY2017, Boral's operations consumed up to 2% more energy than the previous year. In the same year Boral was charged with seven regulatory infringements related to environmental contraventions in Australia. In 2016, Boral were charged by the Environment Protection Authority (EPA) on three counts related to accepting concrete material (Boral Limited).

Boral continues to re-use their own waste materials to produce the same product as their recycling initiative. Boral aims to deal with low amounts of hazardous waste in accordance with government regulations. Biodiversity management initiatives have been put in place at Boral's sites to assist with the protection of listed species, such as:

- maintaining and inspecting bat boxes at Dunmore Quarry in NSW for a number of threatened species;
- the ongoing supply of koala fodder from plantations at Narangba and Petrie quarries in Queensland;
- tracking and conservation work to protect the legless lizard at Deer Park Quarry in Victoria; and
- supporting the Western Swamp tortoise recovery program through Midland Brick's work with Perth Zoo.

## 7 Conclusion

This assessment report has been prepared to address PD requirements following the declaration by DoEE of the project as a controlled action under the EPBC Act.

Additional surveys have been undertaken to collect and collate additional information to ensure these PD requirements have been adequately addressed, and to demonstrate how the project will adequately avoid and minimise impacts, and offset residual significant impacts.

Following all measures to avoid and minimise impacts, the proposed action will result in significant residual impacts to 4.73 ha of Box Gum Woodland, including 4.19 ha of direct impacts and 0.54 ha of indirect impacts. Impacts will be offset through the retirement of 170 credits from a BioBank site in located north-west of Crookwell in the Murrumbateman IBRA sub-region in the South East Highlands IBRA region.



## References

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ACT Government 2004, *Woodlands for Wildlife - ACT Lowland Woodland Conservation Strategy. Action Plan no. 27*, ACT Government, Canberra.

ACT Government 2015a, *ACT Environmental Offsets Calculator Assessment Methodology*, Environment and Planning, Canberra.

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TSSC 2006, *Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*, Threatened Species Scientific Committee, Canberra.

TSSC 2016, *Conservation advice Superb Parrot*, Threatened Species Scientific Committee, Canberra.

Input data to ACT Environmental Offsets Calculator

## Appendix A

Input data to ACT Environmental Offsets Calculator

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**ACT**  
Government

**Environment and  
Planning**

## Assessment of a Development Site

### Assessment Type

The appropriate Assessment Type must be selected before any other data is entered

- Full Assessment (default)
- Assessment for Environment Protection and Biodiversity Conservation Act 1999 listed matters only
- Assessment for Nature Conservation Act 2014 listed matters only

### Development Details

Proposal ID:	<input type="text" value="1"/>
Development Name:	<input type="text" value="Mugga Quarry"/>
Development District:	<input type="text"/>
Division and street address:	<input type="text"/>

### Location Details

ACT Region:	<input type="text" value="South of Molonglo River"/>
ACT Subregion:	<input type="text" value="Other"/>

### Assessment Steps

1. Landscape Value and Vegetation Zones	Complete
2. Identify Geographic and Habitat Features	Complete
3. Undertake Site Survey	Complete
4. Enter Survey Results	Complete
5. Report on Credit Requirements	Complete

Please use the resources in the operational manual to help you identify the location of the site.

### Proponent Details

Proponent Name:	<input type="text" value="Boral"/>
Proponent Address:	<input type="text" value="PO Box 6041, North Ryde NSW 2113"/>
Proponent Phone:	<input type="text" value="02 9033 5056"/>

### Assessor Details

Assessor Name:	<input type="text" value="Nathan Garvey"/>
Assessor Address:	<input type="text" value="Suite 6, 146 Hunter Street, Newcastle, NSW 2300"/>
Assessor Phone:	<input type="text" value="02 4971 4814"/>

Completed ACT Environmental Offsets Calculator training

## Step 1a - Enter Landscape Value Scores

Landscape score: 27.65

### Neighbourhood Habitat Context Value

% Development within zone(must add up to 100%)	Zone Type	Zone Score
0	Very Low	3
0	Low	10
95	Moderate	15
5	High	28
0	Very High	38

calculate landscape value score

### Link Value

% Development within zone(must add up to 100%)	Zone Type	Zone Score
0	Low Linkage	3
100	High linkage	12

Status: Completed

Enter Vegetation Zones

Done

## Step 1b - Enter Vegetation Zones

Veg Zone ID:	<input type="text" value="1"/>	Condition class:	<input type="text" value="Paddock Trees"/>	Status:	Completed	<a href="#">Delete this Veg Zone</a>
Veg Zone Area:	<input type="text" value="2.34"/> ha	Vegetation Zone:	SM_ACT16_Paddock Trees			
Patch Size:	<input type="text" value="1,001.00"/> ha					
Veg Formation:	<input type="text" value="Grassy Woodlands"/>					
	Choose veg type from the drop-down menu					
Veg Type:	<input type="text" value="SM_ACT16"/>					
Veg Type Name:	Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland					

---

Veg Zone ID:	<input type="text" value="2"/>	Condition class:	<input type="text" value="Moderate/Good"/>	Status:	Completed	<a href="#">Delete this Veg Zone</a>
Veg Zone Area:	<input type="text" value="2.39"/> ha	Vegetation Zone:	SM_ACT16_Moderate/Good			
Patch Size:	<input type="text" value="1,001.00"/> ha					
Veg Formation:	<input type="text" value="Grassy Woodlands"/>					
	Choose veg type from the drop-down menu					
Veg Type:	<input type="text" value="SM_ACT16"/>					
Veg Type Name:	Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland					

Add New Veg Zone

Veg Type Definitions

Export Veg Zone Data

Done

**Step 2 - Identify Geographic and Habitat Features**

Print Form

Does any part of the development impact on:

Known Superb Parrot habitat tree, or hollow bearing Blakely's Red Gum or Scribbly Gum, hollow >6 centimetres diameter and between 4 and 12 metres above the ground.	Yes
Presence of kangaroo grass.	No
Surface rock between 5 and 60cm in diameter that is not deeply embedded, mostly Silurian volcanic but Devonian volcanics and sandstone also possible.	No
The area once occupied by natural temperate grassland or within 300m of ecotonal areas between natural temperate grassland and woodland communities.	No

Note: Click the print form button at the top of the page to print a list of features to check in the field.

Done

### Step 3 - Undertake Site Survey

**Proposed Survey Times**

January     July  
 February     August  
 March     September  
 April     October  
 May     November  
 June     December

**Significant Species Requiring an Expert Report or assumed to be present**

Survey guidelines for species requiring further assessment

Significant species predicted on site

Vegetation zones requiring field survey

**Survey Time Matrix**

ScientificName:	Common Name:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calotis glandulosa	Mauve Burr-daisy	Yes	Yes							Yes	Yes	Yes	Yes
Leucochrysum albicans var. tric	Hoary Sunray (white form)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Polytelis swainsonii	Superb Parrot									Yes	Yes	Yes	Yes
Rutidosia leiolepis	Monaro Golden Daisy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Swainsona recta	Small Purple Pea									Yes	Yes	Yes	Yes
Synemon plana	Golden Sun Moth	Yes									Yes	Yes	Yes

Note: Species with no suitable survey months have special requirements. Please see the report 'Survey guidelines for species requiring further assessment' for further details.

Done

### Step 4a - Vegetation Zone: Community or Condition Type and Flag Status

Name	% Cleared	Is it one of the following community and/or condition types?	Flag?	Have minimum number of Transect/ plots been entered?	Area (ha)	Enter Transects/ Plots	Enter Management Zones
SM_ACT16_Moderate/Good Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland	62	None of the above	No	Yes	2.39	Complete	Complete
SM_ACT16_Paddock Trees Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland	62	None of the above	No	Yes	2.34	Complete	Complete

### Step 4b - Enter Vegetation Transect/Plot Data

Vegetation Zone Name: SM\_ACT16\_Moderate/Good

Vegetation Type: Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland

**Required Plots**  
Minimum No. required transect/ plots: 2

Enter measurements for each site attribute

Local Benchmark used: No

Transect/Plot Number/Name:	Native plant species:	Native over-storey cover:	Native mid-storey cover:	Native ground cover (grasses):	Native ground cover (shrubs):	Native ground cover (other):	Exotic plant cover:	Number of trees with hollows:	Overstorey regeneration: length of fallen logs: (Set to 0.0 for Grassland, Wetland or Heathland)	Total length of fallen logs:	Northing : (MGA)	Easting: (MGA)	Zone:	Plot status:	
	<b>Benchmarks</b> >=35   11 to 32   0 to 12.5   23 to 63   0 to 4.5   8 to 16.5   See Manu   >=5   1   >=35														
AR2	7	7.0	1.5	50.0	0.0	8.0	16.0	4	1.00	22.0	693817	6084930	55	Complete	Delete Transect/Plot
AR1	22	13.0	2.0	20.0	14.0	32.0	22.0	4	1.00	49.0	693802	6084830	55	Complete	Delete Transect/Plot

### Step 4b - Enter Vegetation Transect/Plot Data

Vegetation Zone Name: SM\_ACT16\_Paddock Trees

Vegetation Type: Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland

**Required Plots**  
Minimum No. required transect/ plots: 1

Enter measurements for each site attribute

Local Benchmark used: No

Transect/Plot Number/Name:	Native plant species:	Native over-storey cover:	Native mid-storey cover:	Native ground cover (grasses):	Native ground cover (shrubs):	Native ground cover (other):	Exotic plant cover:	Number of trees with hollows:	Overstorey regeneration: length of fallen logs: (Set to 0.0 for Grassland, Wetland or Heathland)	Total length of fallen logs:	Northing : (MGA)	Easting: (MGA)	Zone:	Plot status:	
	<b>Benchmarks</b> >=35   11 to 32   0 to 12.5   23 to 63   0 to 4.5   8 to 16.5   See Manu   >=5   1   >=35														
AR2	16	0.0	0.0	23.0	0.0	2.0	19.0	0	1.00	2.0	693666	6084680	55	Complete	Delete Transect/Plot
CE1	6	10.0	1.5	56.0	0.0	4.0	28.0	3	1.00	18.0	693517	6084660	55	Complete	Delete Transect/Plot

### Step 4c - Management Zones

Vegetation zone name: SM\_ACT16\_Moderate/Good

Vegetation Type: Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland

Total Vegetation Zone area(ha): 2.39

Veg Zone Area	Veg Zone ID	Area	Vegetation Zone
1		2.34	SM_ACT16_Paddock Trees
2		2.39	SM_ACT16_Moderate/Good

Management Zone	Veg Zone	Area(ha)	Status		
2-Direct	2	2.22	Complete	Site Value	Delete
2-Indirect	2	0.17	Complete	Site Value	Delete

### Step 4c - Management Zones

**Vegetation zone name:** SM\_ACT16\_Paddock Trees  
**Vegetation Type:** Eucalyptus melliodora – E. blakelyi Tableland Grassy Woodland  
**Total Vegetation Zone area(ha):** 2.34

Veg Zone Area			
Veg Zone ID	Area	Vegetation Zone	
1	2.34	SM_ACT16_Paddock Trees	
2	2.39	SM_ACT16_Moderate/Good	

Management Zone	Veg Zone	Area(ha)	Status		
1-Direct	1	1.97	Complete	Site Value	Delete
1-Indirect	1	0.37	Complete	Site Value	Delete

### Step 4d - Enter Management Zone Attribute Score with Development

**Management Zone:** 2-Direct  
**Vegetation Zone:** SM\_ACT16\_Moderate/Good  
**Vegetation Zone Type:** Eucalyptus melliodora – E. blakelyi Tableland Grassy Woodland  
**Veg Zone ID:** 2

Enter score with development for each site attribute

	Current Score (0-3)	Score with development (0-3)	
Native plant species:	1	0	
Native over-storey cover:	2	0	
Native mid-storey cover:	3	0	
Native ground cover (grasses):	3	0	
Native ground cover (shrubs):	1	0	
Native ground cover (other):	2	0	
Exotic plant cover:	2	0	
Number of trees with hollows:	2	0	
Overstorey regeneration:	3	0	
Total length of fallen logs:	3	0	
	<b>Current Site Value Score (out of 100)</b>	<b>Future Site Value Score (out of 100)</b>	<b>Decrease in Site Value Score</b>
	64	0	64

Done

### Step 4d - Enter Management Zone Attribute Score with Development

**Management Zone:** 2-Indirect

**Vegetation Zone:** SM\_ACT16\_Moderate/Good

**Vegetation Zone Type:** Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland

**Veg Zone ID:** 2

Enter score with development for each site attribute

	Current Score (0-3)	Score with development (0-3)	
Native plant species:	1	<input type="text" value="1"/>	
Native over-storey cover:	2	<input type="text" value="2"/>	
Native mid-storey cover:	3	<input type="text" value="3"/>	
Native ground cover (grasses):	3	<input type="text" value="2"/>	
Native ground cover (shrubs):	1	<input type="text" value="1"/>	
Native ground cover (other):	2	<input type="text" value="1"/>	
Exotic plant cover:	2	<input type="text" value="1"/>	
Number of trees with hollows:	2	<input type="text" value="2"/>	
Overstorey regeneration:	3	<input type="text" value="2"/>	
Total length of fallen logs:	3	<input type="text" value="3"/>	
	<b>Current Site Value Score (out of 100)</b>	<b>Future Site Value Score (out of 100)</b>	<b>Decrease in Site Value Score</b>
	<b>64</b>	<b>54</b>	<b>10</b>

Done

### Step 4d - Enter Management Zone Attribute Score with Development

**Management Zone:** 1-Direct

**Vegetation Zone:** SM\_ACT16\_Paddock Trees

**Vegetation Zone Type:** Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland

**Veg Zone ID:** 1

Enter score with development for each site attribute

	Current Score (0-3)	Score with development (0-3)	
Native plant species:	1	<input type="text" value="0"/>	
Native over-storey cover:	1	<input type="text" value="0"/>	
Native mid-storey cover:	3	<input type="text" value="0"/>	
Native ground cover (grasses):	3	<input type="text" value="0"/>	
Native ground cover (shrubs):	3	<input type="text" value="0"/>	
Native ground cover (other):	1	<input type="text" value="0"/>	
Exotic plant cover:	1	<input type="text" value="0"/>	
Number of trees with hollows:	1	<input type="text" value="0"/>	
Overstorey regeneration:	3	<input type="text" value="0"/>	
Total length of fallen logs:	1	<input type="text" value="0"/>	
	<b>Current Site Value Score (out of 100)</b> 45	<b>Future Site Value Score (out of 100)</b> 0	<b>Decrease in Site Value Score</b> 45

Done

### Step 4d - Enter Management Zone Attribute Score with Development

**Management Zone:** 1-Indirect

**Vegetation Zone:** SM\_ACT16\_Paddock Trees

**Vegetation Zone Type:** Eucalyptus melliodora - E. blakelyi Tableland Grassy Woodland

**Veg Zone ID:** 1

Enter score with development for each site attribute

	Current Score (0-3)	Score with development (0-3)	
Native plant species:	1	1	
Native over-storey cover:	1	1	
Native mid-storey cover:	3	3	
Native ground cover (grasses):	3	2	
Native ground cover (shrubs):	3	3	
Native ground cover (other):	1	1	
Exotic plant cover:	1	0	
Number of trees with hollows:	1	1	
Overstorey regeneration:	3	3	
Total length of fallen logs:	1	1	
	<b>Current Site Value Score (out of 100)</b> 45	<b>Future Site Value Score (out of 100)</b> 41	<b>Decrease in Site Value Score</b> 4

Done

### Step 4e - Significant Species - Survey Results

		Is the species impacted by the development?	Identification Method	Loss	Units	No. considered a negligible loss
Synemon plana	Golden Sun Moth	No	Survey	0	individuals	N/A
Synemon plana	Golden Sun Moth	No	Survey	0	ha	N/A
Swainsona recta	Small Purple Pea	No	Survey	0	individuals	0
Rutidosia leiolepis	Monaro Golden Daisy	No	Survey	0	individuals	0
Polytelis swainsonii	Superb Parrot	No	Survey	0	hollow bearing trees	N/A
Leucochrysum albicans var. tricolor	Hoary Sunray (white form)	No	Survey	0	individuals	100
Calotis glandulosa	Mauve Burr-daisy	No	Survey	0	individuals	0

Credit report

## Appendix B

Credit report

---

# ACT Environmental Offsets Calculator

## *Offset Credit Report*

This report identifies the number and type of credits required at a DEVELOPMENT SITE.

Date of report: 18/10/2018 Time: 11:20 Tool Version: 0.2.5

---

### Development Details

Proposal ID: 1  
Development Name: Mugga Quarry  
Development Location:  
Development Address:

ACT Region: South of Molonglo River  
Proponent Name: Boral  
Proponent Address: PO Box 6041, North Ryde NSW 2113  
Proponent Phone: 02 9033 5056  
Assessor Name: Nathan Garvey  
Assessor Address: Suite 6, 146 Hunter Street, Newcastle, NSW 2300  
Assessor Phone: 02 4971 4814  
Assessor Accreditation Number:

---

The following information is required to be submitted with this Credit Statement (where ticked)

- An Expert Report for the following species
- The minimum number of plots were not entered for the following vegetation zones



**ACT**  
Government

---

**Environment and  
Planning**

## Improving or maintaining biodiversity values

The development is capable of improving or maintaining all biodiversity values



**ACT**  
Government

---

**Environment and  
Planning**

## Ecological Community Credits

Vegetation Type	Area (ha)	Credits Required	Flag
Eucalyptus melliodora – E. blakelyi Tableland Grassy Woodland _SM_ACT16_Moderate/Good	2.4	97	No
Eucalyptus melliodora – E. blakelyi Tableland Grassy Woodland _SM_ACT16_Paddock Trees	2.3	73	No

## Species Credits



---

Appendix H

# Air Quality Impact assessment

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Intended for  
**EMM Consulting Pty Ltd**


Document type  
**Report**

Date  
**September 2018**

Project Number  
**318000177**

# **MUGGA QUARRY OVERBURDEN EXPANSION PROJECT AIR QUALITY ASSESSMENT**

# MUGGA QUARRY OVERBURDEN EXPANSION PROJECT AIR QUALITY ASSESSMENT

Revision	Date	Made by	Checked by	Approved by	Signed
Final	03/09/2018	S. Fishwick	PG	S. Fishwick	

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## EXECUTIVE SUMMARY

### Introduction

Boral Resources (Country) Pty Ltd (Boral), a wholly owned subsidiary of Boral Limited, proposes to establish a new permanent bund and temporary stockpile area to store quarried overburden and weathered rock material from its Mugga Quarry operations (the project) at 321 Mugga Lane, Symonston (the site).

Ramboll Australia Pty Ltd (Ramboll) has been engaged by EMM Consulting Pty Ltd (EMM), on behalf of Boral, to undertake the Air Quality Impact Assessment (AQIA) to support the project.

### Existing environment

The ACT Environment Protection Authority (EPA) maintain an air quality monitoring station at Monash, which is representative of the local area and suitable to describe the existing environment. Data from the Monash air quality station was adopted for this AQIA for particulate matter less than 10 microns and 2.5 microns in aerodynamic equivalent diameter (PM<sub>10</sub> and PM<sub>2.5</sub>). Further, Bureau of Meteorology (BoM) stations at Tuggeranong and Canberra Airport were adopted for input into meteorological modelling for the area. A representative dataset for 2015 was adopted and used for modelling.

### Emissions

A peak emissions scenario, combining routine site operations and new bund emplacement emissions was quantified for the prediction of air quality impacts in the surrounding environment. The scenario adopted a number of assumptions with regard to distance of truck movements, active areas of emissions and proximity of emissions to receptors in order conservatively represent particulate matter emissions and predicted potential impacts from the project on any given day.

Emissions were quantified for particulate matter (total suspended particulates (TSP), PM<sub>10</sub> and PM<sub>2.5</sub>).

### Model predictions

The results of the dispersion modelling conducted for the developed emissions scenario indicate that all modelled pollutants are below applicable assessment criteria and goals at all selected assessment locations.

The results of the dispersion modelling conducted indicated that the operation of the project, including the construction of the new bund, is unlikely to result in exceedances of the applicable EPA impact assessment criteria for any of the assessed pollutants at any of the surrounding assessment locations or receptors.

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Wind roses

### Appendix 3

Emission inventory background

## 1. INTRODUCTION

Boral Resources (Country) Pty Ltd (Boral), a wholly owned subsidiary of Boral Limited, proposes to establish a new permanent bund and temporary stockpile area to store quarried overburden and weathered rock material from its Mugga Quarry operations (the project) at 321 Mugga Lane, Symonston (the site).

The project is required to enable the ongoing extraction operations of the quarry and supply of aggregates and quarry products to the construction market within the Australian Capital Territory (ACT) and surrounding New South Wales (NSW) regional areas.

The site in its regional and local context can be seen in **Figure A1-1** and **Figure A1-2 (Appendix 1)**.

EMM Consulting Pty Limited (EMM) has been engaged by Boral to prepare an Environment Impact Statement (EIS) for the project. Ramboll Australia Pty Ltd (Ramboll) has been engaged by EMM, on behalf of Boral, to undertake the Air Quality Impact Assessment (AQIA) for the project.

### 1.1 Assessment background

Ramboll were previously commissioned by EMM in March 2017 (then Ramboll Environ) to complete an AQIA for a proposed new asphalt plant at the Mugga Quarry site. For consistency of assessment, the resources developed during the assessment for the proposed new asphalt plant, including meteorology, emission calculations and dispersion model configuration, have been applied in this study wherever practicable. The March 2017 AQIA for the proposed new asphalt plant will hereafter be referred to as the "2017 AQIA".

### 1.2 Site overview

The project involves the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 cubic metres (m<sup>3</sup>) of quarried overburden and weathered rock material from Mugga Quarry.

The additional bund and emplacement areas will be located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road) and resides within an extractive industry lease area of 106.4 hectares (ha).

The topography of the site is undulating with a slope across the proposed extension area from the south-west to the north-east. Elevation within the proposed extension area varies from approximately 730 m Australian Height Datum (AHD) in the south-west to approximately 690 m AHD in the north-east.

The site has a long history of supporting construction materials manufacturing and contains four Boral operations, namely an asphalt plant, a concrete batching plant, a recycling facility and the hard rock quarry that is associated with the proposed emplacement area **Figure A1-3 (Appendix 1)**.

The quarry is located in the central portion of the site and currently produces crushed rock products with a production rate at times up to 1,000,000 tonnes per annum (tpa). The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities. The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00 am to 6:00 pm Monday to Saturday.

As total production of the quarry will not be increasing, there will be no change to current operating hours, external traffic movements, groundwater management or employment. No changes are proposed to the other operations at the site.

## 1.3 The site and surrounds

### 1.3.1 The site

The site is leased Territory Land, identified as Block 2031 Jerrabomberra District. The site is located approximately 10 kilometres (km) to the south-east of Canberra Central. The site is generally known as 321 Mugga Lane, Symonston.

Located within a broadacre rural setting and surrounded by low density land uses and established remnant native vegetation, the site has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility. Vehicular access to the site is via an existing entry off Mugga Lane, adjacent to the site's south-western boundary.

An overview of the existing site operations is provided in **Table 1-1**.

The topography is undulating with a significant slope across the site from the north-east to south-east with a fall of approximately 40 metre (m). The site is zoned Non-Urban NUZ1 Broadacre under the Territory Plan.

### 1.3.2 The project area

This project includes the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 m<sup>3</sup> of quarried overburden and weathered rock material located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road).

A plan of the project can be seen in **Figure A1-3 (Appendix 1)**.

### 1.3.3 The surrounds

The site is situated within a broadacre rural setting surrounded by low density land uses and established remnant native vegetation.

The land use zoning for the site has made provisions requiring a 1 km clearance buffer around the site to afford protection from conflicting development. The nearest rural residence is therefore located approximately 2 km to the south and approximately 2 km to the west of the site.

Land uses surrounding the site include:

- **north** – Mugga Lane (public road), vacant broadacre land, reservoir, bus depot, one rural residence and Mugga 2 quarry;
- **east** - vacant broadacre land;
- **south** – vacant broadacre land and one rural residence; and
- **east** – Mugga Lane, vacant broadacre land and one rural residence.

Surrounding land uses can be seen in **Figure A1-3 (Appendix 1)**.

<b>Table 1-1: Overview of site operations</b>		
<b>Operational element</b>	<b>Production rate</b>	<b>Details</b>
Hard rock quarry	Up to 1,000,000 tpa.  Average production rate approximately 500,000tpa	<p>Located in the central portion of the site and currently produces crush rock products with a production rate at times up to 1,000,000 tpa.</p> <p>The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities.</p> <p>The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00 am to 6:00 pm Monday to Saturday.</p>
Fixed asphalt plant	Up to 75,000 tpa  Average 145 tons per day (tpd) production rate, with maximum 1,000 tpd	<p>The project would produce up to 75,000 tpa of asphalt, with an average of 140 tpd to a peak of 1,000 tpd.</p> <p>The fixed asphalt plant is approved to operate 24 hours a day, 7 days a week.</p>
Concrete Batching Plant (CBP)	36,000 m <sup>3</sup> per annum  Maximum capacity to produce up to 60,000 m <sup>3</sup>	<p>Located to the north of the asphalt plant. It currently produces 36,000 m<sup>3</sup> per annum and has a maximum capacity to produce up to 60,000 m<sup>3</sup>.</p> <p>Elements of the existing CBP include cement and flyash silos, aggregate storage bins, concrete production and loading facilities, offices and amenities.</p> <p>The CBP operates 24 hours a day, seven days a week.</p>
Recycling facility	Up to 100,000 tpa	<p>Recycling is located on the central western edge of the quarry and currently processes up to 100,000 tpa of recycled construction and demolition waste.</p> <p>Elements of the recycling facility include raw and finished material stockpiles, a mobile crushing plant, offices and amenities.</p> <p>The recycling facility can operate 24 hours a day, 7 days a week however deliveries generally occur between 7:00 am and 4:30 pm with production occurring overnight when needed to meet market demand.</p>

## 2. ASSESSMENT APPROACH AND CRITERIA

In the absence of specific ACT air quality impact assessment guidance, the approach to this AQIA follows guidelines recommended in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ("the Approved Methods for Modelling") (NSW Environment Protection Authority (NSW EPA), 2005)<sup>1</sup>.

Local air quality impacts have been assessed using a Level 2 assessment approach in accordance with the Approved Methods for Modelling, as follows:

- Emissions were estimated for all project related activities, using best practice emission estimation techniques;
- Dispersion modelling was undertaken using a regulatory dispersion model to predict ground level concentrations for key pollutants at nearby sensitive receptors;
- Ground level concentrations are compared against the relevant air quality impact assessment criteria and standards; and
- Cumulative impacts are considered, taking into account existing baseline air quality.

### 2.1 Pollutant indicators

The key emissions to air from the site are fugitive dust or particulate matter (PM), products of combustion and a range of toxic and odorous pollutants associated with quarry and asphalt production.

This assessment will focus on the quantification of emissions and impacts of particulate matter pollutants, specifically total suspended particulate matter (TSP), particulate matter less than 10 microns in aerodynamic diameter (PM<sub>10</sub>) and particulate matter less than 2.5 microns in aerodynamic diameter (PM<sub>2.5</sub>). Emission of TSP will be used to derive dust deposition impacts.

Pollutants associated with fuel combustion and individual odorous pollutants associated with asphalt production were addressed in the 2017 AQIA. The additional emission sources associated with the project are not likely to alter the conclusions of the 2017 AQIA with regards to air quality criteria compliance and have therefore not been considered further in this study.

### 2.2 ACT Government assessment criteria

In the ACT, the *Environment Protection Act 1997* (the Act) is supported by a number of Environment Protection Policies (EPPs) which provide guidelines on how the legislation is administered by the Environment Protection Authority (EPA).

The main objectives of the Air EPP are:

- To ensure air quality in the ACT meets national standards for ambient air; and
- To minimise environmental harm from local emissions of air pollutants in accordance with requirements and objects of the Act.

Air quality within the ACT is generally reported to National Environment Protection Measure (NEPM) Ambient Air Quality (AAQ) reporting standards (AAQ NEPM). The standards relevant to this assessment are presented in **Table 2-1**.

It is noted that the AAQ NEPM reporting standards do not address all pollutants of interest listed in **Section 2.1**. To supplement the NEPM AAQ, impact assessment criteria specified by the NSW EPA, listed within the Approved Methods for the Modelling have also be adopted (**Section 2.3**).

---

<sup>1</sup> This approach was previously accepted by ACT EPA 2017 AQIA

<b>Pollutant</b>	<b>Averaging period</b>	<b>Maximum concentration standard</b>	<b>Maximum allowable exceedances per year</b>
PM <sub>10</sub>	24-hour	50 µg/m <sup>3</sup>	None
	Annual	25 µg/m <sup>3</sup>	None
PM <sub>2.5</sub>	24-hour	25 µg/m <sup>3</sup>	None
	Annual	8 µg/m <sup>3</sup>	None

µg/m<sup>3</sup> – micrograms per cubic metre

## 2.3 NSW EPA Assessment Criteria

### 2.3.1 Assessment criteria for particulate matter

The NSW EPA's impact assessment criteria and AAQ NEPM standards and goals for PM, against which the potential impacts of the project have been assessed, are presented in **Table 2-2**.

<b>PM metric</b>	<b>Averaging period</b>	<b>Concentration (µg/m<sup>3</sup>)</b>
TSP	Annual	90
PM <sub>10</sub>	24 hour	50
	Annual	25
PM <sub>2.5</sub>	24 hour	25
	Annual	8

The NSW EPA impact assessment criteria for dust deposition are summarised in **Table 2-3**, which include the maximum acceptable increase and total dust deposition rates to minimise nuisance impacts. Total dust deposition rates within residential areas, which are in excess of 4g/m<sup>2</sup>/month, are generally considered to indicate that nuisance dust impacts may occur.

The criteria for PM are applied at the nearest existing or likely future off-site sensitive receptor and compared against the 100<sup>th</sup> percentile (i.e. the highest) dispersion modelling prediction. Both the incremental and cumulative impacts need to be considered (i.e. consideration of background is required for criteria pollutants).

<b>Pollutant</b>	<b>Maximum Increase in Dust Deposition</b>	<b>Maximum Total Dust Deposition Level</b>
Deposited dust	2 g/m <sup>2</sup> /month	4 g/m <sup>2</sup> /month

## 2.4 Receptor locations

Surrounding residential receptors and other potentially sensitive locations, such as schools, community buildings and industrial sites have been selected as discrete sensitive receptors for assessment of impacts. The assessment locations are shown in **Figure 2-1** and listed in **Table 2-4**.

<b>Table 2-4: Representative assessment locations</b>			
<b>ID</b>	<b>Receptor type</b>	<b>Coordinates (m, MGA56)</b>	
		<b>Easting</b>	<b>Northing</b>
R1	Rural residential	694035	6083251
R2	Rural residential	693132	6084263
R3	Rural residential	693574	6084861
R4	Animal shelter	693860	6085983
R5	Correctional facility	693856	6085926
R6	Therapeutic goods administration	695394	6085559
R7	Mugga 2 (former quarry)	693226	6085866
R8	Bus depot	693742	6085286
R9	Industrial (Landfill)	694102	6082049
R10	Water storage tank	693536	6084999

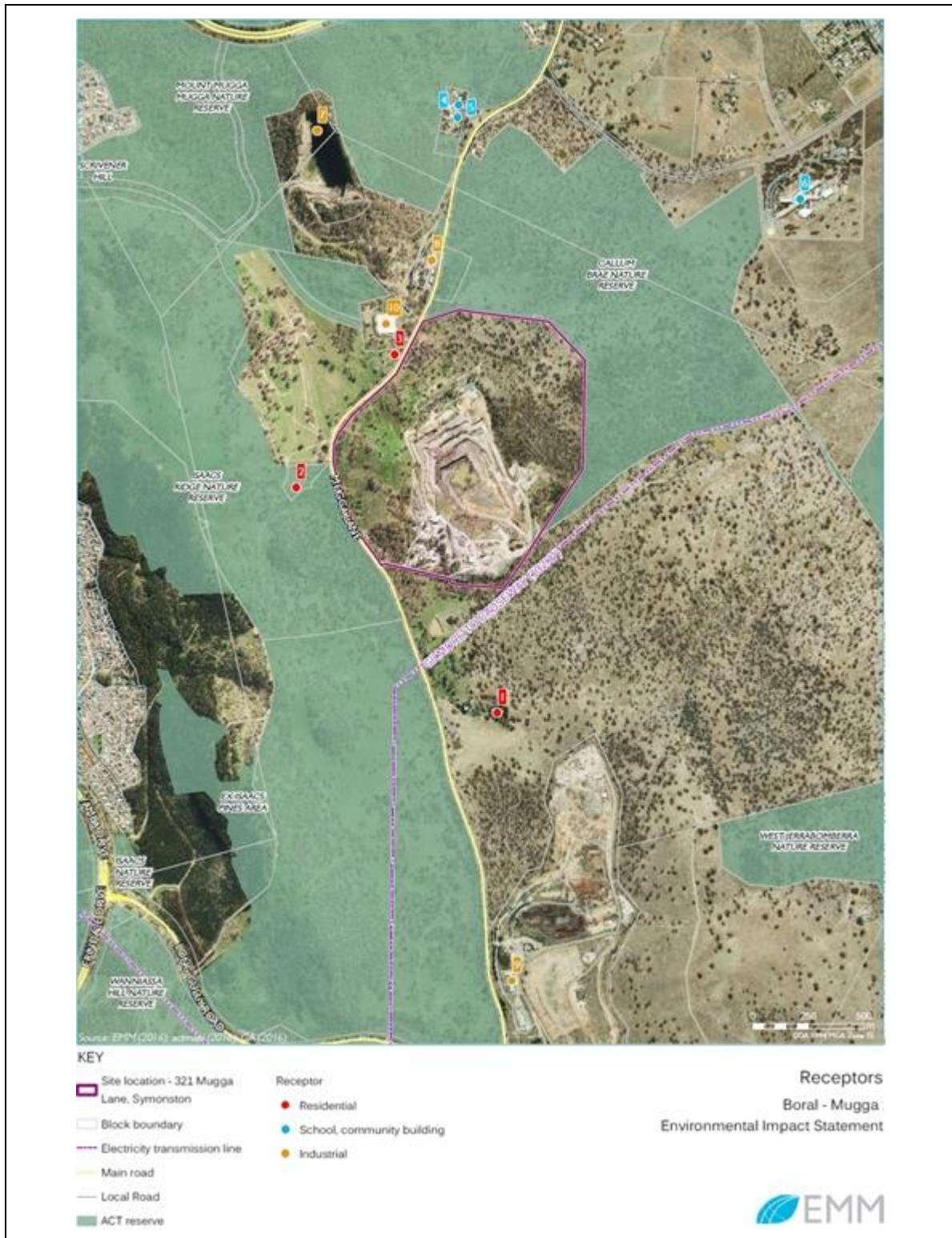


Figure 2-1: Surrounding assessment locations

### 3. CLIMATE AND DISPERSION METEOROLOGY

Meteorological mechanisms affect the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. Dust generation rates are particularly dependent on wind energy, the moisture budget, which is a function of rainfall and evaporation rates, material movement, and activity.

The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the boundary layer (the general term for the layer of the atmosphere adjacent to the earth's surface) and other factors such as wind speed and direction.

Thermal turbulence is driven by incoming solar radiation and surface heating during the daylight hours. Mechanical turbulence is associated with wind speed, in combination with the surface roughness of the surrounding area. The stability of the atmosphere increases with a decrease in thermal and mechanical turbulence.

Air pollutant dispersion consists of vertical and horizontal components of motion. Vertical motion is defined by the stability of the atmosphere (e.g. a stable atmosphere has low vertical dispersion potential) and the depth of the surface-mixing layer (typically defined as the vertical distance between the earth's surface and a temperature inversion during the day).

The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field (i.e., wind speed and direction). The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The wind direction, and the variability in wind direction, determines the general path pollutants will follow and the horizontal spread of the plume.

Airborne particulate concentration levels, therefore, fluctuate in response to changes in atmospheric stability, mixing depth and winds (Oke, 2003; Sturman and Tapper, 2006; Seinfeld and Pandis, 2006).

Long-term climate records, time-resolved meteorological monitoring data and meteorological modelling for the region were used to characterise the dispersion meteorology of the quarry. This is documented in the following sections.

#### 3.1 Meteorological data and selected year

No meteorological monitoring is conducted at the Mugga Quarry site. The NSW EPA specifies in Section 4.1 of the Approved Methods for Modelling that meteorological data representative of a site should be used in the absence of actual onsite observations. The data should cover a period of at least one year with a percentage completeness of at least 90%. Site representative data can be obtained from either a nearby meteorological monitoring station or synthetically generated using the CSIRO prognostic meteorological model The Air Pollution Model (TAPM).

In the absence of onsite meteorological monitoring data, a combination of meteorological modelling and regional monitoring datasets were drawn upon. Details regarding the meteorological modelling conducted are presented in this section. The following regional data sets were used in the meteorological analysis:

- 1-hour average meteorological data from the Bureau of Meteorology (BoM) Automatic Weather Stations (AWS) at Canberra Airport (Station Number 070014) and Tuggeranong (Station Number 070339) recorded between 2011 and 2015; and
- Long-term climate statistics (1996-2017) obtained from the BoM Tuggeranong AWS.

Wind roses have been generated from recorded wind speed and direction data at the Tuggeranong AWS for the period between 2011 and 2015. These figures are presented within **Appendix 2** and indicate that minimal inter-annual variation in winds occurred across this period. Consistent with the 2017 AQIA, the 2015 calendar year will form the modelling period for this current assessment.

### 3.2 Meteorological modelling

The CALPUFF (Version 6.2) modelling system has been selected for application in this assessment. It comprises three main components:

- the CALMET meteorological model;
- CALPUFF air dispersion model; and
- CALPOST post-processor, in addition to a large set of pre-processing programs designed to interface the model to standard routinely available meteorological and geophysical databases.

The CALMET meteorological model develops wind and temperature fields on a three-dimensional gridded modelling domain (Scire *et. al.*, 2000). Associated two dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final wind field thus reflects regional airflow patterns in addition to the influences of local topography and land uses.

The CALMET model can integrate hourly average surface meteorological data as input, including wind speed, wind direction, mixing depth, cloud cover, temperature, relative humidity, pressure and precipitation. Additionally, CALMET can use concurrent upper air meteorological data containing similar parameters in order to calculate the conditions at heights above ground level.

Hourly-average surface meteorological conditions recorded at the two BoM stations listed in **Section 3.1** were processed for input into CALMET. In the absence of a suitably complete upper air monitoring dataset, the CSIRO's TAPM software was used to generate the upper air meteorological parameters required for input within CALMET. TAPM was configured and run in accordance with the Section 4.5 of the Approved Methods for Modelling. The configuration of CALMET using a combination of Prognostic Model output data from TAPM and surface observations is in general accordance with the Hybrid Mode recommended in TRC (2011).

The configuration of the CALMET model applied within this assessment is outlined in **Table 3-1**.

<b>Table 3-1: CALMET Grid Settings and Input Data</b>	
<b>CALMET Grid Settings and Input Data</b>	
Meteorological grid domain	35 km x 35 km
Meteorological grid resolution	500 m
Vertical resolution (cell heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1,200 m, 2,000 m, 3,000 m, 4,000 m,)
Modelling year	1 January 2015 to 31 December 2015
Surface meteorological stations	Canberra Airport (BoM) Tuggeranong (BoM)
Upper air meteorological stations	TAPM 3-Dimensional Prognostic Dataset
Land Use	Generated from aerial photography and topographic maps
Topography	SRTM-3 Topography Data
<b>CALMET Radius Parameter Values</b>	
TERRAD	3 km
R	5 km surface, 20 km aloft
RMAX	12 km

### 3.3 Prevailing wind regime

The annual wind roses for the BoM Canberra Airport and Tuggeranong AWS and CALMET-generated dataset extracted at the project site are illustrated in **Figure 3-1**.

The CALMET-generated project site dataset shows a dominance of wind direction from the northwest and southeast quadrants, with a less defined southwest quadrant flow. Investigation of this southwest flow shows the predicted flow occurs during night/early morning hours and is associated with the influence of the ridgeline to the west of the site.

The general southeast-northwest alignment of winds is evident in both the BoM Canberra Airport and Tuggeranong AWS wind roses, with directional variations by site attributable to local terrain features around the two monitoring stations.

The wind speed of the two monitoring datasets and CALMET-generated dataset compares well, with comparison charts presented in **Appendix 2**. It is considered that CALMET has performed well in generating wind conditions for the project site on this basis.

The average CALMET-generated wind speed for the 2015 modelling period is 2.45m/s, with a predicted frequency of calm conditions (wind speeds less than 0.5 m/s) of 11%. Frequency of wind speed by BoM station and CALMET dataset are illustrated in **Figure 3-2**. While there is a lower percentage of calm conditions for the CALMET site dataset relative to the two BoM stations, there is a higher percentage of wind speeds in the 0.5m/s to 1.5m/s category for the CALMET site dataset. It is considered that the low wind speeds of the area (less than 1.5m/s) are captured in the CALMET generated site dataset.

Seasonal and diurnal (dividing the day into night and day) wind roses for the CALMET-predicted meteorological dataset are presented within **Appendix 2**.

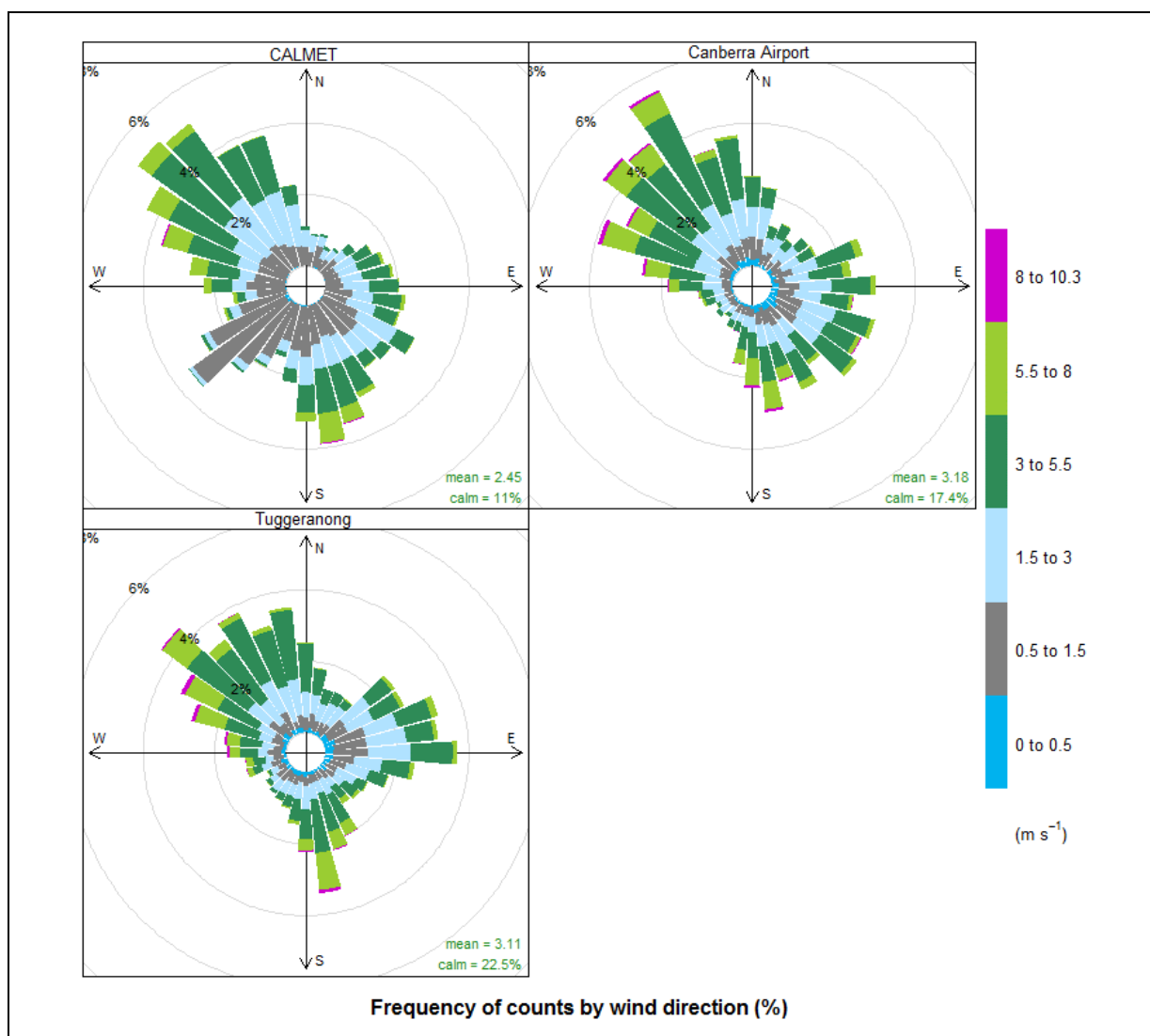


Figure 3-1: Annual wind roses - CALMET-Predicted site and BoM Canberra Airport and Tuggeranong stations - 2015

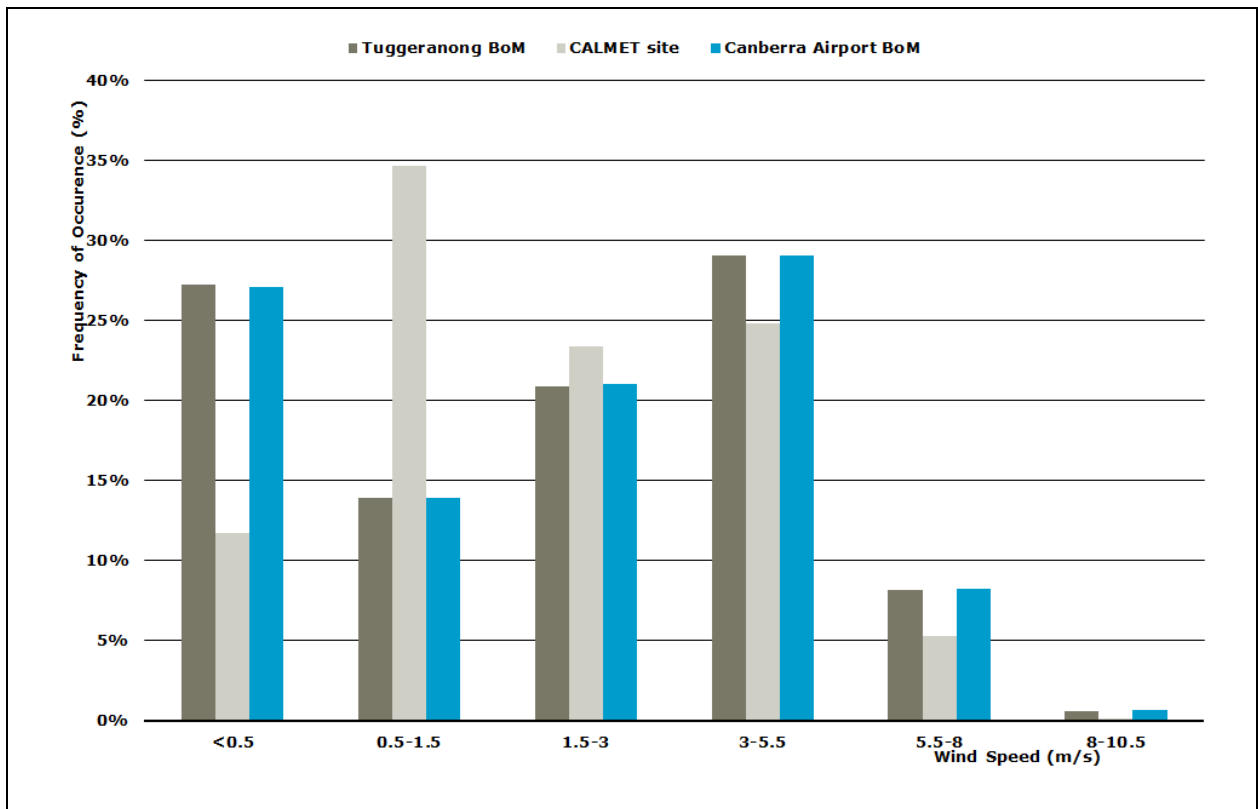
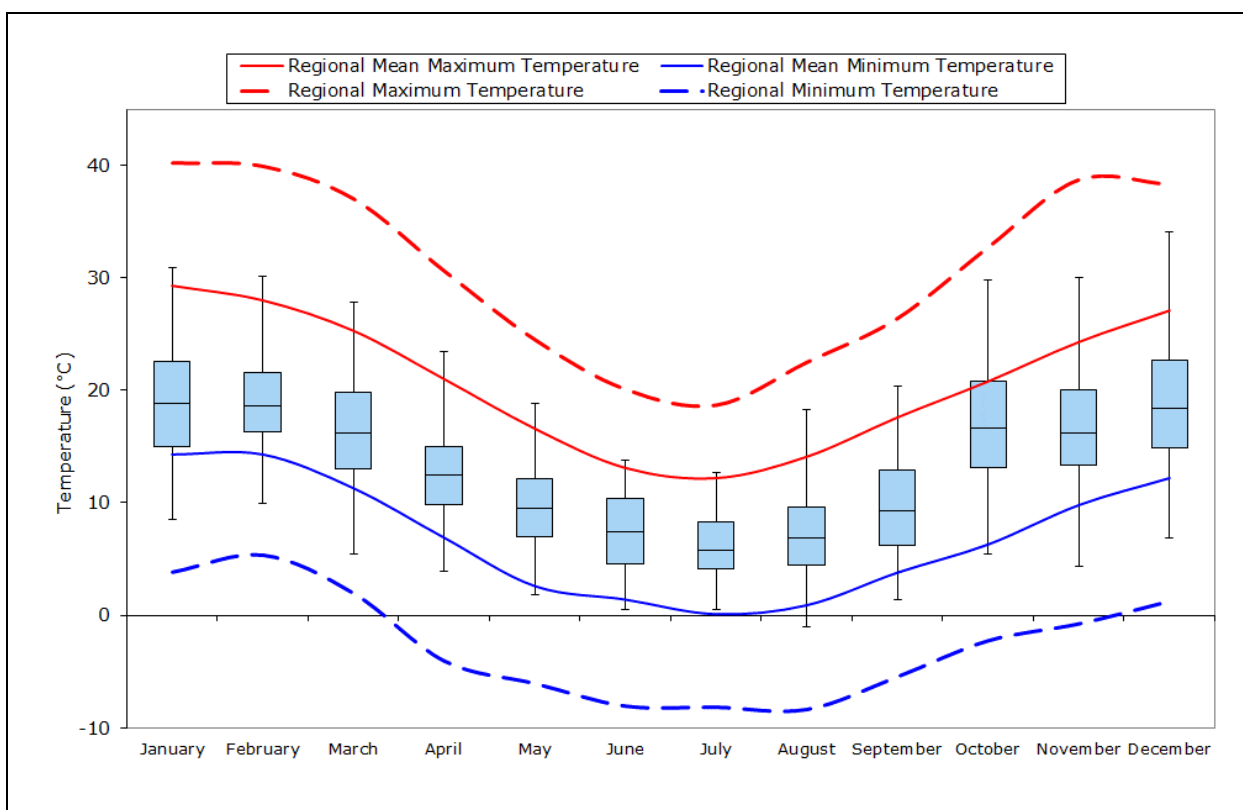


Figure 3-2: Wind speed frequency - CALMET-Predicted site and BoM Canberra Airport and Tuggeranong stations - 2015

### 3.4 Ambient temperature

Monthly mean minimum temperatures are in the range of 0°C to 14°C, with mean maxima of 12°C to 29°C, based on the long-term average record from the BoM Tuggeranong AWS. Peaks occur during summer months with the highest temperatures typically being recorded between November and February. The lowest temperatures are usually experienced between June and August.

The CALMET-generated 2015 project site temperature dataset has been compared with long-term trends recorded at the Tuggeranong AWS BoM climate station to determine the representativeness of the dataset. **Figure 3-3** presents the monthly variation in recorded temperature during 2015 compared with the recorded station mean, minimum and maximum temperatures. There is good agreement between temperatures recorded during 2015 and the recorded historical trends, indicating that the dataset is representative of conditions likely to be experienced in the region.



**Figure 3-3: Temperature Comparison between CALMET site 2015 dataset and Historical Averages (1996-2017) – Tuggeranong AWS**

Note: 2015 CALMET predictions at the site are illustrated by the 'box and whisker' indicators. Boxes indicate 25<sup>th</sup>, median and 75<sup>th</sup> percentile temperature values while upper and lower whiskers indicate maximum and minimum values. Maximum and minimum temperatures from long-term measurements at Tuggeranong AWS are depicted as line graphs.

### 3.5 Rainfall

Precipitation is important to AQIA, as it impacts on dust generation potential and represents a removal mechanism for atmospheric pollutants. Based on historical data recorded since 1996 at the BoM Tuggeranong AWS, the region is characterised by low to moderate rainfall, with a mean annual rainfall of 640 mm, and an annual rainfall range between 340 mm and 1,100 mm. There is notable variation in monthly rainfall throughout the year, with the lowest rainfall occurring in mid to late autumn and peaking during the summer months.

To provide a conservative (upper bound) estimate of the pollutant concentrations, wet deposition (removal of particles from the air by rainfall) was excluded from the dispersion modelling simulations undertaken in this report.

### 3.6 Atmospheric stability

Atmospheric stability refers to the degree of turbulence or mixing that occurs on the atmosphere and is a controlling factor in the rate of atmospheric dispersion of pollutants.

The Monin-Obukhov length (L) provides a measure of the stability of the surface layer (i.e. the layer above the ground in which vertical variation of heat and momentum flux is negligible; typically about 10 % of the mixing height). Negative L values correspond to unstable atmospheric conditions, while positive L values correspond to stable atmospheric conditions. Very large positive or negative L values correspond to neutral atmospheric conditions.

**Figure 3-4** illustrates the seasonal variation of atmospheric stability derived from the Monin-Obukhov length predicted by CALMET for the project site. The diurnal profile presented illustrates that atmospheric instability increases during daylight hours as convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile

indicates that the potential for atmospheric dispersion of emissions would be greatest during day time hours and lowest during evening through to early morning hours.

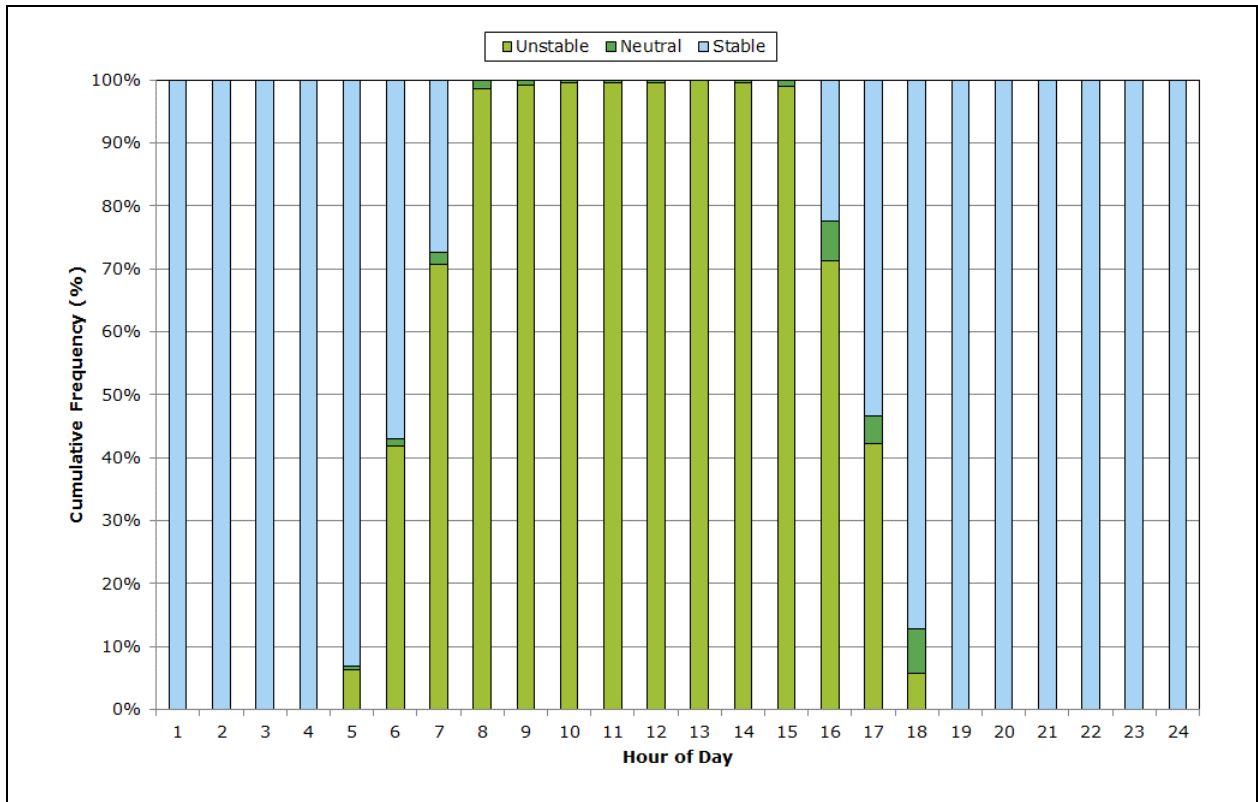
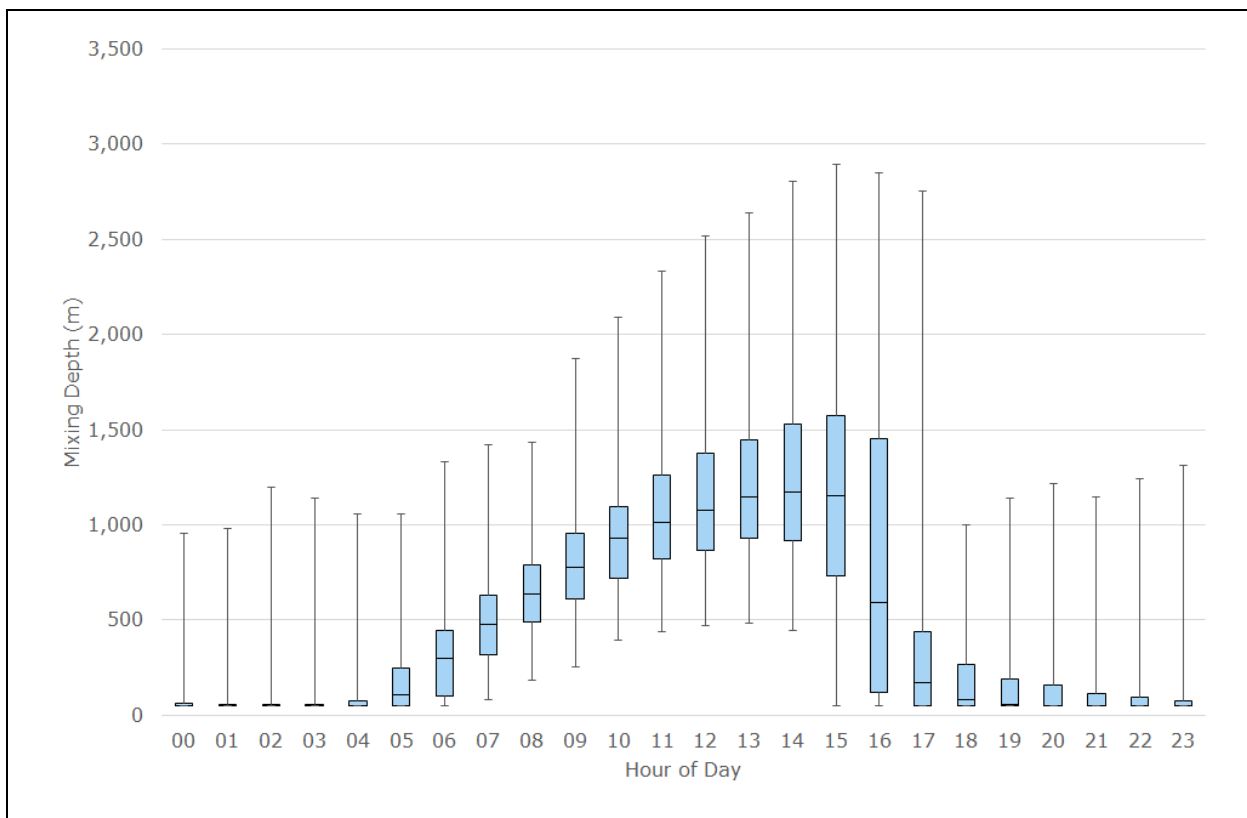


Figure 3-4: CALMET-predicted Diurnal Variation in Atmospheric Stability- Project Site 2015

### 3.7 Mixing depth

The diurnal variation in CALMET-predicted atmospheric mixing depth for the Project site is illustrated in **Figure 3-5**. It can be seen that greater boundary layer depths are experienced during the day time hours, peaking in the mid to late afternoon. Higher day-time wind velocities and the onset of incoming solar radiation increases the amount of mechanical and convective turbulence in the atmosphere. As turbulence increases so too does the depth of the boundary layer, generally contributing to higher mixing depths and greater potential for atmospheric dispersion of pollutants.



**Figure 3-5: CALMET-predicted Diurnal Variation in Atmospheric Mixing Depth – Project Site**

Note: Boxes indicate 25<sup>th</sup>, Median and 75<sup>th</sup> percentile of CALMET-predicted mixing height data while upper and lower whiskers indicate maximum and minimum values.

## 4. EXISTING ENVIRONMENT

### 4.1 Baseline ambient air quality

Background air quality is described with reference to the ACT EPA Monash air quality monitoring site, located approximately 6.7km southwest of the project site. Concentrations of PM<sub>10</sub> and PM<sub>2.5</sub>, were collated from the Monash station.

#### 4.1.1 PM<sub>10</sub> and PM<sub>2.5</sub> concentrations

The relevant summary statistics for PM<sub>10</sub> and PM<sub>2.5</sub> for the previous six years (2012 to 2017) from the Monash monitoring site are presented in **Table 4-1**. It is noted that PM<sub>2.5</sub> measurements only commenced in 2013.

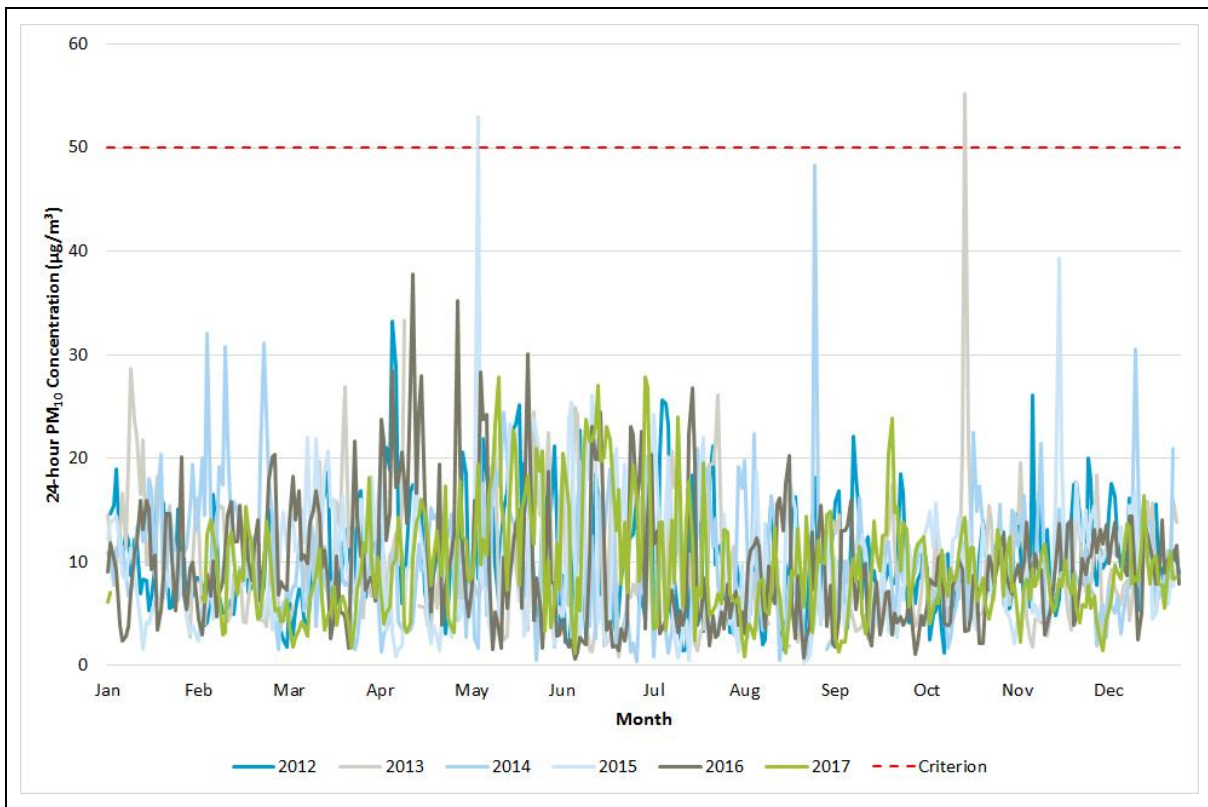
Annual mean PM<sub>10</sub> concentrations range from 9.7 µg/m<sup>3</sup> to 10.4 µg/m<sup>3</sup> and on average over the past six years baseline concentrations are 40% of the AAQ NEPM standard. Annual mean PM<sub>2.5</sub> concentrations range from 6.5 µg/m<sup>3</sup> to 7.8 µg/m<sup>3</sup> and on average over the past five years baseline concentrations are 89% of the AAQ NEPM standard.

Exceedances of the 24-hour average reporting standards for PM<sub>10</sub> have occurred in two of the past six years and during all years for PM<sub>2.5</sub>. Exceedances are principally attributable to regional events such as dust storms and hazard reduction burns/bushfires.

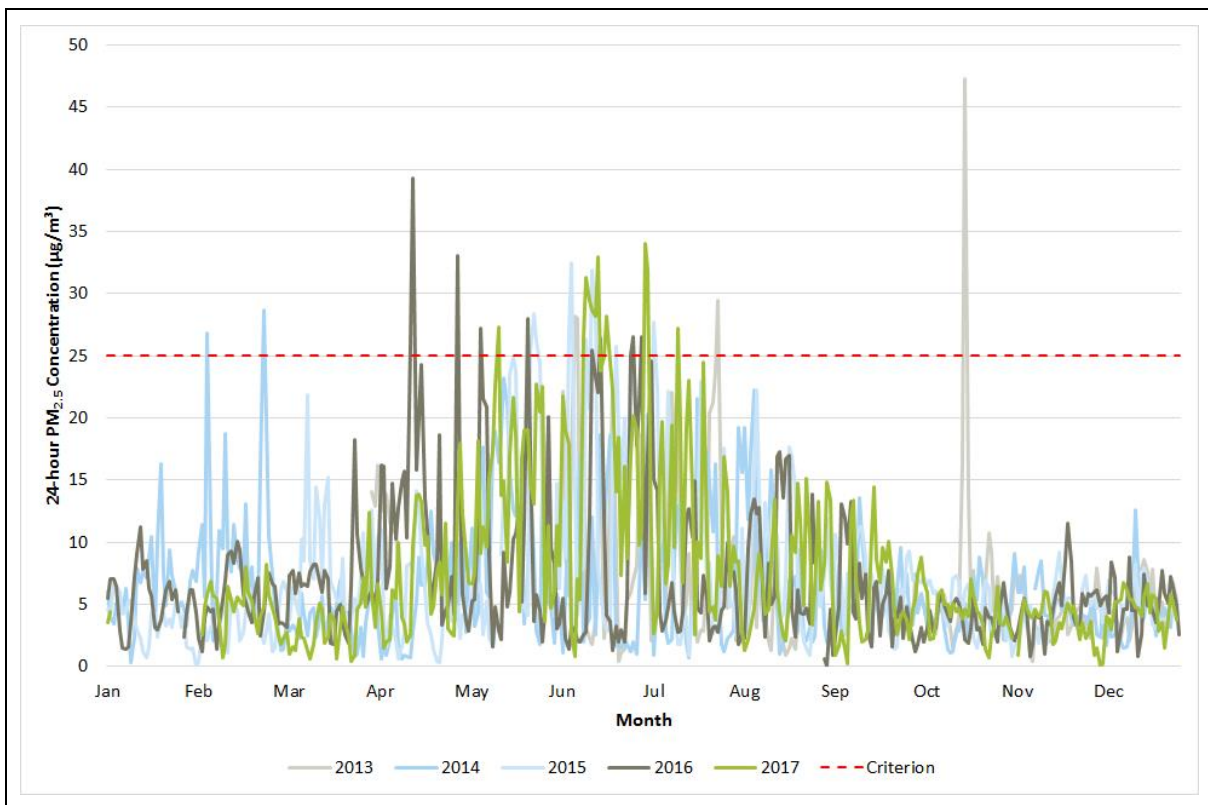
Recorded PM<sub>2.5</sub> concentrations are typically higher during the winter months at the Monash air quality monitoring station than other times of the year. ACT Health commissioned a study in 2009 (Bridgeman, 2009) investigating the air quality of the Tuggeranong Valley (within which the Monash station is located). This report that found that domestic wood heating during winter months significantly influenced particulate matter concentrations experienced in the area.

An inter-annual comparison of 24-hour average PM<sub>10</sub> and PM<sub>2.5</sub> concentrations recorded between 2012 and 2017 is presented in **Figure 4-1** and **Figure 4-2** respectively. For PM<sub>2.5</sub>, the increase in recorded concentrations during winter attributable to domestic wood heating emissions can be observed in **Figure 4-2**.

Pollutant	Statistic	2012	2013	2014	2015	2016	2017
PM <sub>10</sub>	Mean	10.4	9.8	9.9	9.8	9.7	9.7
	Max daily	33.2	55.2	48.3	52.9	37.8	27.9
	99 <sup>th</sup> percentile	25.4	26.5	30.6	24.7	28.3	25.9
	95 <sup>th</sup> percentile	20.1	20.6	19.8	20.7	21.7	20.6
	Days over 50 µg/m <sup>3</sup>	0	1	0	1	0	0
PM <sub>2.5</sub>	Mean	-	7.3	6.5	7.2	7.0	7.8
	Max daily	-	47.3	28.7	32.5	39.3	34.0
	99 <sup>th</sup> percentile	-	28.2	21.8	27.6	26.8	30.7
	95 <sup>th</sup> percentile	-	20.6	17.1	22.2	19.9	22.6
	Days over 25 µg/m <sup>3</sup>	-	4	2	10	10	11

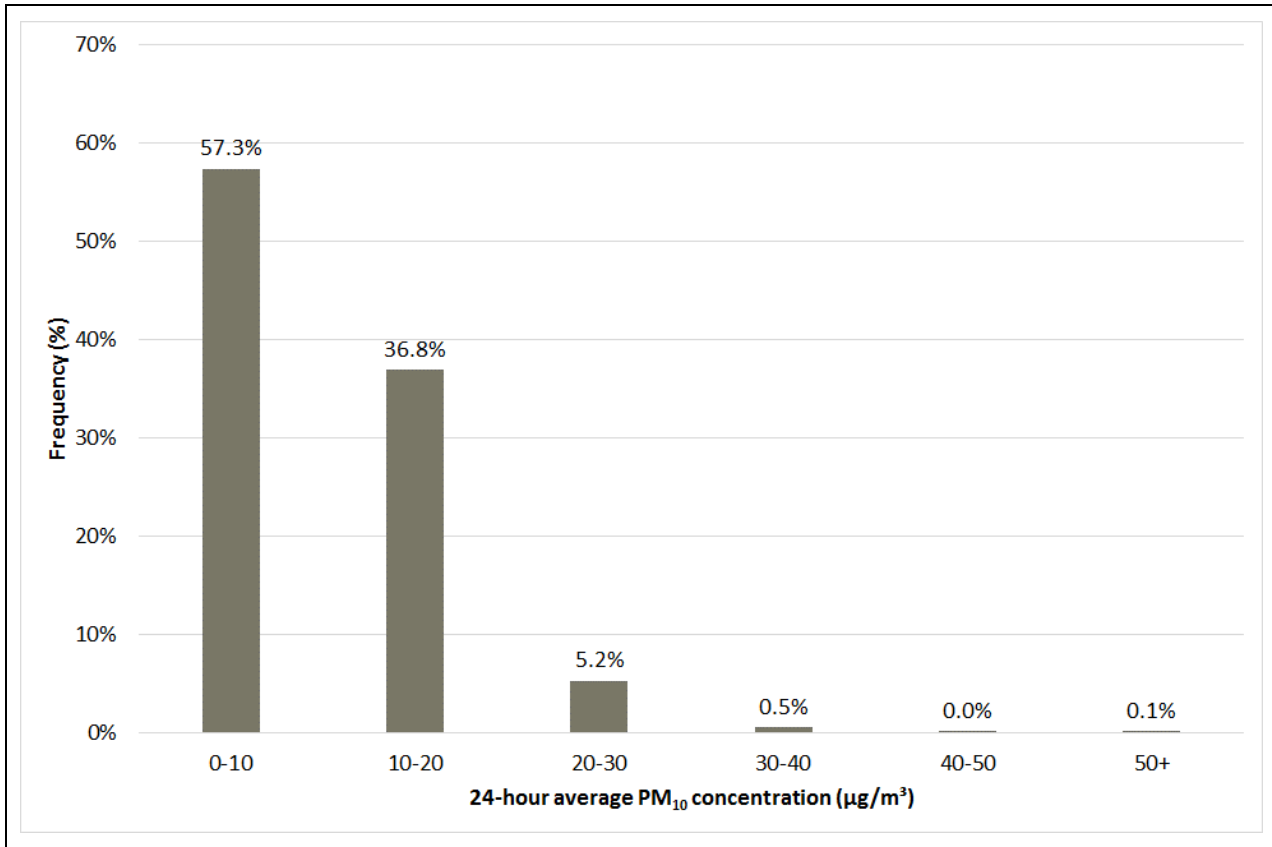


**Figure 4-1: Inter-annual comparison of 24-hour average PM<sub>10</sub> concentrations at Monash monitoring station – 2012 to 2017**

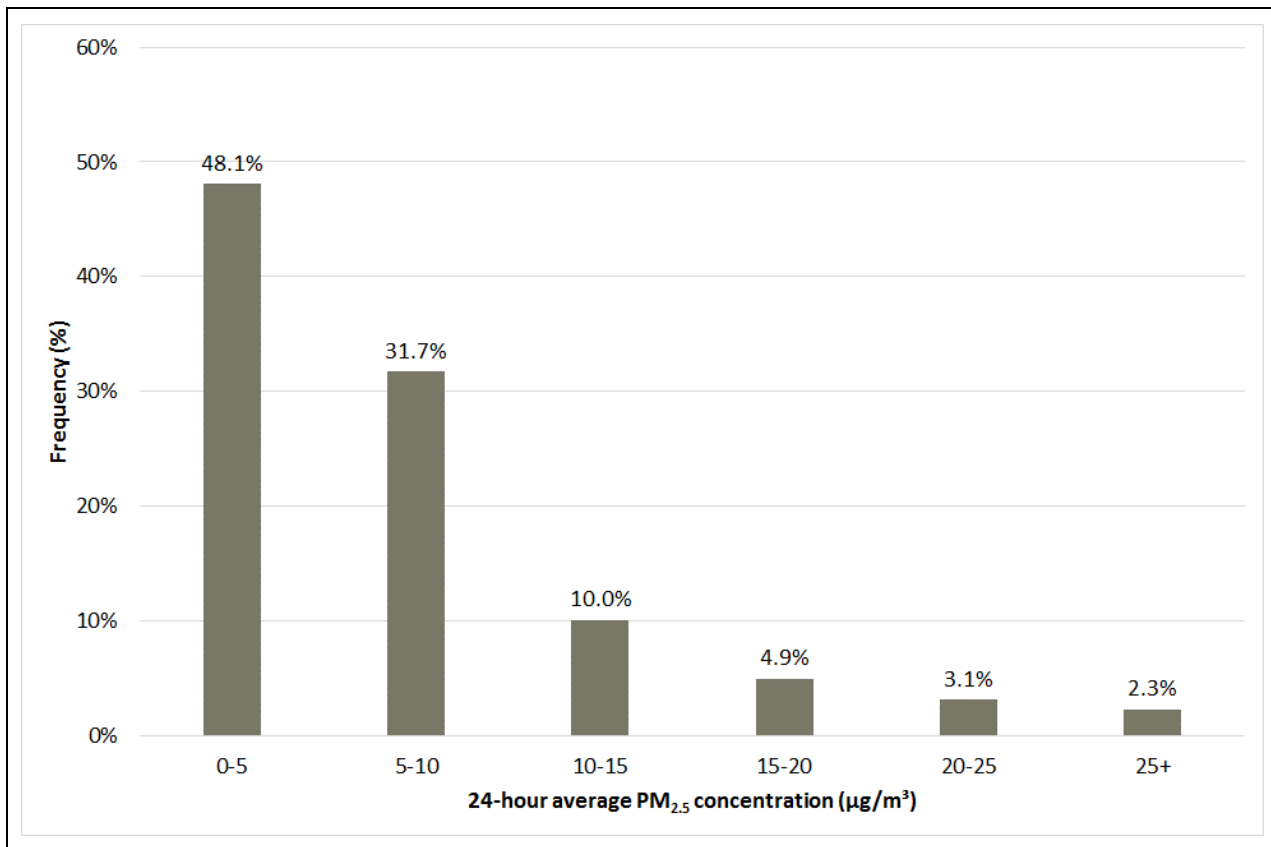


**Figure 4-2: Inter-annual comparison of 24-hour average PM<sub>2.5</sub> concentrations at Monash monitoring station – 2013 to 2017**

The frequency distribution of recorded PM<sub>10</sub> and PM<sub>2.5</sub> concentrations between 2012 and 2017 are illustrated in **Figure 4-3** and **Figure 4-4** respectively. These figures show that PM<sub>10</sub> concentrations in the region were below 30µg/m<sup>3</sup> approximately 96% of the time, while PM<sub>2.5</sub> concentrations were below 15µg/m<sup>3</sup> approximately 97% of the time between 2010 and 2015.



**Figure 4-3: Frequency distribution of 24-hour Average PM<sub>10</sub> Concentrations recorded at Monash – 2012 to 2017**



**Figure 4-4: Frequency distribution of 24-hour Average PM<sub>2.5</sub> Concentrations recorded at Monash – 2013 to 2017**

#### 4.1.2 TSP concentrations

There is no local TSP monitoring data in the vicinity of the project to characterise baseline. However historical measurements of TSP and PM<sub>10</sub> in Sydney<sup>2</sup> indicate that PM<sub>10</sub>/TSP ratios in urban areas typically range from 0.4 to 0.5. Further, rural/semi-rural areas typically experience a PM<sub>10</sub>/TSP ratio of 0.4 (ENVIRON, 2009). A ratio of 0.4 was applied to the PM<sub>10</sub> concentration data to derive an annual average TSP concentration of 24.5 µg/m<sup>3</sup> (based on 2015 monitoring at the Monash station).

#### 4.1.3 Nuisance dust

Boral maintain four dust deposition locations in the vicinity of the project as part of EPA licence conditions for the existing Mugga Quarry operations. The four locations are sited at varying distances from the quarry. The site least affected by quarry emissions is located to the west of the site near Mugga Lane. During 2015, this site recorded an annual average dust deposition rate of 2.2 g/m<sup>2</sup>/month. This deposition level will be adopted as background dust deposition for the neighbouring receptors.

<sup>2</sup> Reported in Quarterly Air Quality Monitoring Reports - <http://www.environment.nsw.gov.au/aqms/datareports.htm#quarterlies>

## 5. EMISSIONS INVENTORY

### 5.1 Emissions scenario

Emissions to air associated with the operation of the project primarily comprise fugitive dust in each of the particle size metrics described in **Section 2.1** (TSP, PM<sub>10</sub> and PM<sub>2.5</sub>). Fine particulate emissions generated by the combustion of diesel fuel by plant and equipment onsite has also been accounted for in this AQIA.

Sources of fugitive dust at the project include:

- Extraction within the quarry pit, loading to trucks, haulage and unloading of overburden material at the proposed new permanent bund and temporary emplacement areas;
- New bund construction activities, including handling of material by bulldozer and excavator;
- Removal, handling, hauling and dumping of hard rock product from the quarry pit, including drilling and blasting;
- Processing of extracted material (crushing, screening and conveying);
- Concrete batching plant operations;
- Asphalt plant operations;
- Recycling plant operations;
- Wind erosion from assorted stockpiles and exposed surfaces; and
- Transportation (hauling) of product along unpaved internal roads and the paved site access road.

A single particulate matter emissions inventory has been developed for the project to represent the new overburden and bund construction activities and existing site operations. In order to conservatively estimate impacts from proposed operations, the following key conservative assumptions are made:

- The assessment assumes the haulage of overburden material from the quarry pit continually extends to the furthest point on the new dump footprint, maximising haulage distance in emission calculations;
- No shielding of overburden haulage, unloading or handling (dozer, excavator) from the bund is ever assumed;
- The full footprint of the new bund/temporary emplacement area is assumed to be active for wind erosion emissions at all times.

Emission factors developed by the US EPA<sup>3</sup> have been applied to estimate the amount of dust produced by each activity. Emissions were quantified for each particle size fraction, with the TSP size fraction also used to predict dust deposition rates. It is noted that fugitive emission factors are also provided in the National Pollution Inventory (NPI) Emission Estimation Technique Manual for Mining (NPI, 2012), however these are typically based on, or the same as, those presented in the US EPA AP-42.

Emission estimates for fugitive dust from the various operations occurring at site were quantified through the application of emission factors listed in:

- National Pollution Inventory Emission Estimation Technique Manual for Mining, Version 3 (NPI, 2012);
- US-EPA AP-42 Chapter 13.2.1 *Paved Roads* (US-EPA, 2006a);
- US-EPA AP-42 Chapter 13.2.2 *Unpaved Roads* (US-EPA, 2011);
- US-EPA AP-42 Chapter 11.19.2 *Crushed Stone Processing and Pulverized Mineral Processing* (US-EPA, 2004b);
- US-EPA AP-42 Chapter 13.2.4 *Aggregate Handling and Storage Piles* (US-EPA, 2006b); and
- US-EPA AP-42 Chapter 13.2.5 *Industrial Wind Erosions* (US-EPA, 2006c).

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<sup>3</sup> United States Environmental Protection Agency (US EPA) AP-42 Compilation of Air Pollutant Emission Factors (US EPA, 1998, US EPA, 2004, US EPA, 2006)

Further details on the emission inventory are provided in **Appendix 3**.

## 5.2 Emission controls

Emission reductions were applied to the emissions estimates to account for dust emission controls in place at the quarry. The specific emission reductions applied in the emission inventories are described in **Table 5-1**.

<b>Table 5-1: Emission controls</b>		
<b>Emission source</b>	<b>Measure</b>	<b>% Control</b>
Hauling on unpaved roads	Watering (NPI, 2012) plus maintaining vehicle speeds below 40 km/hr (Countess Environmental, 2006)	86% (75% and 44%)
Material handling and working and new bund area	Water spraying (NPI, 2012)	50%
Truck unloading to processing plant hopper	Water spraying (NPI, 2012)	50%
Crushing and screening components	Water spraying (NPI, 2012)	50%
	Partial enclosure (NPI, 2012)	70%
		Combined 85%
Conveyor transfer points	Water spraying	50%
Wind erosion from stockpiles and exposed surfaces	Water spraying (NPI, 2012)	50%

## 5.3 Summary of estimated emissions

A summary of annual emissions calculated for the modelling scenario is presented in **Table 5-2**. It is noted that the emissions for the Asphalt Plant were taken from the 2017 AQIA, corresponding conservatively to peak day operations occurring continuously throughout the modelled year. Emissions from the concrete batching plant (CPB) and recycling area were taken from the AQIA completed by ENVIRON in 2011.

The contribution of various source groups to annual emissions is presented in **Figure 5-1**. Emissions of haulage associated with each source group are included within that source group (e.g. overburden haulage is grouped within overburden (OB) operations).

The proposed overburden handling and new emplacement construction represent a significant proportion of annual emissions for all size fractions. Wind erosion emissions are also a key contributing source to annual emissions. The asphalt plant is a key contributor to fine particulates (PM<sub>2.5</sub>), largely associated with the plant emissions stack.

<b>Table 5-2: Annual emissions by source</b>			
<b>Emissions Source</b>	<b>Calculated Emissions (tpa) by Source</b>		
	<b>TSP</b>	<b>PM<sub>10</sub></b>	<b>PM<sub>2.5</sub></b>
OB loading in pit	0.18	0.08	0.01
OB haulage - Pit to top	7.74	2.20	0.22
OB haulage - Pit top to dump	20.70	5.67	0.57
Truck unloading OB to dump area	0.09	0.04	0.01
Dozer operations on dump	2.61	0.49	0.27
Drill	0.25	0.13	0.02
Blast	0.08	0.04	0.01
FEL handling blasted rock	1.22	0.58	0.09
Quarry haulage - Pit to top	8.85	2.52	0.25
Quarry haulage - Pit top to processing	3.79	1.08	0.11
Unloading to Processing Plant hopper	0.61	0.29	0.04
Primary Crusher	0.20	0.09	0.02
Secondary Crusher	0.20	0.09	0.02
Tertiary Crusher	0.20	0.09	0.02
Screening	0.94	0.32	<0.01
Stockpile loading	0.61	0.29	0.04
FEL handling product material	1.22	0.58	0.09
Loading to trucks	1.22	0.58	0.09
Product to CPB	4.55	1.25	0.13
Transport to site exit	6.07	1.67	0.17
Wind Erosion - quarry pit	15.13	7.57	1.13
Wind Erosion - OB Dump	0.77	0.38	0.06
Wind Erosion - OB Dump rehab	2.13	1.06	0.16
Wind Erosion - processing area	1.11	0.55	0.08
Wind Erosion - CPB area	0.26	0.13	0.02
Diesel Combustion - trucks and mobile plant	1.01	1.01	0.93
Recycling area operations	0.93	0.33	0.02
CPB operations	4.71	2.30	0.22
Asphalt Plant operations	13.7	6.8	4.5
<b>Total</b>	<b>101.1</b>	<b>38.2</b>	<b>9.3</b>

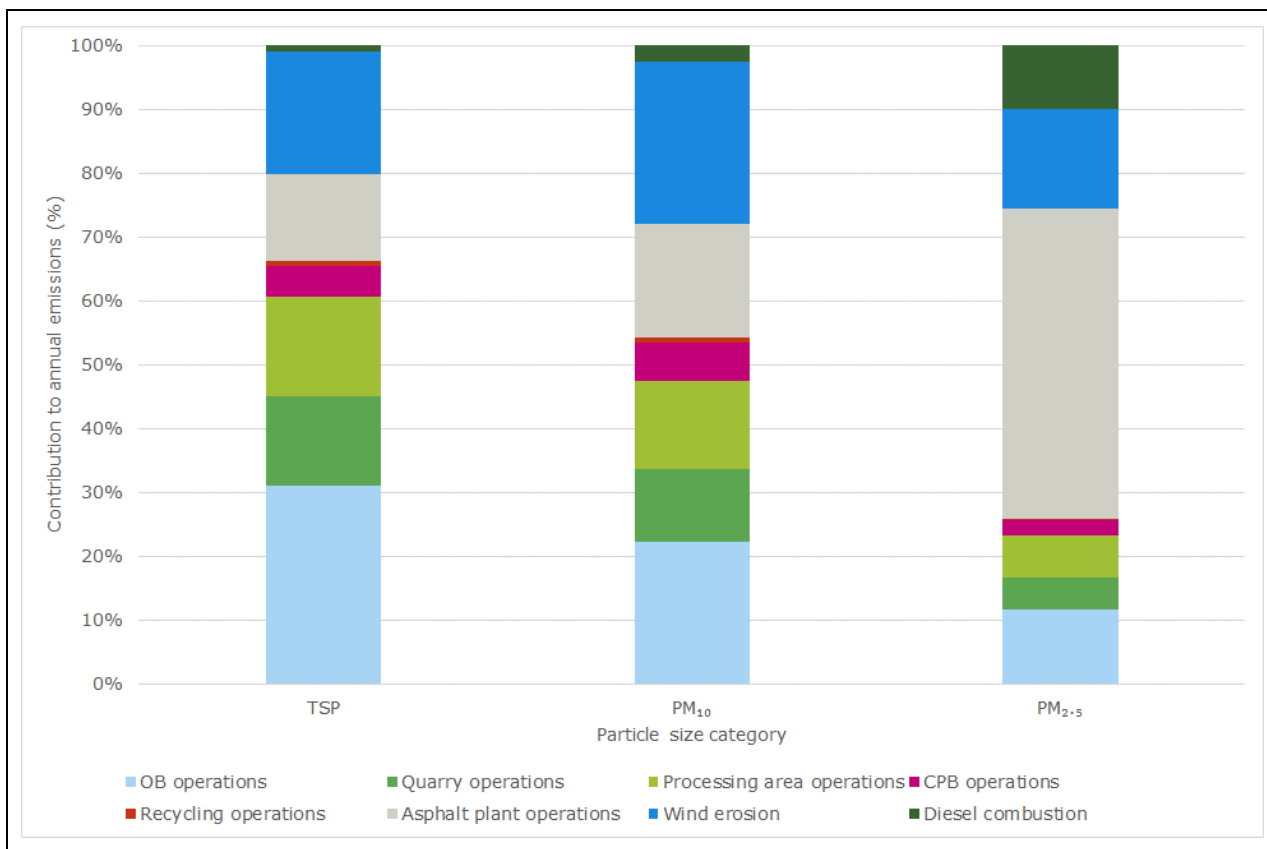


Figure 5-1: Contribution to annual emissions of particulate matter size fraction by source category

## 6. OVERVIEW OF MODELLING

### 6.1 Dispersion model

As discussed in **Section 3.2**, the CALPUFF (Version 6.2) modelling system has been applied in this assessment. Model configuration was conducted in accordance with the recommendations in TRC (2011).

CALPUFF is a transport and dispersion model that advects “puffs” of material emitted from the modelled sources, simulating dispersion and transformation processes along the transport pathway. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout the simulation period. The primary output files from CALPUFF contain either hourly concentration or hourly deposition fluxes evaluated at selected receptor locations and at grid intercepts across the modelling domain.

Air pollutant concentrations of particulate matter pollutants were simulated for a regular Cartesian receptor grid covering a 5km (east-west) by 5km (north-south) computational domain, set within the CALMET modelling domain and centred over the project site, with a grid resolution of 250m. Additionally, concentrations and deposition rates were predicted at the various sensitive receptor locations listed in **Table 2-4**. Pollution simulations were undertaken for the 12 month period between 1 January 2015 and 31 December 2015.

All emissions sources are represented by a series of volume sources, located according to site layout (**Appendix 1**).

### 6.2 Presentation of model results

Dispersion simulations were undertaken to predict the concentrations of TSP, PM<sub>10</sub>, PM<sub>2.5</sub> and dust deposition. Incremental project-related concentrations and deposition rates occurring due to the project were predicted. Model results are expressed as the maximum predicted concentration for each averaging period at the selected assessment locations over the 2015 modelling period.

Tabulated results are presented in **Section 7** of concentrations and dust deposition rates at the selected assessment locations. Further, isopleth plots, illustrating spatial variations in project-only incremental TSP, PM<sub>10</sub>, PM<sub>2.5</sub>, and dust deposition are provided.

The isopleth plots of the maximum 24-hour average concentrations presented do not represent the dispersion pattern on any individual day, but rather illustrate the maximum daily concentration that was predicted to occur at each model calculation point given the range of meteorological conditions occurring over the 2015 modelling period.

### 6.3 Cumulative impacts assessment

Cumulative impacts in the environment surrounding the project have been assessed in the following way:

- For 24-hour average PM<sub>10</sub> and PM<sub>2.5</sub>, each predicted project-only concentration has been paired with every individual 24-hour average recorded PM<sub>10</sub> and PM<sub>2.5</sub> concentration in the ACT Monash air quality monitoring datasets for 2012 to 2017 (**Section 4.1**). A frequency analysis of potential cumulative PM<sub>10</sub> and PM<sub>2.5</sub> was derived and compared with ambient background to determine potential frequency of any additional criterion exceedances beyond those already occurring in the ambient environment (further discussion in **Section 7.2.1**).
- For annual average pollutants, the annual average project-only concentration is paired with the applicable 2015 ambient annual average background concentration (**Section 4**).

## 7. IMPACT ASSESSMENT

### 7.1 Incremental (site-only) ground level concentrations

Predicted project-only incremental concentrations and deposition rates at each of the receptor assessment locations are presented in **Table 7-1**.

The predicted incremental concentrations and deposition rates are below all applicable assessment criteria at all selected assessment locations. Relevant cumulative impacts have been addressed in **Section 7.2**.

<b>Table 7-1: Predicted project-only increment impacts – TSP, PM<sub>10</sub>, PM<sub>2.5</sub> and dust deposition</b>						
Receptor ID	TSP	PM <sub>10</sub>		PM <sub>2.5</sub>		Dust deposition
	Annual	24-hour	Annual	24-hour	Annual	Annual
Unit	µg/m <sup>3</sup>					g/m <sup>2</sup> /month
Criteria	90	50	30	25	8	2
1	2.0	6.8	1.0	1.0	0.2	0.1
2	1.2	3.8	0.7	0.7	0.1	<0.1
3	7.6	22.9	2.8	4.6	0.5	1.0
4	1.2	3.9	0.7	1.2	0.3	0.1
5	1.3	5.4	0.8	1.4	0.2	0.1
6	0.4	1.0	0.3	0.4	0.1	<0.1
7	0.8	4.9	0.5	1.0	0.1	0.1
8	2.3	11.7	1.3	2.5	0.3	0.3
9	0.6	2.0	0.5	0.9	0.2	<0.1
10	3.2	15.6	1.6	3.1	0.3	0.5

Isopleth contour plots of project-only incremental concentrations of PM<sub>10</sub> (24-hour and annual), PM<sub>2.5</sub> (24-hour and annual), TSP (annual) and dust deposition (annual) are presented in **Figure 7-1** through to **Figure 7-6**.

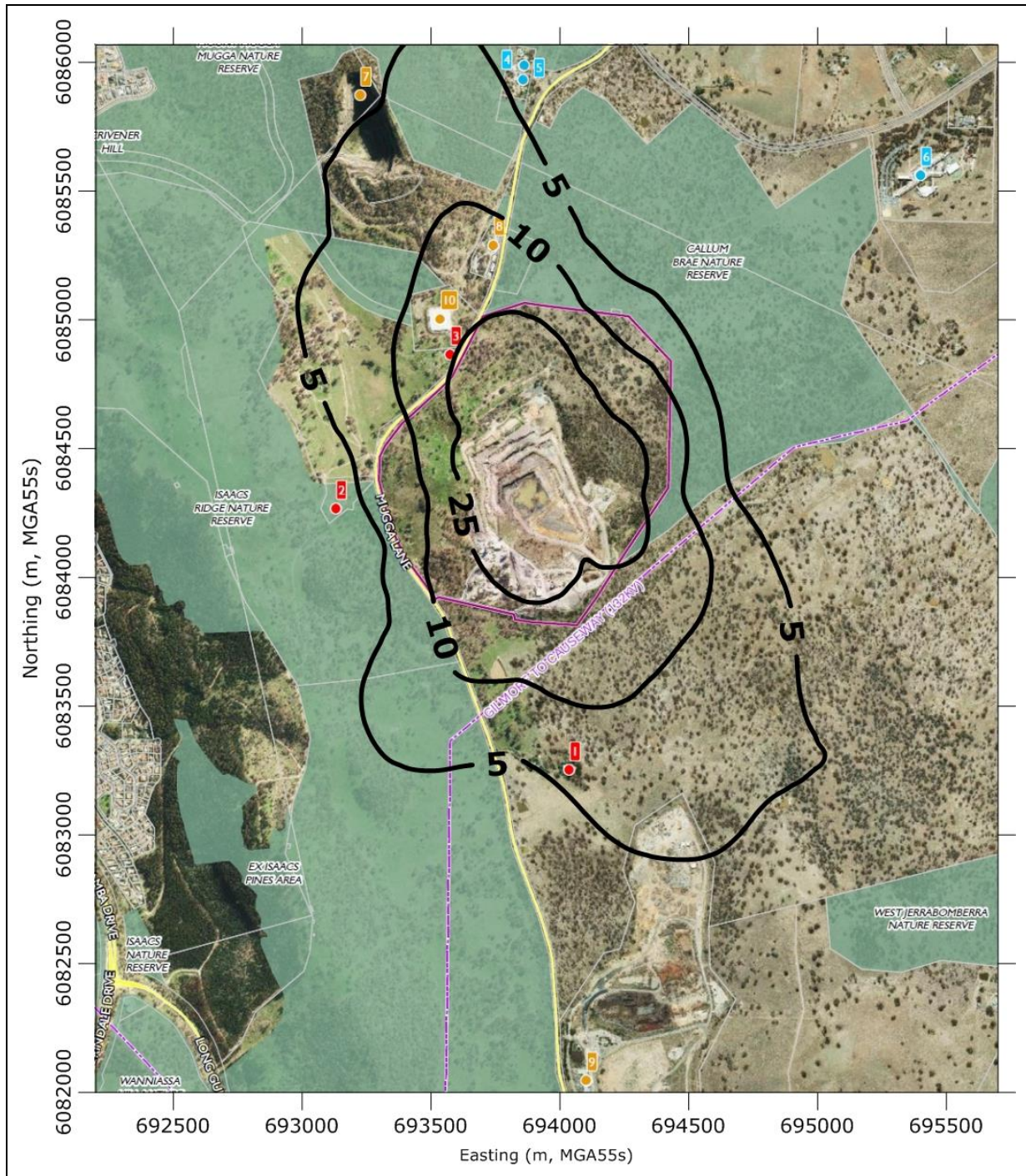


Figure 7-1: Maximum predicted 24-hour average PM<sub>10</sub> (µg/m<sup>3</sup>) – site only

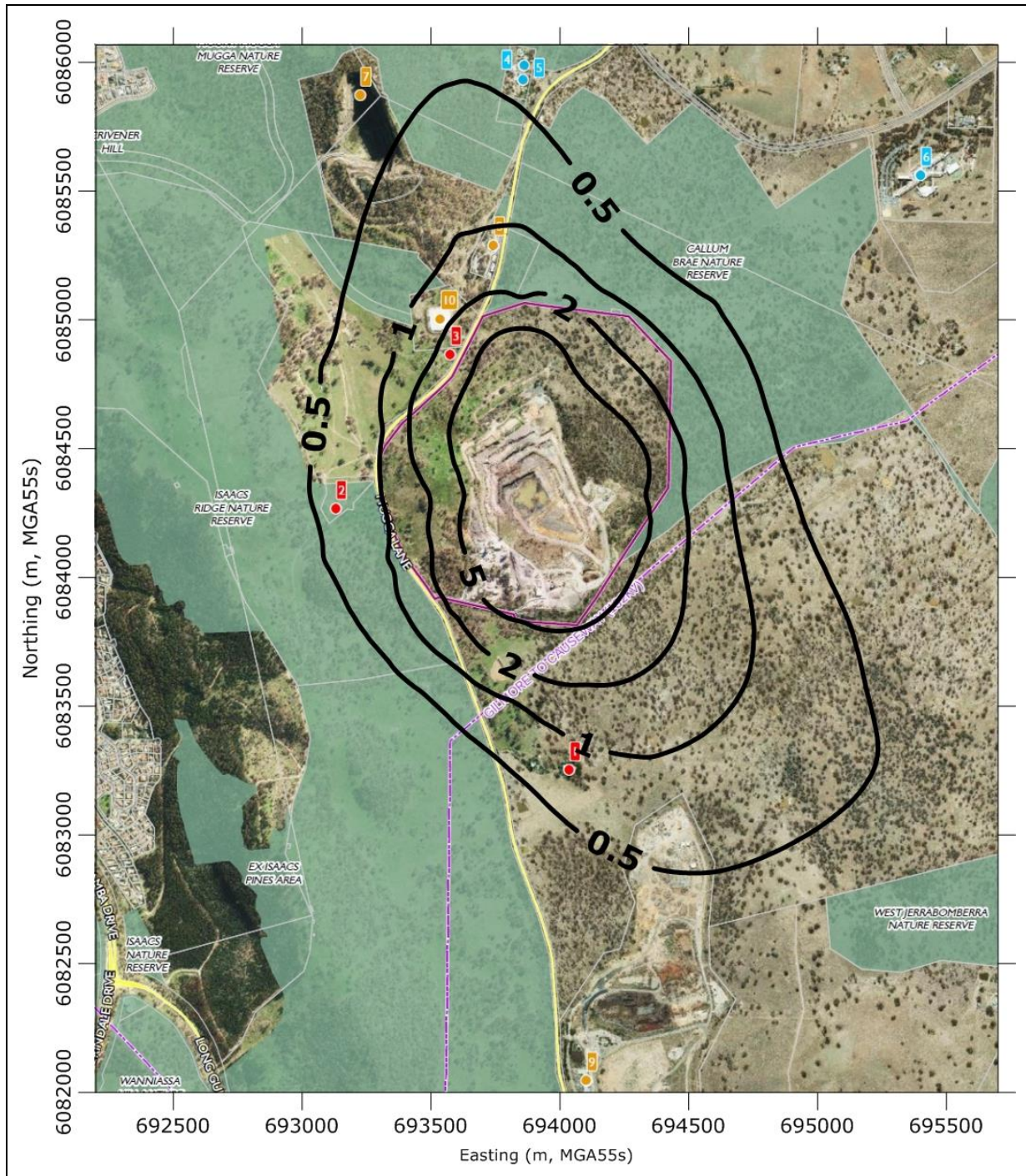


Figure 7-2: Predicted annual average PM<sub>10</sub> (µg/m<sup>3</sup>) – site only

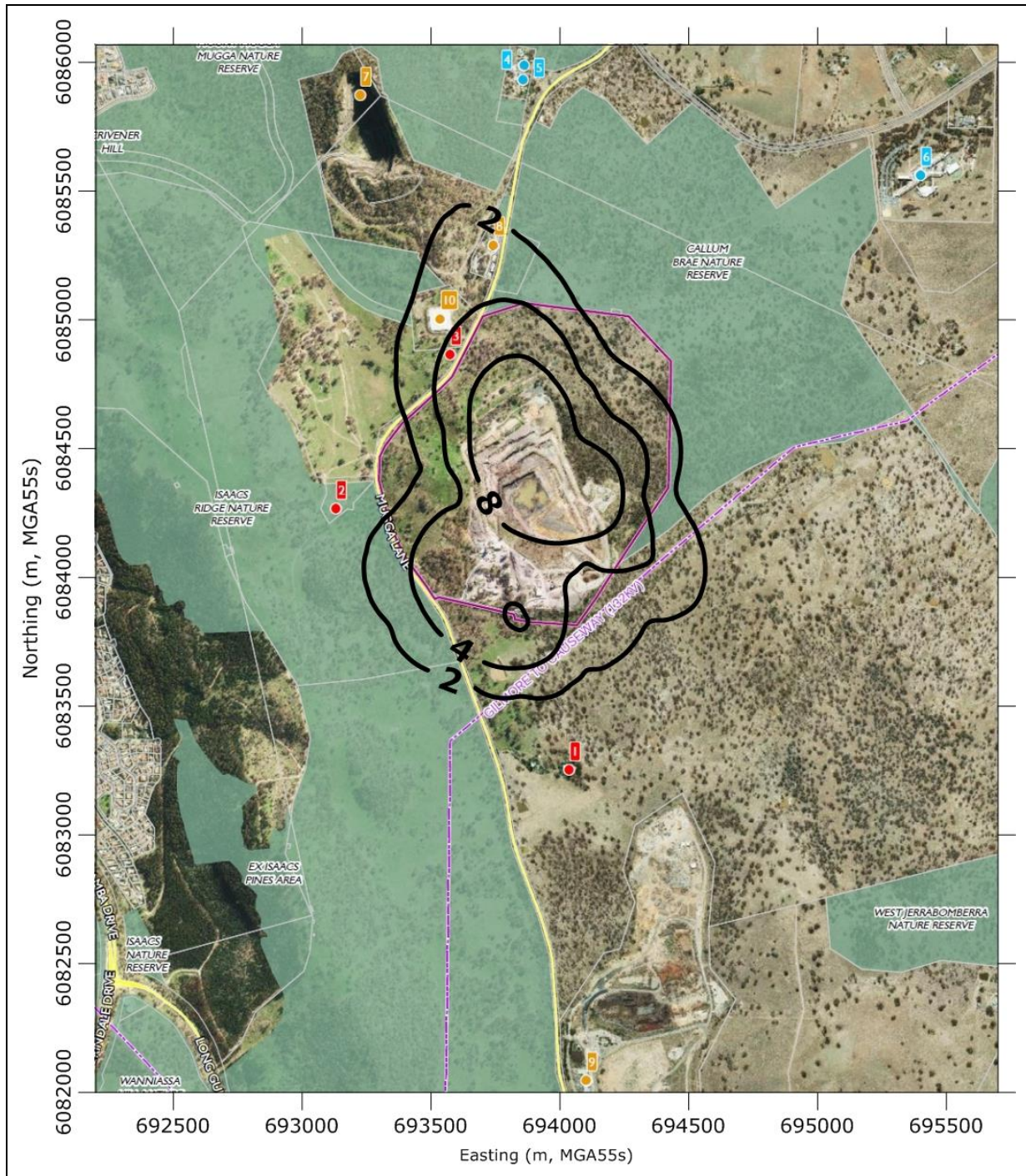


Figure 7-3: Maximum predicted 24-hour average PM<sub>2.5</sub> (µg/m<sup>3</sup>) – site only

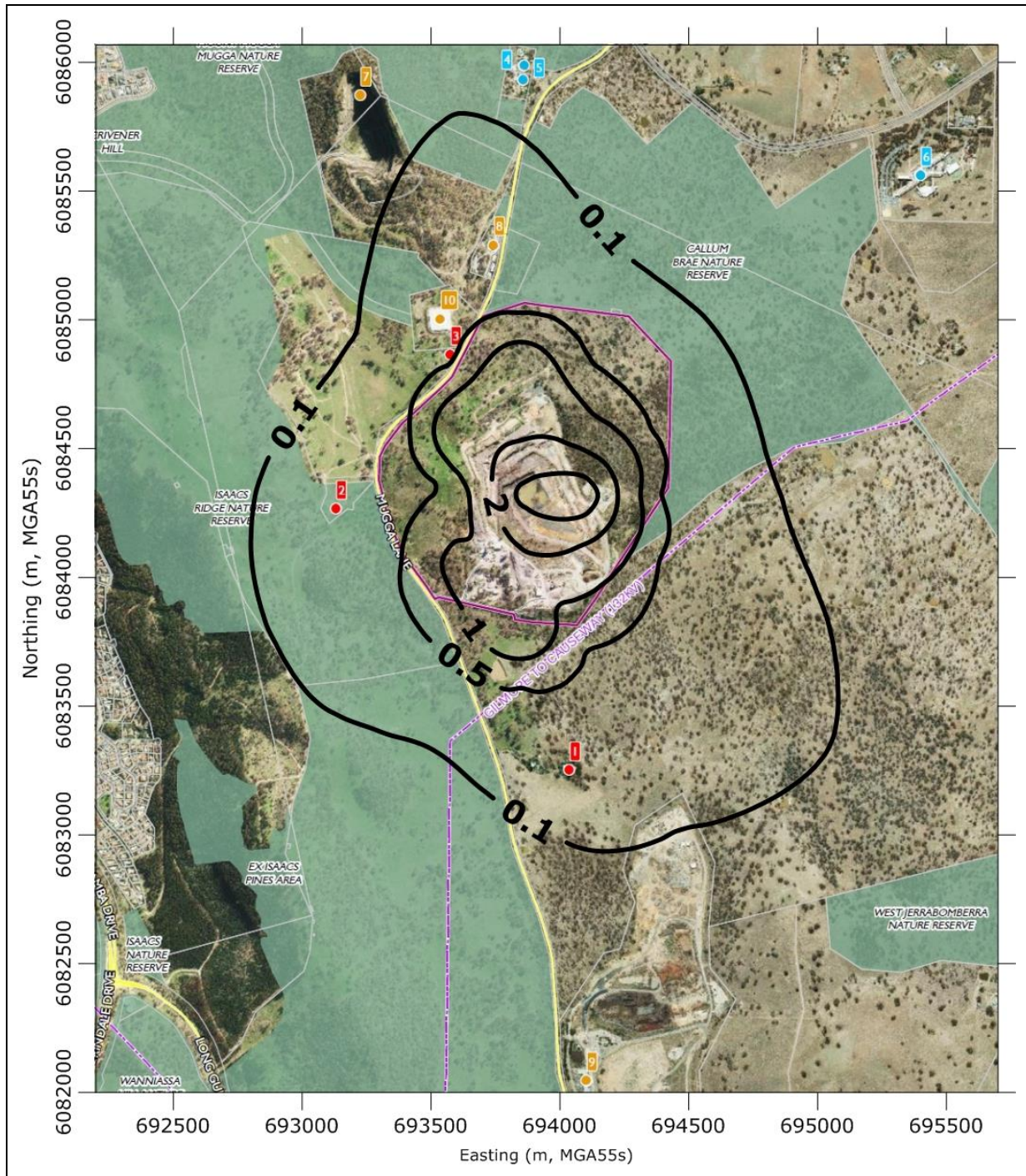


Figure 7-4: Predicted annual average PM<sub>2.5</sub> (µg/m<sup>3</sup>) – site only

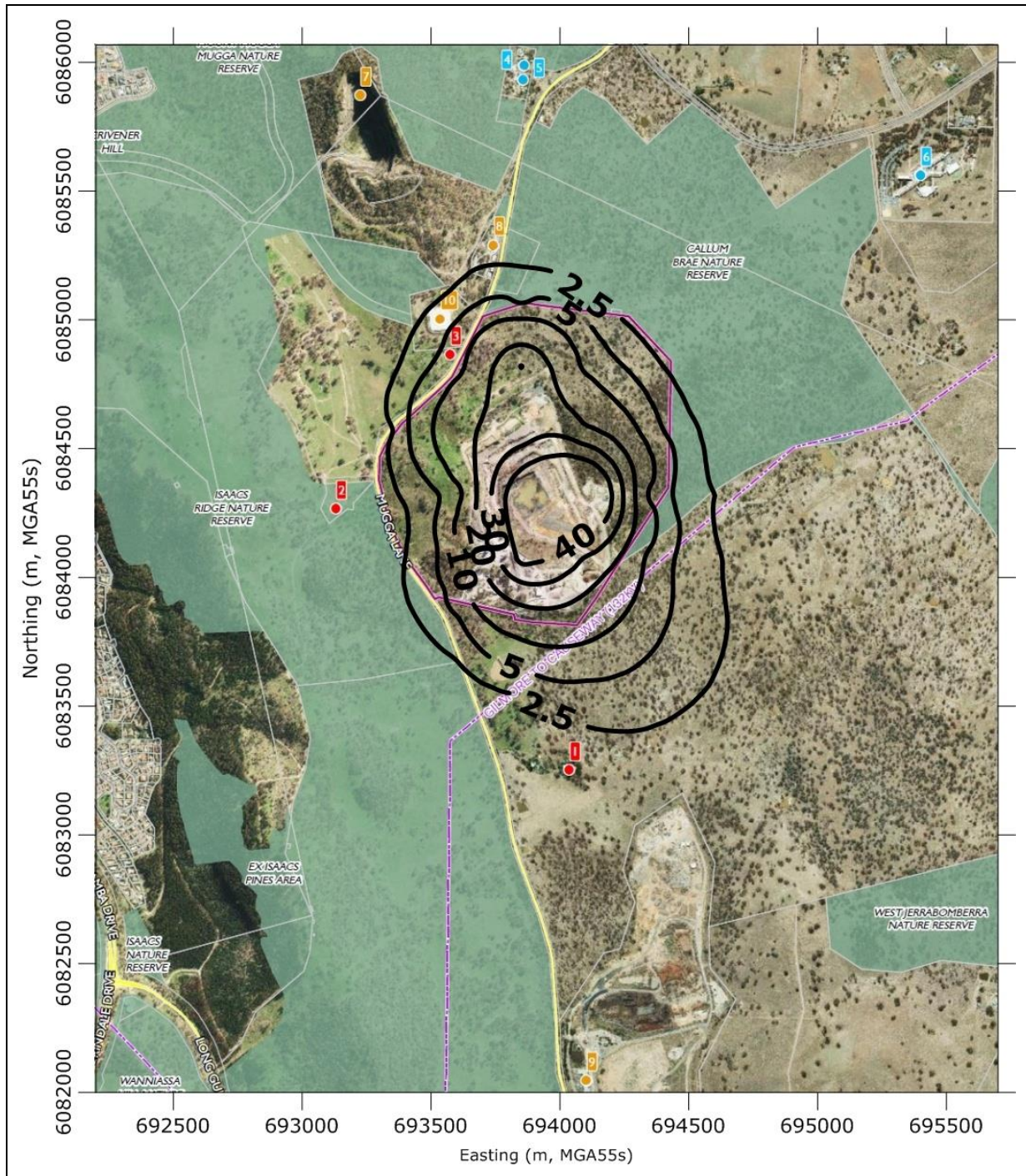


Figure 7-5: Predicted annual average TSP (µg/m³) – site only

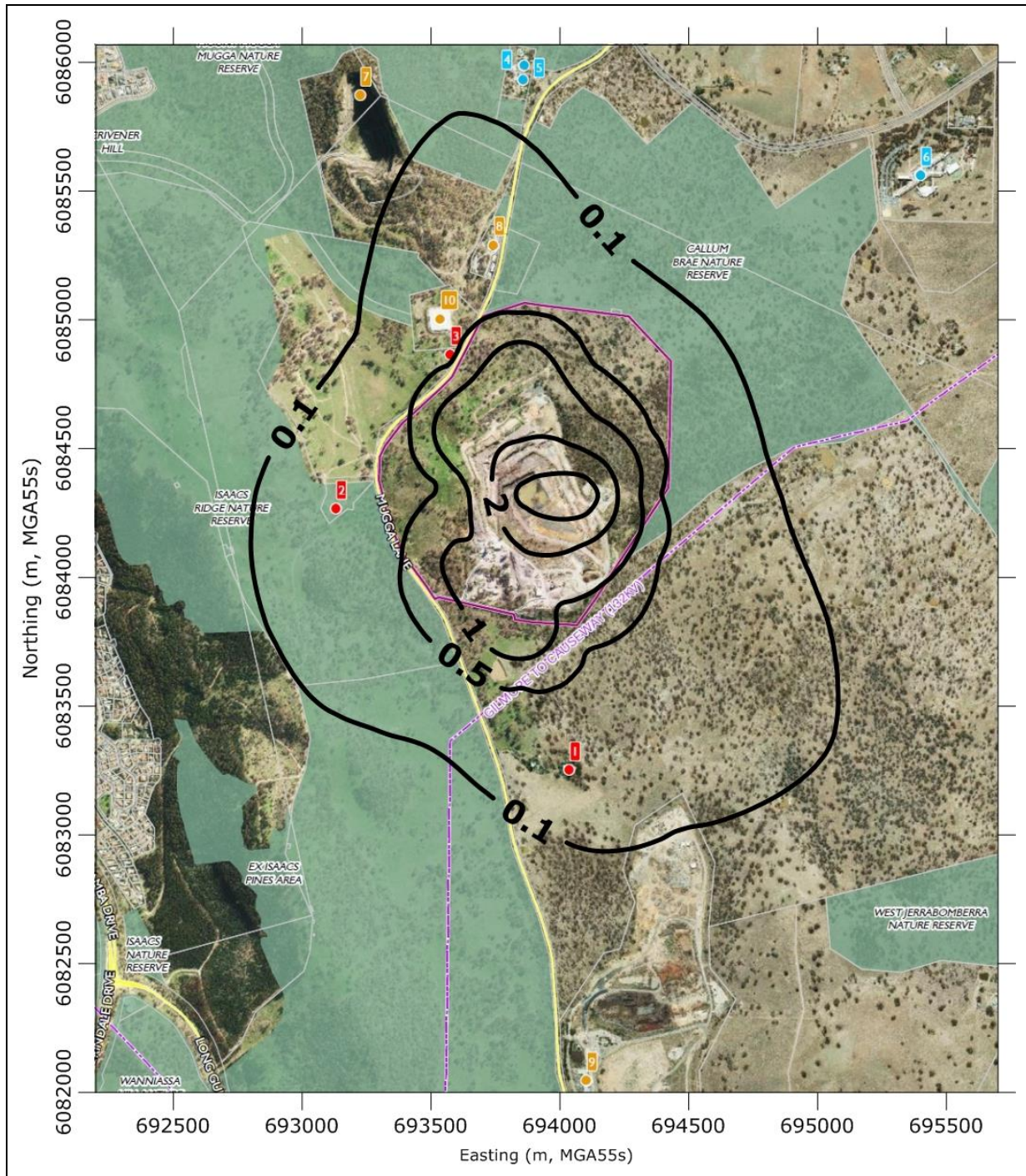


Figure 7-6: Predicted dust deposition (g/m<sup>2</sup>/month) – site only

## 7.2 Cumulative ground level concentrations

### 7.2.1 Cumulative 24-hour average concentrations

Cumulative impacts (project + ambient air quality levels) for 24-hour  $PM_{10}$  and  $PM_{2.5}$  have been evaluated using a statistical approach which presents the likelihood of the project causing additional exceedances of the 24-hour average assessment criterion of  $50\mu\text{g}/\text{m}^3$  and  $25\mu\text{g}/\text{m}^3$  for  $PM_{10}$  and  $PM_{2.5}$  respectively.

To provide an analysis of the likelihood of compliance with the assessment criterion, every predicted 24-hour average concentration (365 individual concentrations) has been paired with every recorded 24-hour average concentration from the Monash monitoring station as detailed in **Section 4** (2,145 for  $PM_{10}$ , 1,736 for  $PM_{2.5}$ ).

Each combination of model prediction and recorded concentration (782,925 potential combinations for  $PM_{10}$ ; 633,640 potential combinations for  $PM_{2.5}$ ) has been collated. The process assumes that any background value from the dataset could occur on any given day during the project operation.

For each receptor assessment location, a frequency distribution of cumulative concentrations has been derived. Frequency histogram plots for cumulative 24-hour average  $PM_{10}$  and  $PM_{2.5}$  concentrations are presented in **Figure 7-7** and **Figure 7-8** respectively.

The frequency histogram profiles presented in **Figure 7-7** and **Figure 7-8** demonstrate that the most notable change from the "ambient background" frequency occurs in the lower concentration bands (less than  $20\mu\text{g}/\text{m}^3$  for  $PM_{10}$  and less than  $10\mu\text{g}/\text{m}^3$  for  $PM_{2.5}$ ).

The frequency analysis of the ambient background dataset from the Monash station (2012 to 2017) indicates that the region has a 0.09% likelihood (or 0.3 days per year) of experiencing a 24-hour average  $PM_{10}$  concentration greater than  $50\mu\text{g}/\text{m}^3$  and a 2.3% likelihood (or 8 days per year) of experiencing a 24-hour average  $PM_{2.5}$  concentration greater than  $25\mu\text{g}/\text{m}^3$ . As discussed in **Section 4**, infrequent exceedances of the  $PM_{10}$  criterion are generally associated with large-scale natural events, such as bushfires and dust storms, while exceedance of the  $PM_{2.5}$  criterion is attributable to domestic wood heater emissions.

For both 24-hour  $PM_{10}$  and  $PM_{2.5}$ , the receptor location with the highest change from ambient background is receptor R3. Change in the frequency of cumulative concentrations at receptor R3 is as follows:

- For 24-hour average  $PM_{10}$  concentrations, the frequency of cumulative 24-hour average concentrations greater than  $50\mu\text{g}/\text{m}^3$  at receptor R3 is 0.15%, representing an increase of 0.6% or 0.2 additional exceedance days per year relative to the ambient background dataset.
- For 24-hour average  $PM_{2.5}$  concentrations, the frequency of cumulative 24-hour average concentrations greater than  $25\mu\text{g}/\text{m}^3$  at receptor R3 is 2.5%, representing an increase of 0.2% or 0.7 additional exceedance days per year relative to the ambient background dataset.

Therefore, for the most affected receptor location R3, emissions from the project are unlikely to result in an additional exceedance day for both 24-hour average  $PM_{10}$  and  $PM_{2.5}$ .

On the basis of this cumulative analysis, it is considered unlikely that emissions from the project, combined with ambient background concentrations, will result in additional exceedances of the 24-hour average  $PM_{10}$  or  $PM_{2.5}$  criteria at any surrounding receptor, beyond those that would occur in the absence of the project (i.e. days influenced by bushfires, dust storms, etc.).

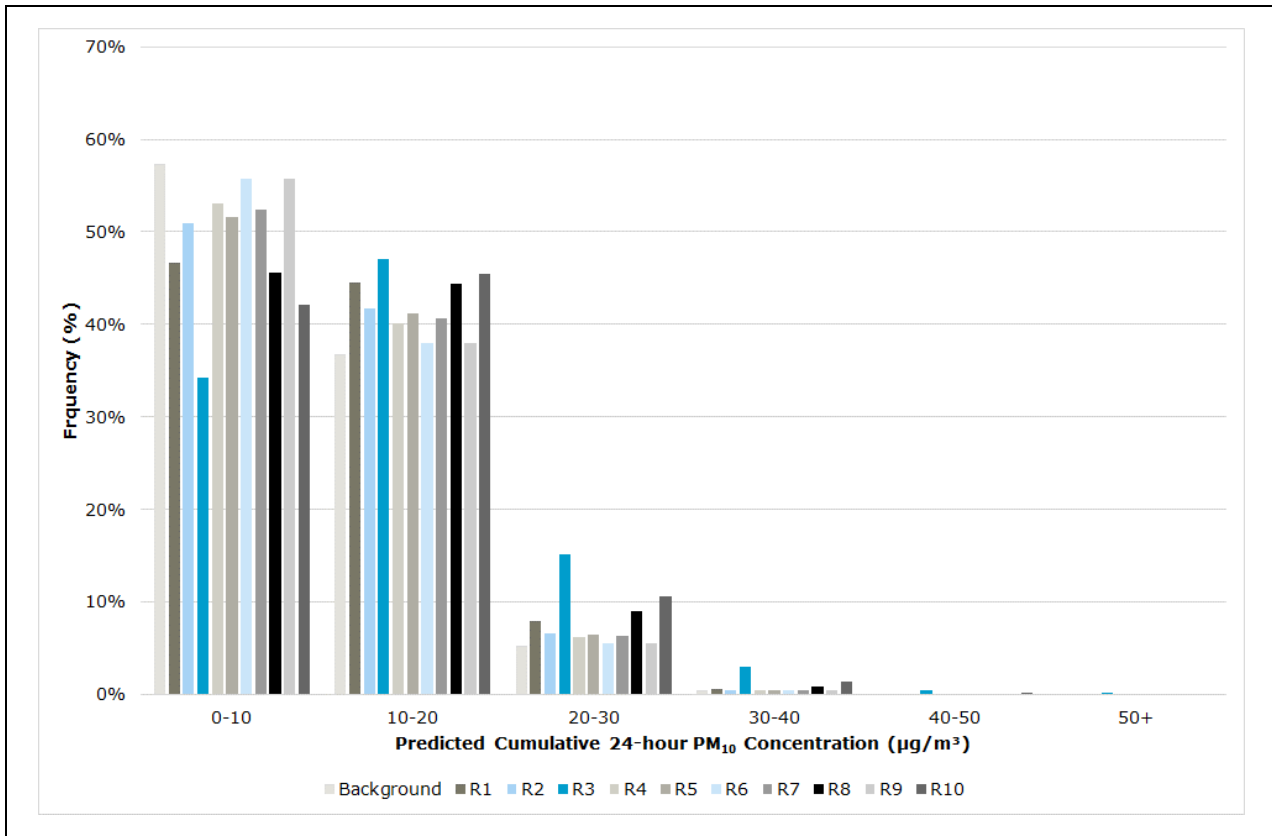


Figure 7-7: Frequency histogram of cumulative 24-hour average PM<sub>10</sub> concentrations relative to ambient background

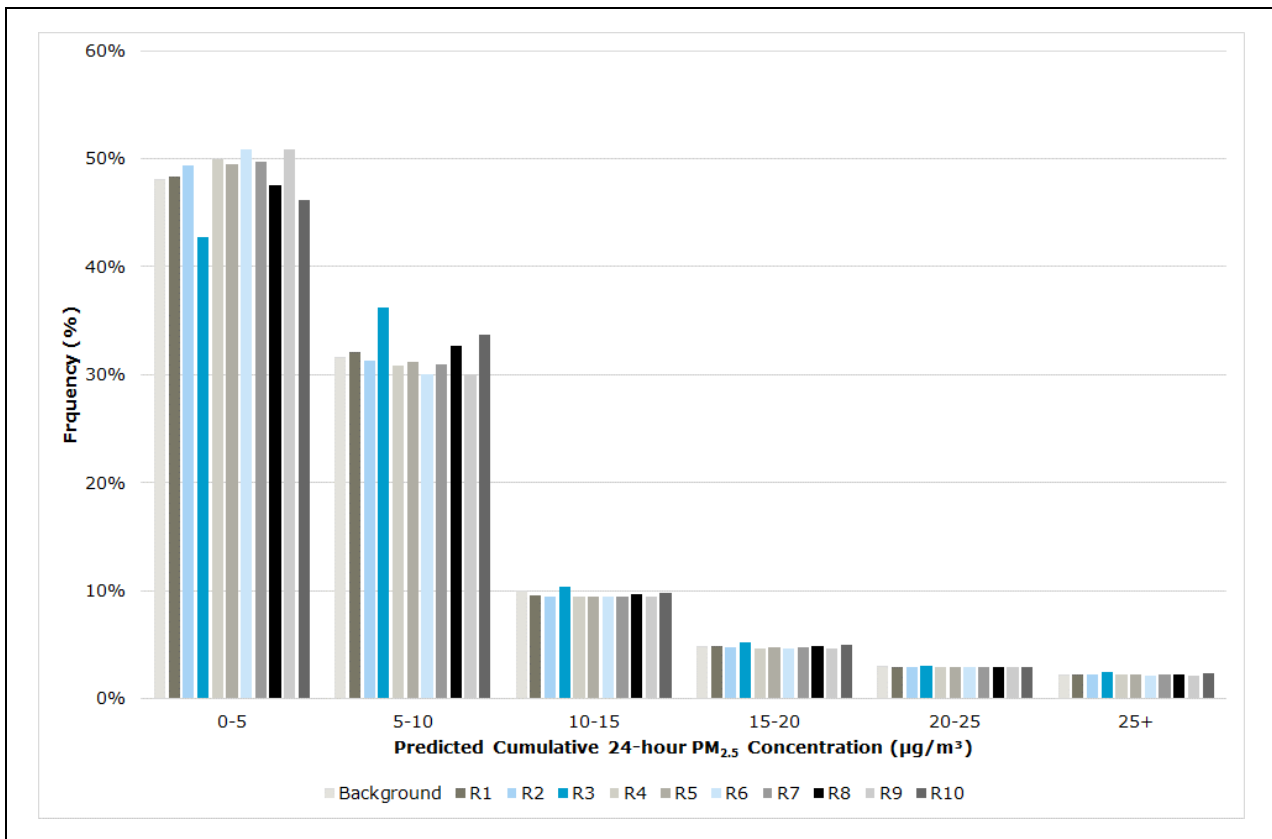


Figure 7-8: Frequency histogram of cumulative 24-hour average PM<sub>2.5</sub> concentrations – operational scenario – watering only at product stockpiles

### 7.2.2 Annual Average Concentrations

**Table 7-2** presents the cumulative annual average concentrations for TSP, PM<sub>10</sub> and PM<sub>2.5</sub> and cumulative annual average dust deposition. It can be seen from the results presented that the cumulative concentrations/deposition rates for all pollutants are below the applicable criterion across all assessment locations.

<b>Table 7-2 Cumulative concentration/deposition due to project</b>				
<b>Receptor Location</b>	<b>Pollutant</b>			
	<b>Annual Average TSP</b>	<b>Annual Average PM<sub>10</sub></b>	<b>Annual Average PM<sub>2.5</sub></b>	<b>Annual Average Dust Deposition</b>
<b>Unit</b>	<b>µg/m<sup>3</sup></b>			<b>g/m<sup>2</sup>/month</b>
1	26.5	10.8	7.4	2.3
2	25.7	10.5	7.3	2.2
3	32.1	12.6	7.7	3.2
4	25.7	10.5	7.5	2.3
5	25.8	10.6	7.5	2.3
6	24.9	10.1	7.3	2.2
7	25.3	10.3	7.3	2.3
8	26.8	11.1	7.5	2.5
9	25.1	10.3	7.4	2.2
10	27.7	11.4	7.5	2.7
<b>Criterion</b>	<b>90</b>	<b>30</b>	<b>8</b>	<b>4</b>

## 8. CONCLUSIONS

Ramboll was commissioned to undertake an AQIA for the project. The work completed for this assessment builds upon the resources developed for the 2017 AQIA.

Emissions of particulate matter associated with routine daily site operations and the proposed construction of the new permanent bund and temporary overburden emplacement area were quantified using publicly available emission estimation techniques. Atmospheric dispersion modelling predictions of air pollution emissions for proposed activities were undertaken using the CALPUFF dispersion model.

The results of the dispersion modelling conducted indicated that the operation of the project is unlikely to result in exceedances of the applicable impact assessment criteria for any of the assessed pollutants at any of the surrounding receptor assessment locations.

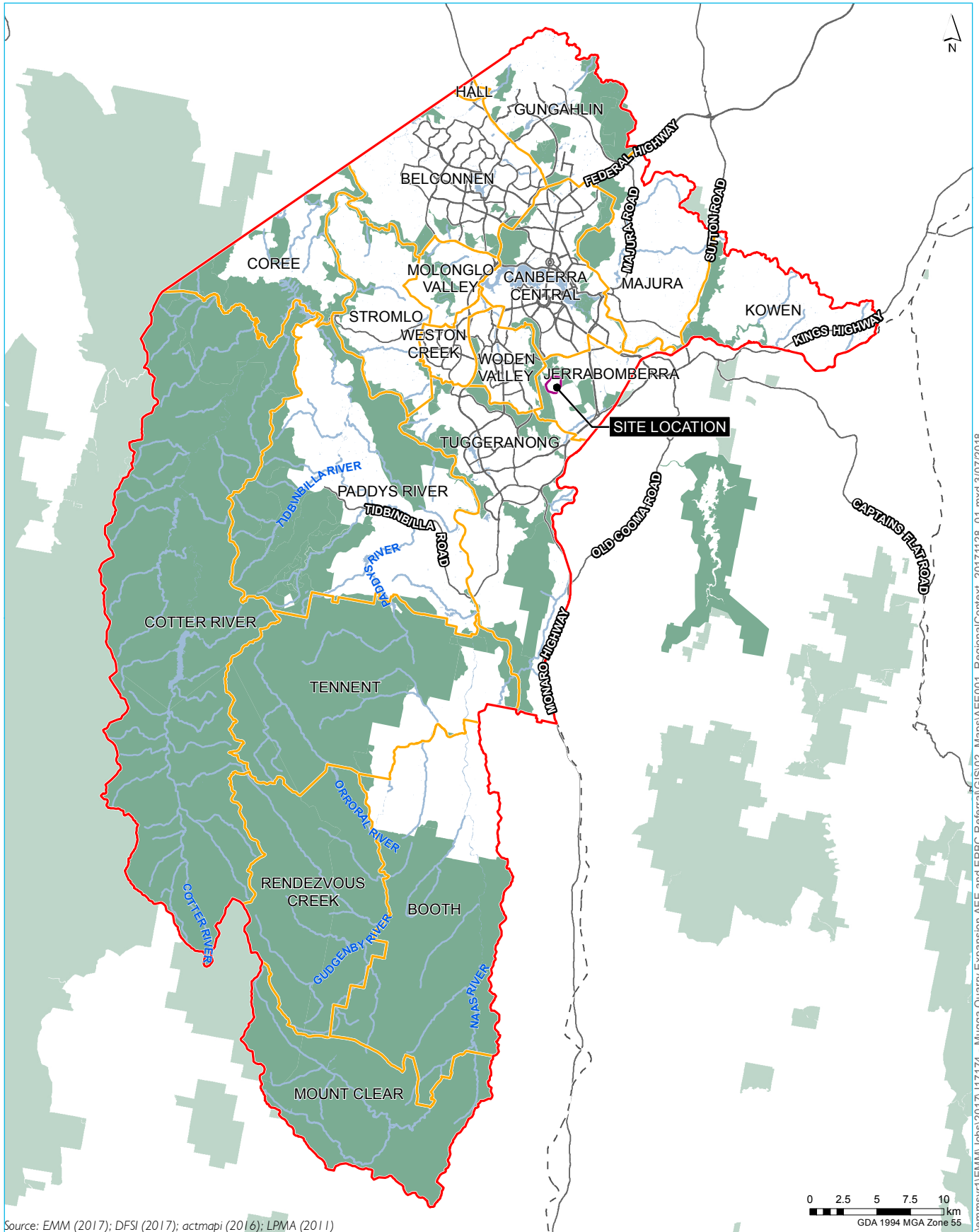
## 9. REFERENCES

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## 10. GLOSSARY OF ACRONYMS AND SYMBOLS

AEE	Assessment of Environmental Effects
AHD	Australian Height Datum
Approved Methods for Modelling	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
AQIA	Air Quality Impact Assessment
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
Boral	Boral Limited
CPB	Concrete batching plant
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EMM	EMM Consulting Pty Limited
EPA	Environmental Protection Authority
FEL	Front end loader
µg	Microgram (g x 10 <sup>-6</sup> )
µm	Micrometre or micron (metre x 10 <sup>-6</sup> )
m <sup>3</sup>	Cubic metre
NPI	National Pollutant Inventory
PM <sub>10</sub>	Particulate matter less than 10 microns in aerodynamic diameter
PM <sub>2.5</sub>	Particulate matter less than 2.5 microns in aerodynamic diameter
Ramboll	Ramboll Australia Pty Ltd
TAPM	"The Air Pollution Model"
The project	New bund construction project at Boral Mugga Quarry
The site	Boral operations at 321 Mugga Lane, Symonston
US-EPA	United States Environmental Protection Agency
VKT	Vehicle Kilometres Travelled

## **APPENDIX 1 PROJECT FIGURES**



Source: EMM (2017); DFSI (2017); actmapi (2016); LPMA (2011)

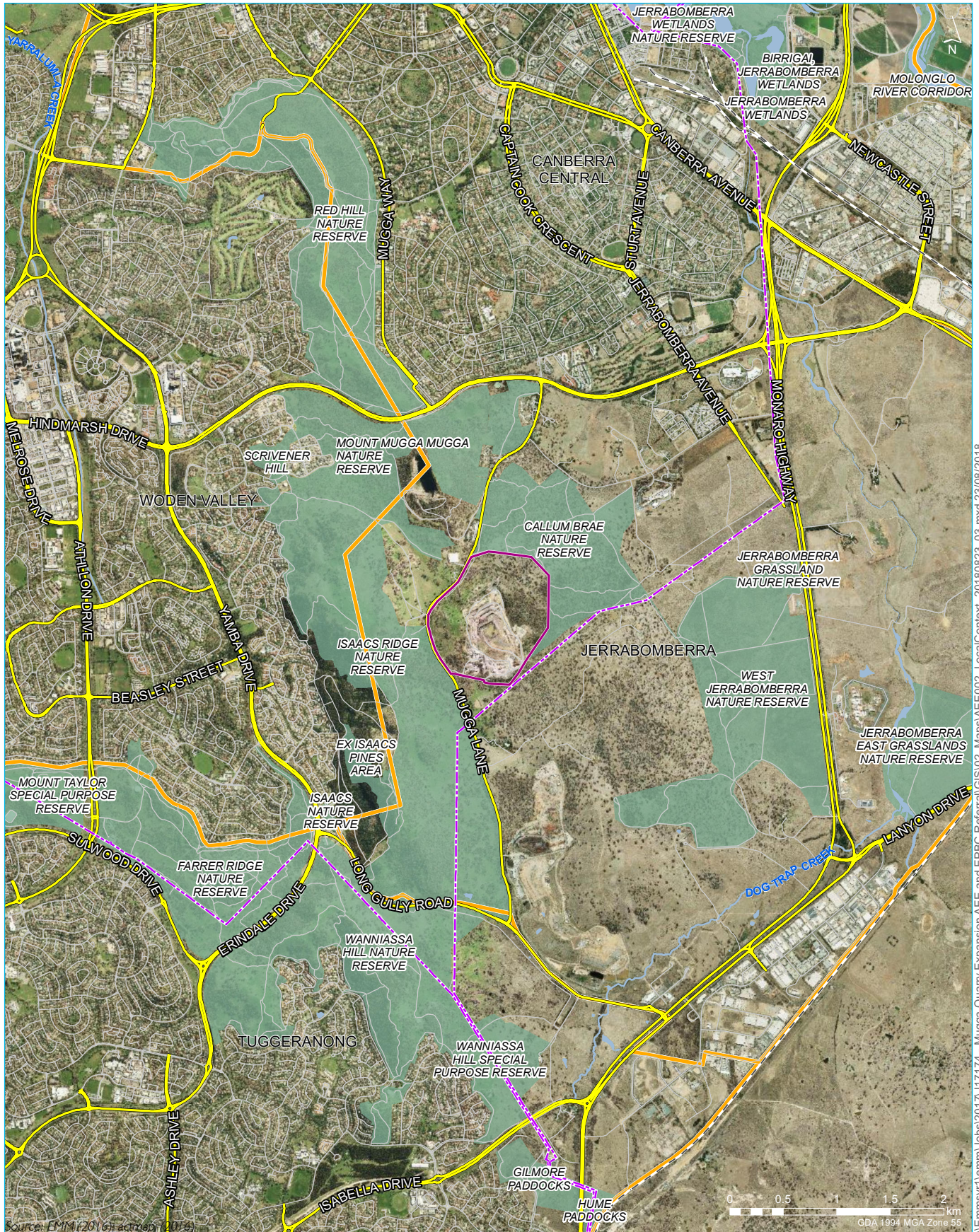
KEY

- Site location - 321 Mugga Lane, Symonston
- ACT boundary
- District boundary
- Railway
- Main road
- Watercourse
- Waterbody
- ACT reserve
- NPWS reserve

Regional context

Boral - Mugga Quarry overburden expansion  
EIS scoping document

Figure 1



KEY

- Site location - 321 Mugga Lane, Symonston
- District boundary
- Electricity transmission line
- Main road
- Local road
- Rail line
- Watercourse
- Waterbody
- ACT reserve

Local context

Boral - Mugga Quarry overburden expansion  
EIS scoping document

Figure 2





**KEY**

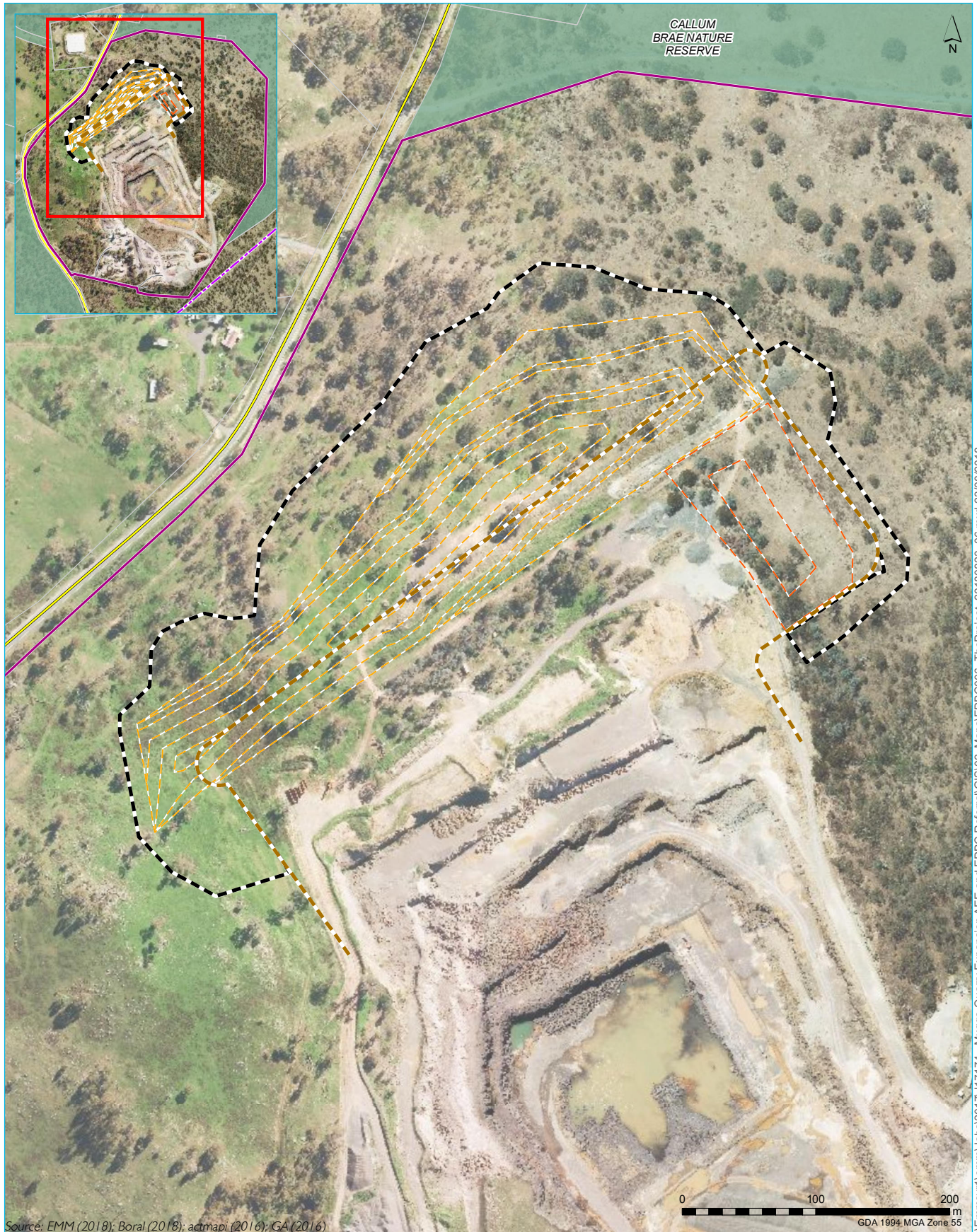
- |   |                               |                |
|---|-------------------------------|----------------|
| Site location - 321 Mugga Lane, Symonston   | Asphalt plant                 | Local Road     |
| Total disturbance area                      | Concrete batching plant       | Block boundary |
| Approved pit extent                         | Quarry                        | ACT reserve    |
| Emplacement contours (Boral)                | Recycling facility            |                |
| Proposed eastern emplacement contours (EMM) | Electricity transmission line |                |
|   | Main road                     |                |

Proposed permanent bund and temporary stockpile  
 Boral - Mugga Quarry overburden expansion  
 EIS scoping document

Figure 3



\\Emmsvr1\emms\Jobs\2017\171774 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02\_Maps\EPBC005\_CurrentSite\_20180823\_06.mxd 23/08/2018



\\Emmsvr1\emms\Jobs\2017\17174 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02\_Maps\EPBC006\_TheProject\_20180823\_06.mxd 23/09/2018

**KEY**

- Site location - 321 Mugga Lane, Symonston
- Total disturbance area
- Approved pit extent
- Emplacement contours (Boral)
- Proposed eastern emplacement contours (EMM)
- Electricity transmission line
- Main road
- Block boundary
- ACT reserve

**The project**

Boral - Mugga Quarry overburden expansion  
EIS scoping document

Figure 4



## **APPENDIX 2 WIND ROSES**

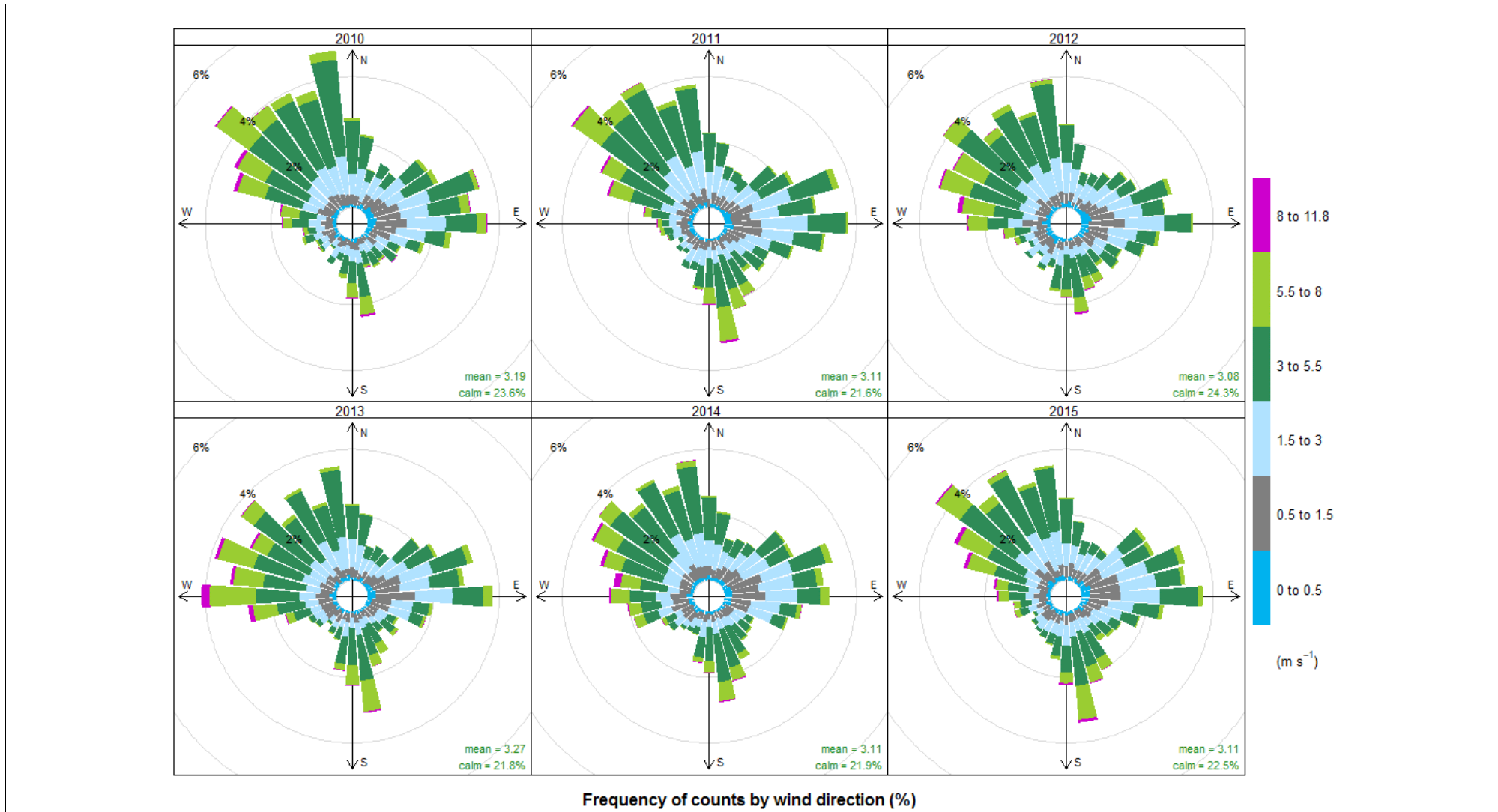


Figure A2-1: Annual wind roses for Tuggeranong BoM AWS site

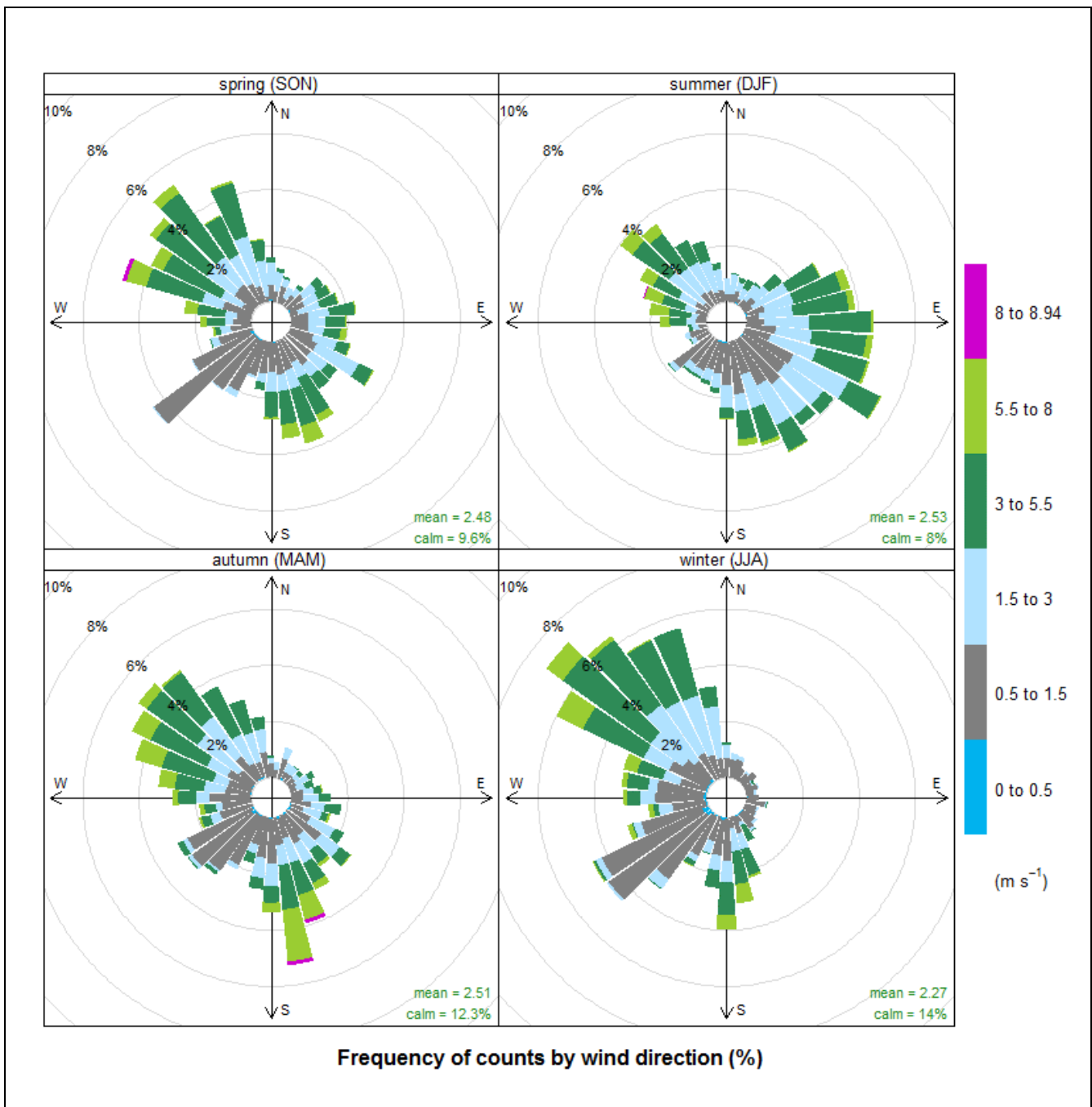


Figure A2-2: Seasonal wind roses for project site – CALMET 2015

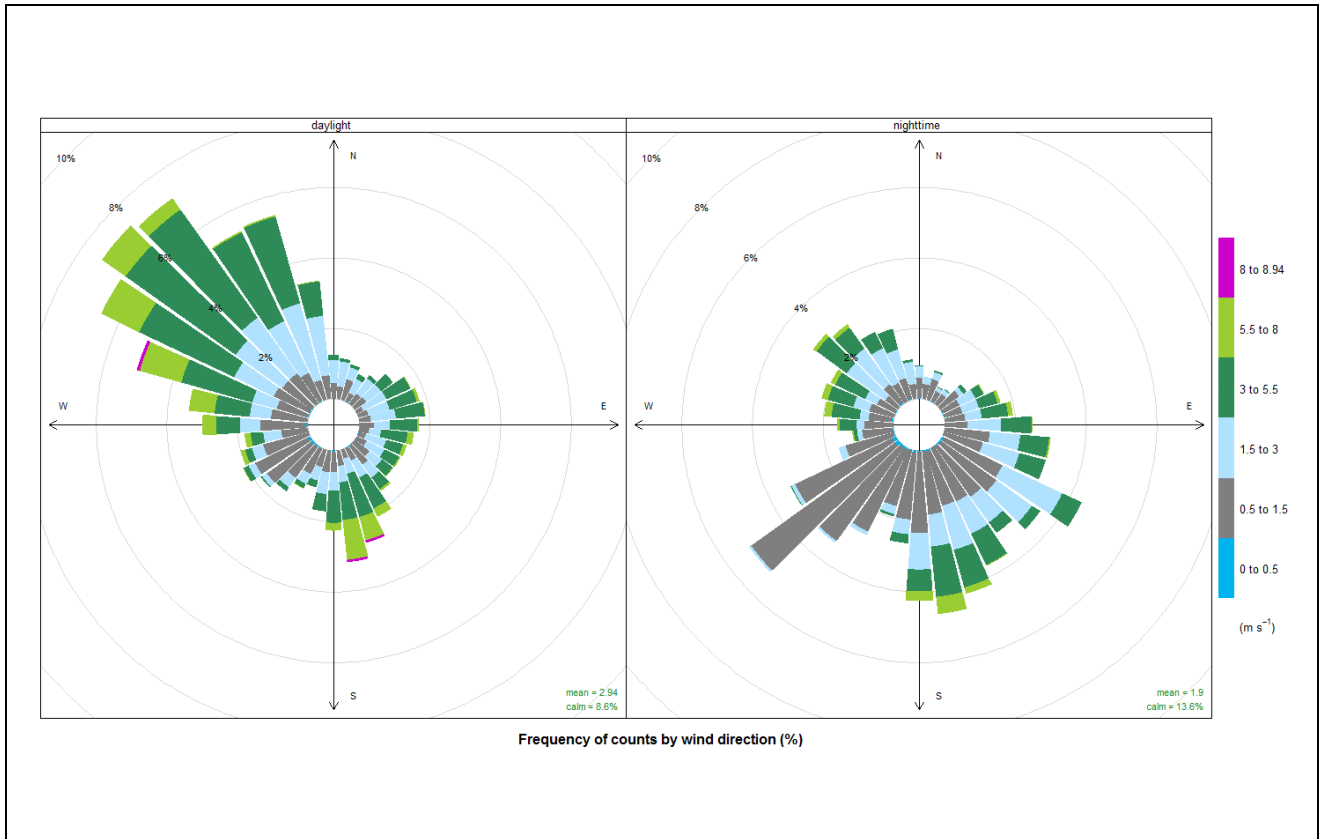


Figure A2-3: Diurnal wind roses for project site – CALMET 2015

## **APPENDIX 3 EMISSION INVENTORY BACKGROUND**

### Fugitive dust emissions

Fugitive dust emissions from aggregate handling, overburden dump development, quarry operations, wheel generated dust and wind erosion were estimated using United States Environmental Protection Authority (USEPA) AP-42 emission factors and predictive equations taken from the following chapters:

- Chapter 13.2.1 Paved Roads
- Chapter 13.2.2 Unpaved Roads
- Chapter 13.2.4 Aggregate Handling and Storage Piles
- Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing.
- Chapter 13.2.5 Industrial Wind Erosion.

The material properties listed in **Table A3-1** are used as input to the various emission factor equations listed in the above literature to derive site specific uncontrolled emission factors for each source. Emission calculation specifics are presented in **Table A3-2**.

Properties	Value	Source of information/assumption
Silt content of unpaved roads	8.3%	Quarry pit (AP-42 13.2.2)
	7.1%	Material storage area (AP-42 13.2.2)
	6.9%	Overburden dump (AP-42 13.2.4)
Average truck weight	40t	Overburden trucks
	58.5t	Quarry trucks
	27.5t	Internal transport of aggregate
Moisture content of material	7.9%	Overburden
	1.2%	Blasted rock/aggregate
Silt content of material	6.9%	Overburden
	2%	Blasted rock/aggregate

Emissions were quantified for each particle size fraction, with the TSP size fraction also used to predict dust deposition rates. Fine particles (PM<sub>10</sub> and PM<sub>2.5</sub>) were estimated using the fraction specific equations or ratios for the different particle size fractions available within the literature.

#### Diesel Calculations

Diesel combustion emissions of PM<sub>2.5</sub> are described in the tables below. It is assumed that 92% of PM<sub>10</sub> emissions from diesel combustion is PM<sub>2.5</sub>, emissions have been up-scaled accordingly.

Plant	Make/Model	Number	Power	Hours per Year	kWh /year	Load Factor	Emission factor USEPA Tier 2 (g/kWh)	Annual PM <sub>10</sub> (kg/annum)	Annual PM <sub>2.5</sub> (kg/annum)
Front End Loader - quarry	CAT986	1	271	2899	785,683	0.5	0.2	85.6	78.6
Haul Truck - quarry	CAT 772	1	446	2899	1,293,043	0.5	0.2	141.0	129.3
Haul truck - bund	CAT 730	6	245	2899	4,261,824	0.5	0.2	464.6	426.2
Dozer - bund	CAT D8	1	245	2899	710,304	0.55	0.2	85.2	78.1

30t Excavator - bund	CAT 326	1	149	2899	431,981	0.5	0.2	47.1	43.2
65t excavator - bund	CAT374	1	352	2899	1,020,518	0.5	0.2	111.2	102.1
Excavator - quarry	Komatsu PC350LC	1	195	2899	565,344	0.5	0.2	61.6	56.5

Assumes 80% utilisation for each equipment

Diesel combustion emissions of PM<sub>2.5</sub> from trucks are described in the tables below. It is assumed that 92% of PM<sub>10</sub> emissions from diesel combustion is PM<sub>2.5</sub>, emissions have been up-scaled accordingly.

**Table A2.3 PM<sub>2.5</sub> Emissions – Trucks Moving Onsite**

<b>Equipment</b>	<b>PM Emission Factor (g/VKT) - 1996 ADR70/00</b>	<b>Annual VKT</b>	<b>Annual Emissions (kg/year)</b>
Trucks moving on site	0.584	28,000	17.8

Emission Factor Source: NSW EPA (2012) Technical Report No. 7, Air Emissions Inventory for the Greater Metropolitan Region in New South Wales, 2008 Calendar Year, On-Road Mobile Emissions.

Table A3-2: Emissions inventory																		
Emissions Source	Factor Source	Annual Tonnage	Silt Content	Moisture Content	Haul Distance	Truck Weight	Load in Truck	VKT	Area (ha)	Area/Blast (m2)	Holes/Blast	Blasts/year	TSP Emission Factor	PM10 Emission Factor	PM2.5 Emission Factor	Unit	Annual Hours	Emission Control
OB loading in pit	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	1,008,000	6.9	7.9	-	-	-	-	-	-	-	-	0.00017	0.00008	0.00001	kg/tonne	3,624	
OB haulage - Pit to top	AP-42 13.2.2 - Unpaved Road Equation	1,008,000	8.3	-	0.23	40	30	15,456.0	-	-	-	-	3.57665	1.01707	0.10171	kg/Vehicle KM Travelled	3,624	86%
OB haulage - Pit top to dump	AP-42 13.2.2 - Unpaved Road Equation	1,008,000	6.9	-	0.7	40	30	47,040.0	-	-	-	-	3.14279	0.86128	0.08613	kg/Vehicle KM Travelled	3,624	86%
Truck unloading OB to dump area	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	1,008,000	6.9	7.9	-	-	-	-	-	-	-	-	0.00017	0.00008	0.00001	kg/tonne	3,624	50%
Dozer operations on dump	AP-42 11.9 - Bulldozer on Material Other Than Coal	-	6.9	7.9	-	-	-	-	-	-	-	-	1.79753	0.33874	0.18874	kg/hour	2,899	50%
Drill	AP-42 11.9 - Drilling factor	-	-	-	-	-	-	-	-	1,000	120	12	0.59000	0.31000	0.04650	kg/hole		70%
Blast	AP-42 11.9 - Blasting Equation	-	-	-	-	-	-	-	-	1,000	120	12	6.95701	3.61765	0.54265	kg/blast		
FEL handling	AP-42 13.2.4 -		2	1.2	-	-	-	-	-	-	-	-	0.00245	0.00116	0.00018	kg/tonn	3,624	

Table A3-2: Emissions inventory																		
Emissions Source	Factor Source	Annual Tonnage	Silt Content	Moisture Content	Haul Distance	Truck Weight	Load in Truck	VKT	Area (ha)	Area/Blast (m2)	Holes/Blast	Blasts/year	TSP Emission Factor	PM10 Emission Factor	PM2.5 Emission Factor	Unit	Annual Hours	Emission Control
blasted rock	Materials Handling Equation / NPI Mining Equation 10	500,000														e		
Quarry haulage - Pit to top	AP-42 13.2.2 - Unpaved Road Equation	500,000	8.3	-	0.7	58.5	47	14,893.6	-	-	-	-	4.24394	1.20682	0.12068	kg/Vehicle KM Travelled	3,624	86%
Quarry haulage - Pit top to processing	AP-42 13.2.2 - Unpaved Road Equation	500,000	8.3	-	0.6	58.5	47	6,383.0	-	-	-	-	4.24394	1.20682	0.12068	kg/Vehicle KM Travelled	3,624	86%
Unloading to Processing Plant hopper	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	500,000	2	1.2	-	-	-	-	-	-	-	-	0.00245	0.00116	0.00018	kg/tonne	3,624	50%
Primary Crusher	USEPA AP-42 11.19.2 - Tertiary Crushing Factor	500,000	-	-	-	-	-	-	-	-	-	-	0.00270	0.00120	0.00022	kg/tonne	3,624	85%
Secondary Crusher	USEPA AP-42 11.19.2 - Tertiary Crushing Factor	500,000	-	-	-	-	-	-	-	-	-	-	0.00270	0.00120	0.00022	kg/tonne	3,624	85%
Tertiary Crusher	USEPA AP-42 11.19.2 - Tertiary Crushing Factor	500,000	-	-	-	-	-	-	-	-	-	-	0.00270	0.00120	0.00022	kg/tonne	3,624	85%
Screening	USEPA AP-42		-	-	-	-	-	-	-	-	-	-	0.01250	0.00430	0.00003	kg/tonne	3,624	85%

Table A3-2: Emissions inventory																		
Emissions Source	Factor Source	Annual Tonnage	Silt Content	Moisture Content	Haul Distance	Truck Weight	Load in Truck	VKT	Area (ha)	Area/Blast (m2)	Holes/Blast	Blasts/year	TSP Emission Factor	PM10 Emission Factor	PM2.5 Emission Factor	Unit	Annual Hours	Emission Control
	11.19.2 - Screening Factor	500,000														e		
Stockpile loading	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	500,000	2	1.2	-	-	-	-	-	-	-	-	0.00245	0.00116	0.00018	kg/tonne	3,624	50%
FEL handling product material	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	500,000	2	1.2	-	-	-	-	-	-	-	-	0.00245	0.00116	0.00018	kg/tonne	3,624	
Loading to trucks	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	500,000	2	1.2	-	-	-	-	-	-	-	-	0.00245	0.00116	0.00018	kg/tonne	3,624	
Product to CPB	AP-42 13.2.2 - Unpaved Road Equation	500,000	7.1	-	0.3	27.5	25	12,000.0	-	-	-	-	2.70879	0.74660	0.07466	kg/Vehicle KM Travelled	3,624	86%
Transport to site exit	AP-42 13.2.2 - Unpaved Road Equation	500,000	7.1	-	0.4	27.5	25	16,000.0	-	-	-	-	2.70879	0.74660	0.07466	kg/Vehicle KM Travelled	3,624	86%
Wind	AP-42 11.9 -	-	-	-	-	-	-	-	17.8				850	425	64	kg/ha/y	8,760	

<b>Emissions Source</b>	<b>Factor Source</b>	<b>Annual Tonnage</b>	<b>Silt Content</b>	<b>Moisture Content</b>	<b>Haul Distance</b>	<b>Truck Weight</b>	<b>Load in Truck</b>	<b>VKT</b>	<b>Area (ha)</b>	<b>Area/Blast (m2)</b>	<b>Holes/Blast</b>	<b>Blasts/year</b>	<b>TSP Emission Factor</b>	<b>PM10 Emission Factor</b>	<b>PM2.5 Emission Factor</b>	<b>Unit</b>	<b>Annual Hours</b>	<b>Emission Control</b>
Erosion - quarry pit	Wind erosion of exposed areas factor															ear		
Wind Erosion - OB Dump	AP-42 11.9 - Wind erosion of exposed areas factor	-	-	-	-	-	-	-	1.8				850	425	64	kg/ha/year	8,760	50%
Wind Erosion - OB Dump rehab	AP-42 11.9 - Wind erosion of exposed areas factor	-	-	-	-	-	-	-	5				850	425	64	kg/ha/year	8,760	50%
Wind Erosion - processing area	AP-42 11.9 - Wind erosion of exposed areas factor	-	-	-	-	-	-	-	2.6				850	425	64	kg/ha/year	8,760	50%
Wind Erosion - CPB area	AP-42 11.9 - Wind erosion of exposed areas factor	-	-	-	-	-	-	-	0.6				850	425	64	kg/ha/year	8,760	50%

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Appendix I

# Cultural Heritage assessment

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# Mugga Quarry Expansion

Cultural Heritage Assessment

Prepared for Boral Resources (Country) Pty Limited | 11 July 2018

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# Mugga Quarry Expansion

Draft Report

Report J17174RP1 | Prepared for Boral Resources (Country) Pty Limited | 11 July 2018

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Prepared by	Kerryn Armstrong and Ryan Desic	Approved by	Paul Gibbons
Position	Consultant Archaeologist; Senior Archaeologist	Position	Associate Environmental Planner
Signature		Signature	
Date	11/07/2018	Date	11/07/2018

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## Document Control

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## Executive Summary

---

Boral Resources (Country) Pty Ltd (Boral), a wholly owned subsidiary of Boral Limited, proposes to establish a new permanent bund and temporary stockpile area to store quarried overburden and weathered rock material from its Mugga Quarry operations (the project) at 321 Mugga Lane, Symonston (the site).

EMM Consulting Pty Ltd (EMM) has been engaged to prepare a Development Application (DA) under the ACT Planning and Development Act 2007 (P&D Act) for the project. This Cultural Heritage Assessment report forms part of the DA and documents the methods, results and management measures proposed for cultural heritage values associated with the project area. The Cultural Heritage Assessment has been prepared in accordance with the requirements of the *Cultural Heritage Reporting Policy* (ACT Heritage Council 2015a). In summary the cultural heritage assessment has involved:

- background research of the project area's environmental, archaeological and ethno-historical context;
- Aboriginal consultation with ACT Registered Aboriginal Organisations (RAOs);
- Consultation with the ACT Heritage Council, including a search of the ACT Heritage Register;
- an archaeological survey accompanied by interested RAOs;
- an assessment significance for each site in accordance with the *ACT Heritage Assessment Policy* (ACT Heritage Council 2015b); and
- preparation of a Statement of Heritage Effect which includes an impact assessment and management recommendations for the identified Aboriginal cultural heritage values in the project area.

An archaeological survey was undertaken on 14 March 2018 for an area that sampled the extent of the project which extends across crest, hill slope and drainage depression landforms.

The survey team identified nine stone artefact sites in the project area, comprising five isolated artefacts and four artefact scatters [REDACTED]. These sites constitute *Aboriginal places* under the ACT Heritage Act 2004. The stone artefact sites were identified on hill crest and hill slope landforms. A total of 30 artefacts were counted during the survey.

The archaeological resource was characterised as fairly consistent occurrence of isolated stone artefacts and low frequency artefact scatters distributed along hill slopes and crests nearby drainage depressions. The assessment concluded that as the project area is at the very headwaters and only features drainage depressions, it is unlikely that intensive occupation would have occurred in this area, and therefore significant subsurface material is unlikely to exist. As such, the surface archaeological record is likely to be a good representation of the nature and extent of Aboriginal occupation in the project area.

None of the Aboriginal sites were considered to meet the threshold to be included on the ACT Heritage Register.

The Statement of Heritage Effect identified that the project will impact all nine of the Aboriginal sites within the project area through the covering of areas by overburden emplacements; and construction of infrastructure including haul roads and water management. In response to these impacts, these sites will

be collected as a mitigation measure. The Statement of Heritage Effect proposes the following recommendations:

1. An application to have the Statement of Heritage Effect set out in Chapter 8 of this report should be submitted to the ACT Heritage Council for approval under s61H of the Heritage Act.
2. Subject to approval of the Statement of Heritage Effect by the ACT Heritage Council, the Aboriginal site collection method as set out in Section 8.2.2 of this report should be undertaken prior to ground disturbance activities within the project area.
3. Subsequent to the collection of the Aboriginal sites in the project area, a post-approval works report should be prepared in accordance with Section 8.3 of this report.
4. The collected artefacts should be returned to Country in consultation with RAOs. A Return to Country proposal will be prepared post-approval which will be provided to RAOs for their feedback. Once the Return to Country proposal is finalised and RAO feedback has been incorporated into the proposal, an application will be made under Section 61J of the Heritage Act 2004, for ACT Heritage Council approval of a Conservation Management Plan for the Return to Country.
5. The new discovery protocol set out in Section 8.5 of this report should be implemented prior to, during and after works within the project area.

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# 1 Introduction

## 1.1 Assessment overview

Boral Resources (Country) Pty Ltd (Boral), a wholly owned subsidiary of Boral Limited, proposes to establish a new permanent bund and temporary stockpile area to store quarried overburden and weathered rock material from its Mugga Quarry operations (the project) at 321 Mugga Lane, Symonston (the site).

The project is required to enable the ongoing extraction operations of the quarry and supply of aggregate and quarry products to the construction market within the Australian Capital Territory (ACT) and surrounding New South Wales (NSW) regional areas.

The site in its regional and local context can be seen in Figure 1.1 and Figure 1.2.

EMM Consulting Pty Ltd (EMM) has been engaged to prepare a Development Application (DA) under the ACT Planning Development Act 2007 (P&D Act) for the project. The DA will be prepared in accordance with the requirements of the Territory Plan for lodgement to the ACT Environment, Planning and Sustainable Development Directorate - Planning (EPSDD). In preparing the DA the relevant codes and statutory considerations will be addressed in accordance with the requirements of the ACT *Planning and Development Act 2007* (P&D Act) and the *Territory Plan 2008* (Territory Plan).

This Cultural Heritage Assessment report will form part of the DA and documents the methods, results and management measures proposed for cultural heritage values associated with the project area. The Cultural Heritage Assessment has been prepared in accordance with the requirements of the *Cultural Heritage Reporting Policy* (ACT Heritage Council 2015a).

## 1.2 Project overview

The project involves the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 cubic metres (m<sup>3</sup>) of quarried overburden and weathered rock material from Mugga Quarry.

The additional bund and emplacement areas will be located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road) and resides within an extractive industry lease area of 106.4 hectares (ha).

The topography of the site is undulating with a slope across the proposed project area from the south-west to the north-east. Elevation within the proposed project area varies from approximately 730 m Australian Height Datum (AHD) in the south-west to approximately 690 m AHD in the north-east.

The quarry is located in the central portion of the site and currently produces crushed rock products with a production rate at times up to 1,000,000 tonnes per annum (tpa). The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities. The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00 am to 6:00 pm Monday to Saturday.

As total production of the quarry will not be increasing, there will be no change to current operating hours, external traffic movements, groundwater management or employment. No changes are proposed to the other operations at the site.

## 1.3 Site description

### 1.3.1 The site

The site is leased Territory Land, identified as Block 2031 Jerrabomberra District. The site is located approximately 10 kilometres (km) to the south-east of Canberra Central. The site is generally known as 321 Mugga Lane, Symonston.

Located within a broadacre rural setting and surrounded by low density land uses and established remnant native vegetation, the site has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility (Figure 1.3). Vehicular access to the site is via an existing entry off Mugga Lane, adjacent to the site's south-western boundary. The site is zoned Non-Urban NUZ1 Broadacre under the Territory Plan.

An overview of the existing site operations is provided in Table 1.1.

**Table 1.1 Overview of site operations**

<b>Operational element</b>	<b>Production rate</b>	<b>Details</b>
Hard rock quarry	Up to 1,000,000 tpa. Average production rate approximately 500,000tpa	Located in the central portion of the site and currently produces crush rock products with a production rate at times up to 1,000,000 tpa. The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities. The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00 am to 6:00 pm Monday to Saturday.
Fixed asphalt plant	Up to 75,000 tpa Average 145 tons per day (tpd) production rate, with maximum 1,000 tpd	The project would produce up to 75,000 tpa of asphalt, with an average of 140 tpd to a peak of 1,000 tpd. The fixed asphalt plant is approved to operate 24 hours a day, 7 days a week.
Concrete Batching Plant (CBP)	36,000 m <sup>3</sup> per annum Maximum capacity to produce up to 60,000 m <sup>3</sup>	Located to the north of the asphalt plant. It currently produces 36,000 m <sup>3</sup> per annum and has a maximum capacity to produce up to 60,000 m <sup>3</sup> . Elements of the existing CBP include cement and flyash silos, aggregate storage bins, concrete production and loading facilities, offices and amenities. The CBP operates 24 hours a day, seven days a week.
Recycling facility	Up to 100,000 tpa	Recycling is located on the central western edge of the quarry and currently processes up to 100,000 tpa of recycled construction and demolition waste. Elements of the recycling facility include raw and finished material stockpiles, a mobile crushing plant, offices and amenities. The recycling facility can operate 24 hours a day, 7 days a week however deliveries generally occur between 7:00 am and 4:30 pm with production occurring overnight when needed to meet market demand.

### 1.3.2 The project area

This project area includes the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 m<sup>3</sup> of quarried overburden and weathered rock material located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road).

The project area referenced throughout this report refers to the proposed total disturbance footprint as shown on Figure 1.4 and is the focus of this Cultural Heritage Assessment. The project area is approximately 62 ha in area.

### 1.3.3 The surrounds

The site is situated within a broadacre rural setting surrounded by low density land uses and established remnant native vegetation.

The land use zoning for the site has made provisions requiring a 1 km clearance buffer around the site to afford protection from conflicting development. The nearest rural residence is therefore located approximately 2 km to the south and approximately 2 km to the west of the site.

Land uses surrounding the site include:

- **north** – Mugga Lane (public road), vacant broadacre land, reservoir, bus depot, one rural residence and the ACT Governments Mugga 2 quarry;
- **east** – vacant broadacre land;
- **south** – vacant broadacre land and one rural residence; and
- **east** – Mugga Lane, vacant broadacre land and one rural residence;

## 1.4 Project alternatives

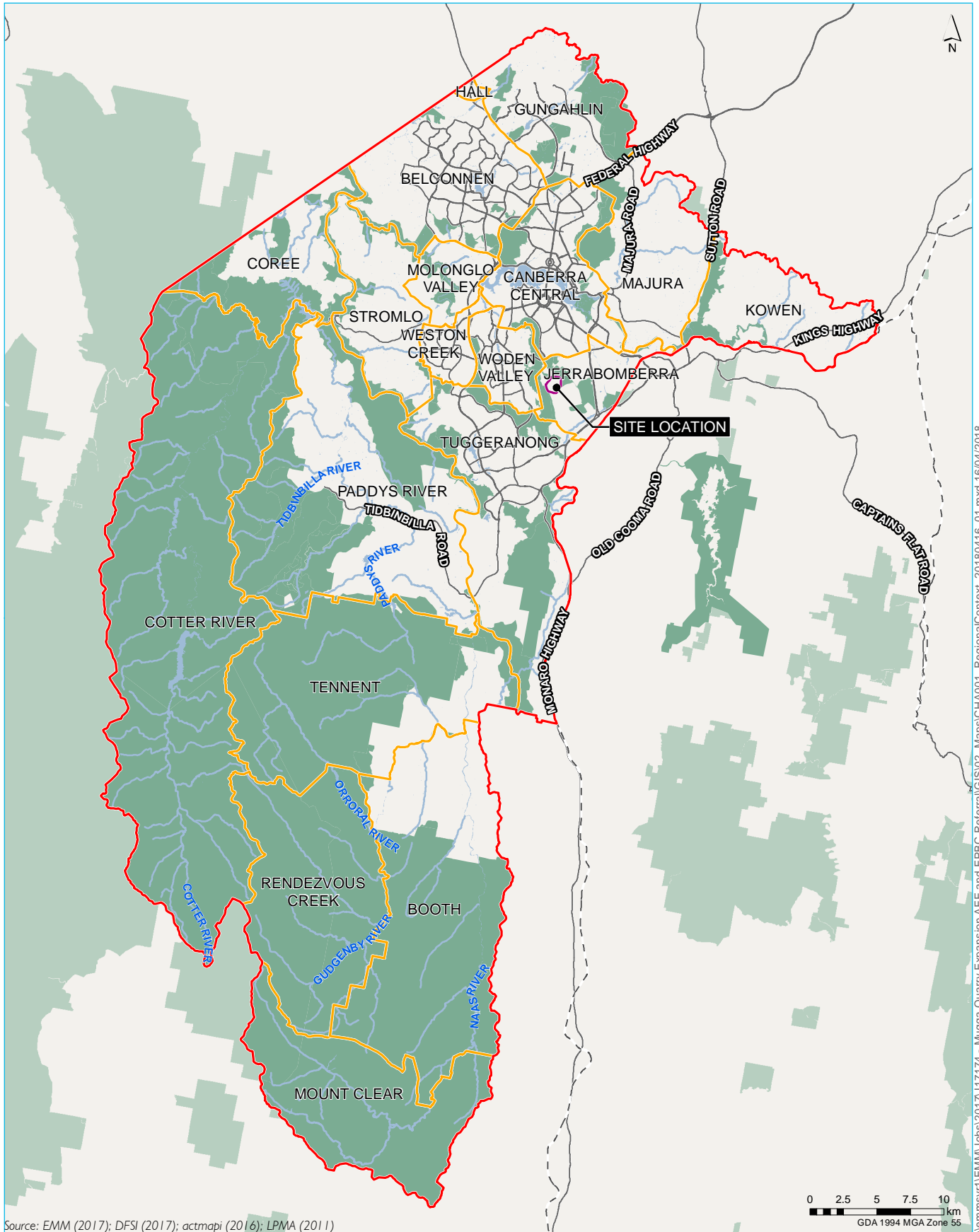
Boral considered the following alternatives for the emplacement of overburden and weathered rock:

- Emplacement within the Mugga 1 pit – Boral is already planning to emplace approximately 270,000 cubic metres of overburden and weathered rock within the pit, for possible processing or relocation. Total overburden material in-pit emplacement is not considered viable as it would begin to sterilise approved resource and shorten the lifespan of the quarry;
- Emplacement within the disused Mugga 2 quarry pit – inquiries are being made with the ACT Government to determine whether this is a possibility and whether it would be commercially viable. However, based on haulage costs, even without a tipping fee, it is not an attractive from a commercial perspective. Emplacement within the Mugga 2 pit would also negate later re-use and blending of the weathered rock material;
- Emplacement at another Boral quarry – the closest Boral Quarry is at Hall Quarry at Jeir NSW, approximately 55 kilometres to the north. Hall Quarry does not have development approval to receive overburden from external sites, and the cost involved in trucking material over such a long distance is not commercially viable. It would also negate later re-use and blending of the weathered rock material; and

- Emplacement out of pit on adjoining quarry land – this has been considered the most viable solution from a commercial perspective, given it's the shortest haulage distance. It also means the weathered rock material can be later blended and re-used, instead of simply being applied to land. The vegetation surveys, topography and stormwater capture requirements have further refined the design of the emplacement to minimise its environmental footprint.

To determine the final overburden emplacement the design process investigated different on-site layouts which combined environmental impacts and Boral's project objectives, including:

- ecological assessment of significance;
- approved final Mugga Quarry pit extent;
- topography and site contours;
- surface water sedimentation dam locations;
- overburden design contours; and
- proposed alternative overburden area.



- KEY**
- LocalGovernmentArea\_DFSI\_...
  - Site location - 321 Mugga Lane, Symonston
  - ACT boundary
  - District boundary
  - Railway
  - Main road
  - Watercourse
  - Waterbody
  - ACT reserve
  - NPWS reserve

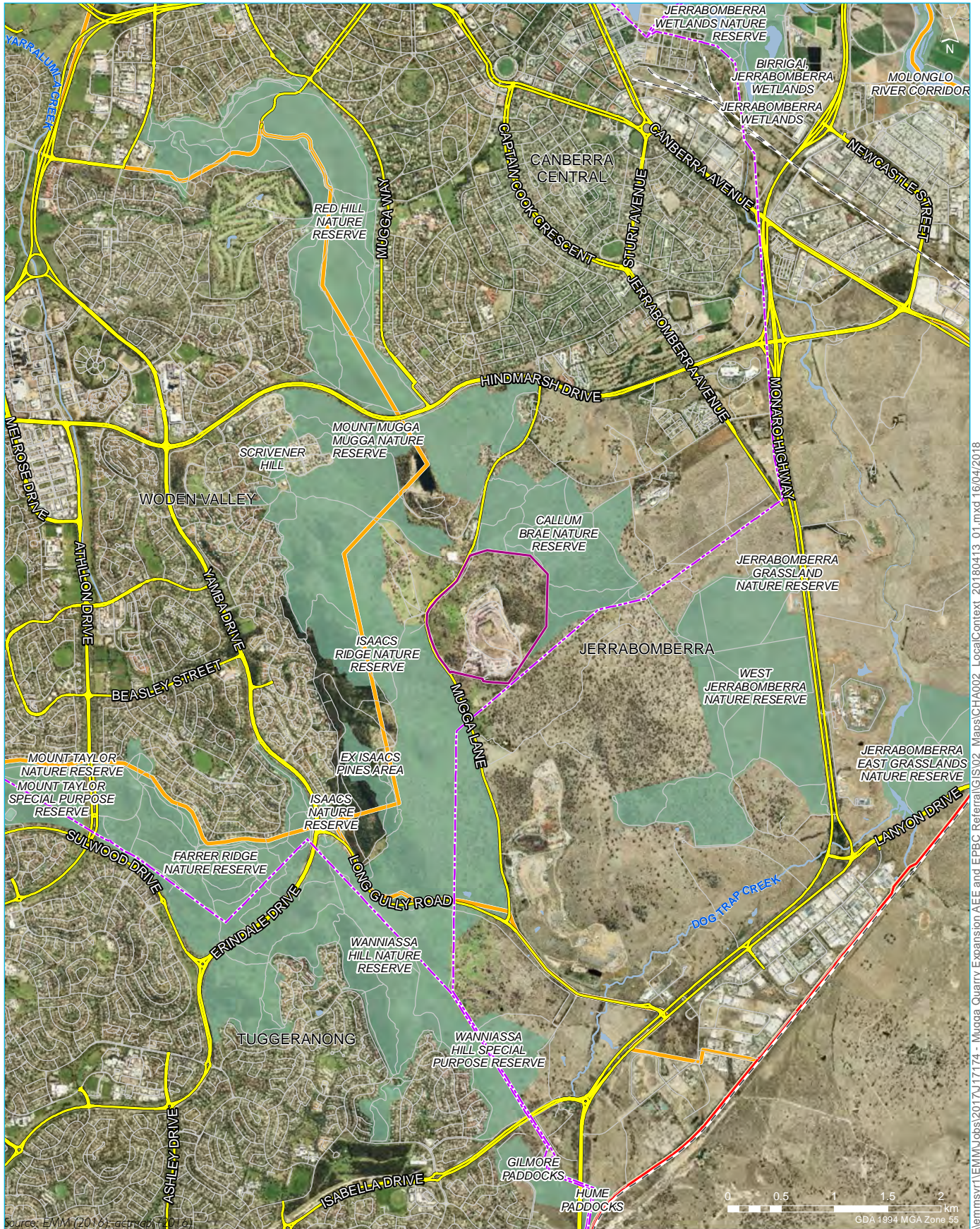
Regional context

Boral - Mugga Quarry overburden expansion  
 Cultural heritage assessment

Figure 1.1



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KEY

- Site location - 321 Mugga Lane, Symonston
- ACT boundary
- District boundary
- Electricity transmission line
- Main road
- Local road
- Rail line
- Watercourse
- Waterbody
- ACT reserve

Local context

Boral - Mugga Quarry overburden expansion  
 Cultural heritage assessment

Figure 1.2



\emmsvr1\EMM\Jobs\2017\U17174 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02\_Maps\CHA002\_LocalContext\_20180413\_01.mxd 16/04/2018



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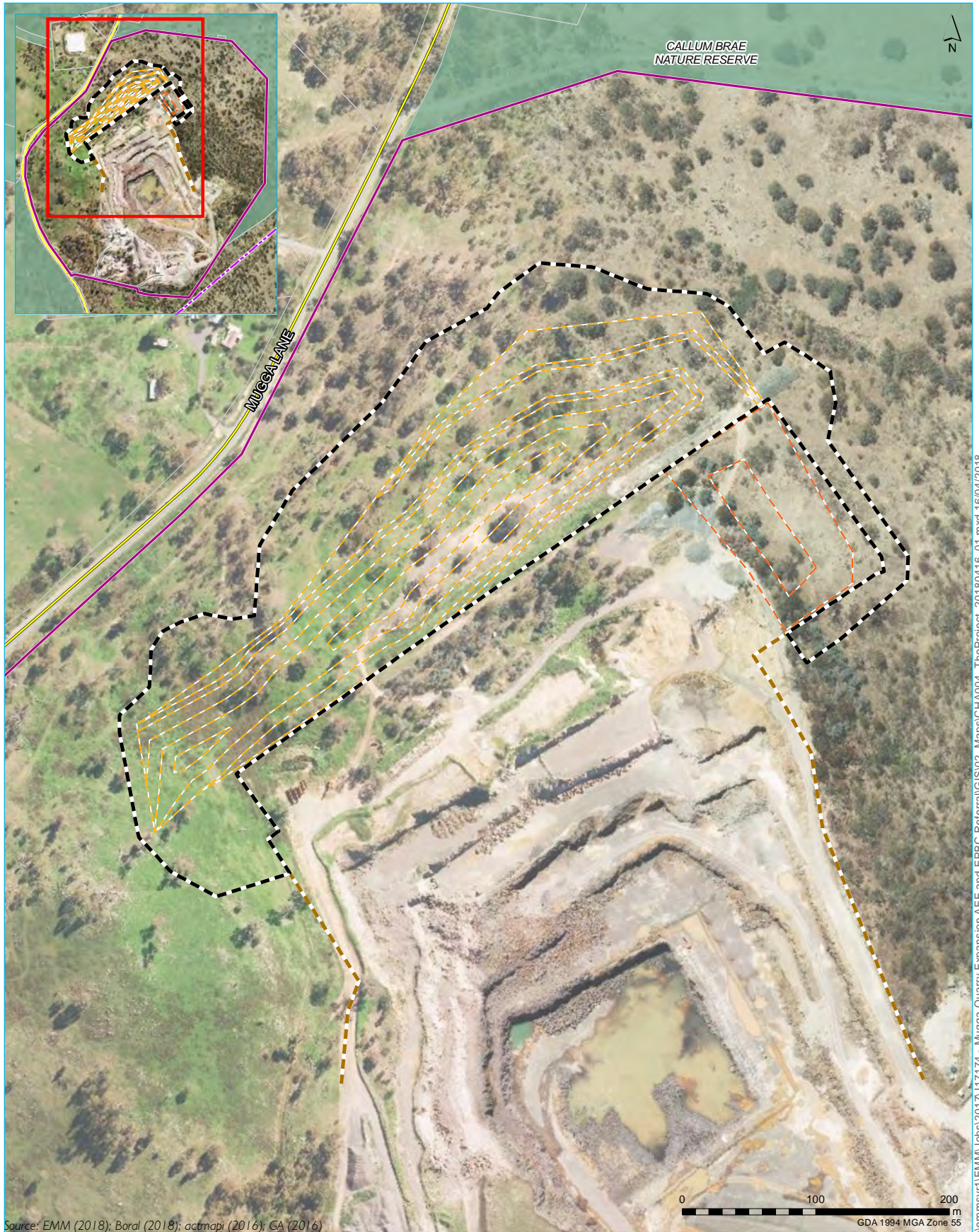
**KEY**

- |   |                               |                |
|---|-------------------------------|----------------|
| Site location - 321 Mugga Lane, Symonston   | Asphalt plant                 | Local Road     |
| Total disturbance area                      | Concrete batching plant       | Block boundary |
| Approved pit extent                         | Quarry                        | ACT reserve    |
| Emplacement contours (Boral)                | Recycling facility            |                |
| Proposed eastern emplacement contours (EMM) | Electricity transmission line |                |
|   | Main road                     |                |

Proposed permanent bund and temporary stockpile  
 Boral - Mugga Quarry overburden expansion  
 Cultural heritage assessment

Figure 1.3





\\emmsvr1\EMM\Jobs\2017\17174 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02\_Maps\CHA004\_TheProject\_20180416\_01.mxd 16/04/2018

**KEY**

- Site location - 321 Mugga Lane, Symonston
- Total disturbance area
- Approved pit extent
- Emplacement contours (Boral)
- Proposed eastern emplacement contours (EMM)
- Electricity transmission line
- Main road
- Block boundary
- ACT reserve

**The project**

Boral - Mugga Quarry overburden expansion  
Cultural heritage assessment

Figure 1.4



## 1.5 Legislative context and terminology

Heritage sites are protected in the ACT under the *Heritage Act 2004* (the Act). Heritage sites are defined in s61E of the Act as a registered place or object (on the ACT Heritage Register), or an Aboriginal place or Aboriginal object. Under s74 of the Act, it is an offence to engage in conduct that diminishes the heritage significance of a registered place or object. Under s75, it is an offence to engage in conduct that causes damage to an Aboriginal place or object. The Act prescribes penalty units applicable for each offence.

Note: an *Aboriginal place* means a place associated with Aboriginal people because of Aboriginal tradition (ACT Heritage Council 2015b p.3). This term often includes what is commonly known as an Aboriginal archaeological site (or simply Aboriginal site) and comprises the physical area where the evidence was found along with the archaeological material associated with the area (such as stone artefacts). As such, the legal term *Aboriginal place* and the standard term Aboriginal site are used interchangeably in this report to suit the context of discussion.

The term *Aboriginal object* means an object associated with Aboriginal people because of Aboriginal tradition (ACT Heritage Council 2015b, p.3). However, this term is often used only where it's clear and observable that Aboriginal archaeological material has been removed from its original context.

Section 76 of the Act provides exceptions to s74 and s75 where the person engages in conduct in accordance with a number of listed processes, including:

- a Heritage Guideline (s76(2)(i));
- a Heritage Direction (s76(2)(ii));
- a Heritage Agreement ((s76(2)(iii));
- a Conservation Management Plan approved by the ACT Heritage Council (s76(2)(iv));
- a Development Approval under the *Planning and Development Act 2007* (ACT) (s76(2)(v));
- an Excavation Permit approved by the ACT Heritage Council (s76(2)(vi)); and
- a Statement of Heritage Effect approved by the ACT Heritage Council (s76(2)(vii)).

## 1.6 Assessment guidelines and requirements

EMM has prepared this Cultural Heritage Assessment report in accordance the *Cultural Heritage Reporting Policy* (ACT Heritage Council 2015a). This policy sets out the requirements to gain approval for an Excavation Permit, a Statement of Heritage Effect or a Conservation Management Plan.

## 1.7 Objectives of the assessment

During the scoping stages of this assessment, Boral and EMM identified the potential for heritage sites to occur within the project area through a review of previous assessments over the site that formed part of a release renewal (Boral 1999, p.41) and local knowledge of the project area held by Boral.

No historical heritage (non-indigenous) items were identified and therefore the focus of the assessment was related to Aboriginal heritage. Notwithstanding, the ACT Heritage Register was searched to identify any historical heritage items and the project area was inspected for potential historical heritage items during the archaeological survey for this assessment, but none were identified.

The primary objectives of this report are to:

- identify Aboriginal cultural heritage values relevant to the project which include:
  - Aboriginal places and/or objects;
  - Aboriginal socio-cultural or historic values which related to places and/or objects; and
  - areas of archaeological sensitivity.
- assess the significance of Aboriginal places and/or objects identified in the course of the archaeological investigations and through Aboriginal community consultation;
- assess the impact of the project on identified Aboriginal cultural heritage values; and
- propose appropriate management measures for potentially impacted Aboriginal cultural heritage values in response to their assessed significance.

## 1.8 Authorship and acknowledgements

This report was prepared by EMM Heritage Consultant Kerry Armstrong and Senior Archaeologist Ryan Desic. EMM would like to acknowledge the registered Aboriginal organisations for their input and considerations:

- Buru Ngunawal Aboriginal Corporation;
- King Brown Tribal Group;
- Little Gudgenby River Tribal Council; and
- Ngarigu Currawong Clan.

## 2 Aboriginal consultation

### 2.1 Statutory basis

The ACT Heritage Council is currently developing a *Representative Aboriginal Organisations (RAO) Consultation Policy*. Although there is no current formal policy for Aboriginal consultation in the ACT; EMM have followed best practice methods similar to the NSW *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010).

Full documentation of the consultation process is provided in Appendix A of this report.

### 2.2 Notification of registered Aboriginal organisations (RAOs)

EMM contacted the ACT Heritage Council on 29 January 2018 for a list of Registered Aboriginal Organisations (RAOs) for the project area (Table 2.1).

The RAOs were contacted on 26 February 2018 with a letter which presented the project, requested cultural information and notified of EMM's intent to survey the project area with an invitation to attend (Appendix A). All RAOs indicated they had received the presentation of information and they would provide a representative for the survey. However, only one RAO (Justin Bell from Buru Ngunawal Aboriginal Corporation) attended the survey.

**Table 2.1** A list of registered Aboriginal organisations supplied by the ACT Heritage Council

Registered Aboriginal Organisation	Contact Type	Date
Buru Ngunawal Aboriginal Corporation	Registered express post	26 February 2018
King Brown Tribal Group	Registered express post	26 February 2018
Little Gudgenby River Tribal Council	Registered express post	26 February 2018
Ngarigu Currawong Clan	Registered express post	26 February 2018

### 2.3 Review of draft cultural heritage assessment

A draft version of this report, which included all background information, survey results, draft significance assessment and draft management recommendations, was issued to all RAOs on 8 June 2018 (Table 2.2). The draft report included highlighted text indicating sections where RAO input was sought in regard to Aboriginal heritage values, input into significance assessment and management measures.

A letter indicating an 18 day timeframe for review was issued with the draft report which can be found in appendix A along with the complete communication log. All drafts were sent with tracking through Australia post and follow up phone calls were made on 21 June and 27 June to all RAOs. Through these communications I was only able to make contact with one RAO; Carl from King Brown Tribal Group; Carl was happy with the report and had nothing further to add.

**Table 2.2** A list of RAOs supplied with the draft cultural heritage assessment

Registered Aboriginal Organisation	Contact Type	Date
Buru Ngunawal Aboriginal Corporation	Registered express post	8 June 2018

**Table 2.2** A list of RAOs supplied with the draft cultural heritage assessment

<b>Registered Aboriginal Organisation</b>	<b>Contact Type</b>	<b>Date</b>
King Brown Tribal Group	Registered express post	8 June 2018
Little Gudenby River Tribal Council	Registered express post	8 June 2018
Ngarigu Currawong Clan	Registered express post	8 June 2018

## 3 Environmental context

### 3.1 Rationale

The environmental characteristics of an area influenced the way Aboriginal people used the landscape. In the past, the availability of resources such as water, flora, fauna, stone material and topography played a substantial role in the choice of camping, transitory movement and ceremonial areas used by Aboriginal people, therefore understanding environmental factors assists with predicting where Aboriginal sites are likely to occur. Additionally, natural and cultural (human-made) site formation processes influence the way archaeological material is distributed and preserved across a landscape.

### 3.2 Landform and topography

The project area lies within the South Eastern Highland bioregion; this area sits lower and to the east of the Australian Alps and covers the inland up to the Sydney Basin. The area covers the south east area of Great Dividing Range and as the geology shows has a tertiary volcanic base. Topographically the South Eastern Highlands is a varied area which has large lava fields in the Monaro (south-west of the ACT) dating back 55 million years; it also has sandstones and volcanic sediments in parallel troughs on the eastern sector of the bioregion.

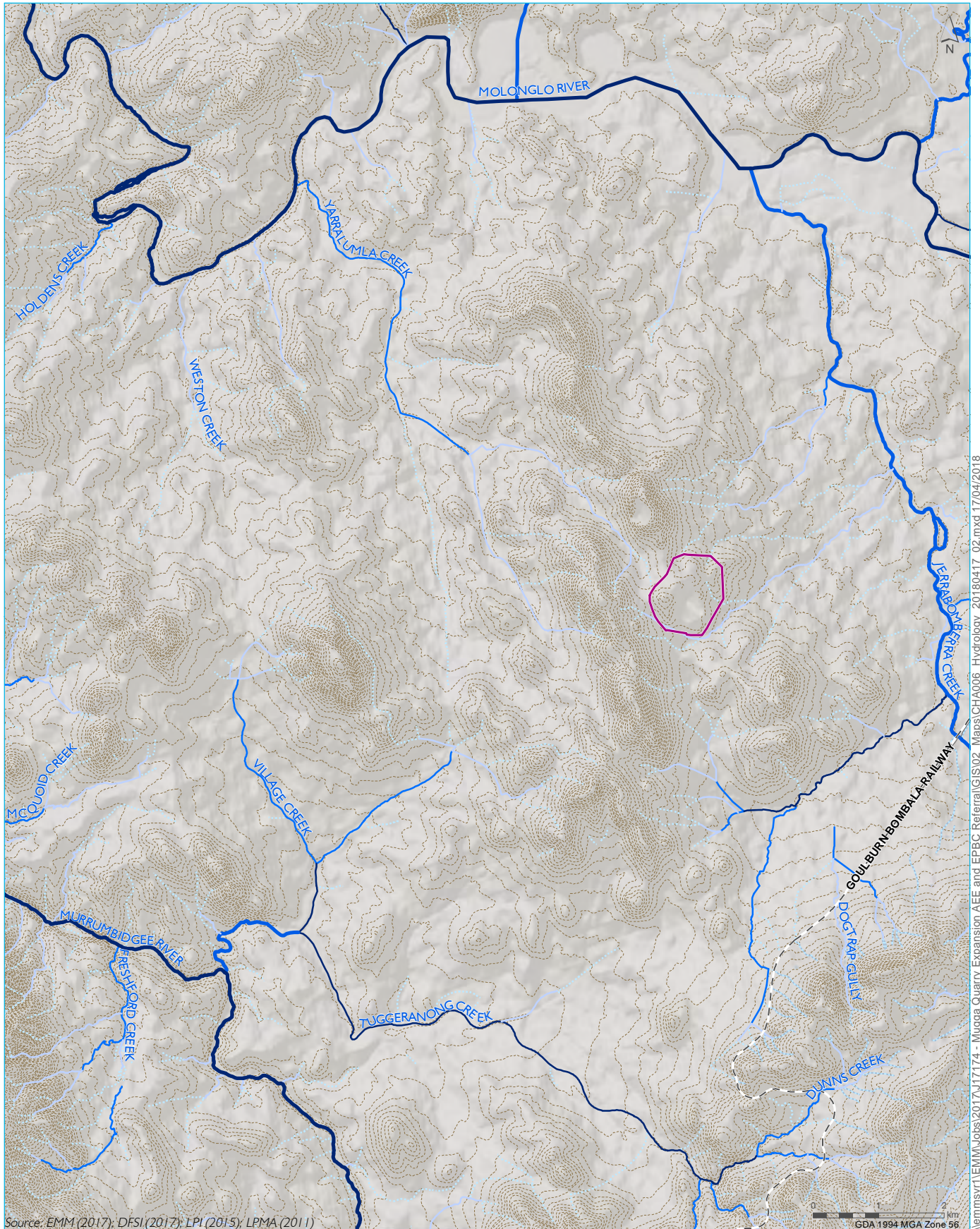
The project area is north of the existing quarry and within a landscape pattern of rolling hills. The project area is on undulating terrain featuring gentle crests, hill slopes and ephemeral drainage depressions. Elevation varies from approximately 730 m Australian Height Datum (AHD) in the south-west to approximately 690 m AHD in the north-east.

The topography and hydrology of the local area is shown in Figure 3.1.

### 3.3 Hydrology

The project area lies on the south-east edge of the Murray Darling Water Basin. The Murray Darling basin is a catchment for both the Murray and the Darling River's. It covers a large part of NSW, and connects with the Queensland, Victoria, Australian Capital Territory and South Australian borders. The primary water systems in the local area includes the Murrumbidgee River which flows north-west approximately 10 km west of the project area as an 8<sup>th</sup> order stream (Strahler system of stream order). The other main water system is the Molonglo River which flows 5.7 km to the north-west as an 8<sup>th</sup> order stream and eventually converges with the Murrumbidgee River approximately 20 km to the north-west of the project area.

On a local level, the project area is within the catchment of the Molonglo River (Figure 3.1). The project area is situated at the headwaters of the tributaries of Jerrabomberra Creek (5<sup>th</sup> order stream) and Yarralumla Creek (3<sup>rd</sup> order stream) which both converge with the Molonglo River. Only the very upper portions of drainage depressions form within the project area as 1<sup>st</sup> order streams.



j:\emmsvr1\EMM\Jobs\2017\17174 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02\_Maps\CHA006\_Hydrology\_20180417\_02.mxd 17/04/2018

**KEY**

- |  |                       |
|--|-----------------------|
| <span style="border: 1px solid pink; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Site location - 321 Mugga Lane, Symonston | Strahler stream order |
| - - Rail line  | ..... 1st order       |
| — Local road   | — 2nd order           |
| ..... 10 m contour   | — 3rd order           |
| — Watercourse / drainage line  | — 4th order           |
| ■ Waterbody  | — 5th order           |
|  | — 8th order           |

**Topography and hydrology**

Boral - Mugga Quarry overburden expansion  
Cultural heritage assessment

Figure 3.1



### 3.4 Geology and soils

The geology for the project area is part of a volcanic belt that travels south from Wellington to the south side of Canberra. The underlying geology of the project area features Silurian volcanics (443 to 419 million years ago) which features various tuffs, with minor siltstone, shale, sandstone and limestone (Jenkins 2000). This igneous rock type is generally referred to as porphyry. The porphyritic mass has intruded into the local Silurian and Ordovician shales which are generally thinly bedded, contorted and highly fractured (Boral 1999, p.36).

The porphyritic rock being quarried varies from a finely crystalline green-grey rock through to a coarsely crystalline pink and brown rock containing phenocrysts of quartz, feldspar and mafic minerals. Minor quartz veining and thin lenses of rhyolite/aplite occur throughout the rock mass (Boral 1999, p.36).

The project area is part of the Burra (bau) Soil Landscape which is a transferral soil profile. Soils on upper slopes typically comprise an A1 soil horizon of sandy loam from 0–8 cm followed by a subsoil (A2 or AB soil horizon) of sandy loam from 8–30 cm. Clay forms at approximately 30 cm as a B soil horizon (Jenkins 2000). The topsoil has moderate erodibility which is accelerated in cleared areas. Bedrock of various tuffs tends to outcrop on crests and upper slopes but also in other landforms with high levels of erosion (eg stream channels). The local soil landscapes are mapped on Figure 3.2.

The project area borders on the quarry to the south which is classed as disturbed terrain and applies to the quarries and waste centres within the ACT. It is classed as disturbed terrain when anthropogenic site formation is altered to a depth of 100 cm or more.

### 3.5 Climate

The South Eastern Highlands bioregion is a mild climate which has a minimum average temperature of -3.8 C and maximum average temperature of 31.3 C. (OEH 2018). An annual mean rainfall which at 460-1883 mm falls is above the national average of between 415.6 – 707.7 mm over the last 30 years (BOM 2018).

Jerrabomberra has a national mean rainfall of approximately 580 mm per year; while the mean maximum temperature sits at 20.6 C (BOM 2018).

### 3.6 Flora and fauna

The project area is within the catchment of the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community (ACTMAPI 2018). This area includes both native grasses which occur when the woodland itself has been removed, and a strong eucalypt community where the trees still stand. The grassland consists of Kangaroo Grass (*Themeda triandra/australis*), Snow Grass (*Poa sieberiana*) and daisies. The woodland consists of numerous species of eucalypt including western grey box (*Eucalyptus macrocarpa*), red stringybark (*E. Macrorhyncha*) and long leaved box (*E. goniocalyx*). Both white (*Callitris glaucophylla*) and black cypress pine (*C. enderlicheri*) can be found in the area along with the Kurrajong (*Brachychiton populneus*) (DEH 2006).

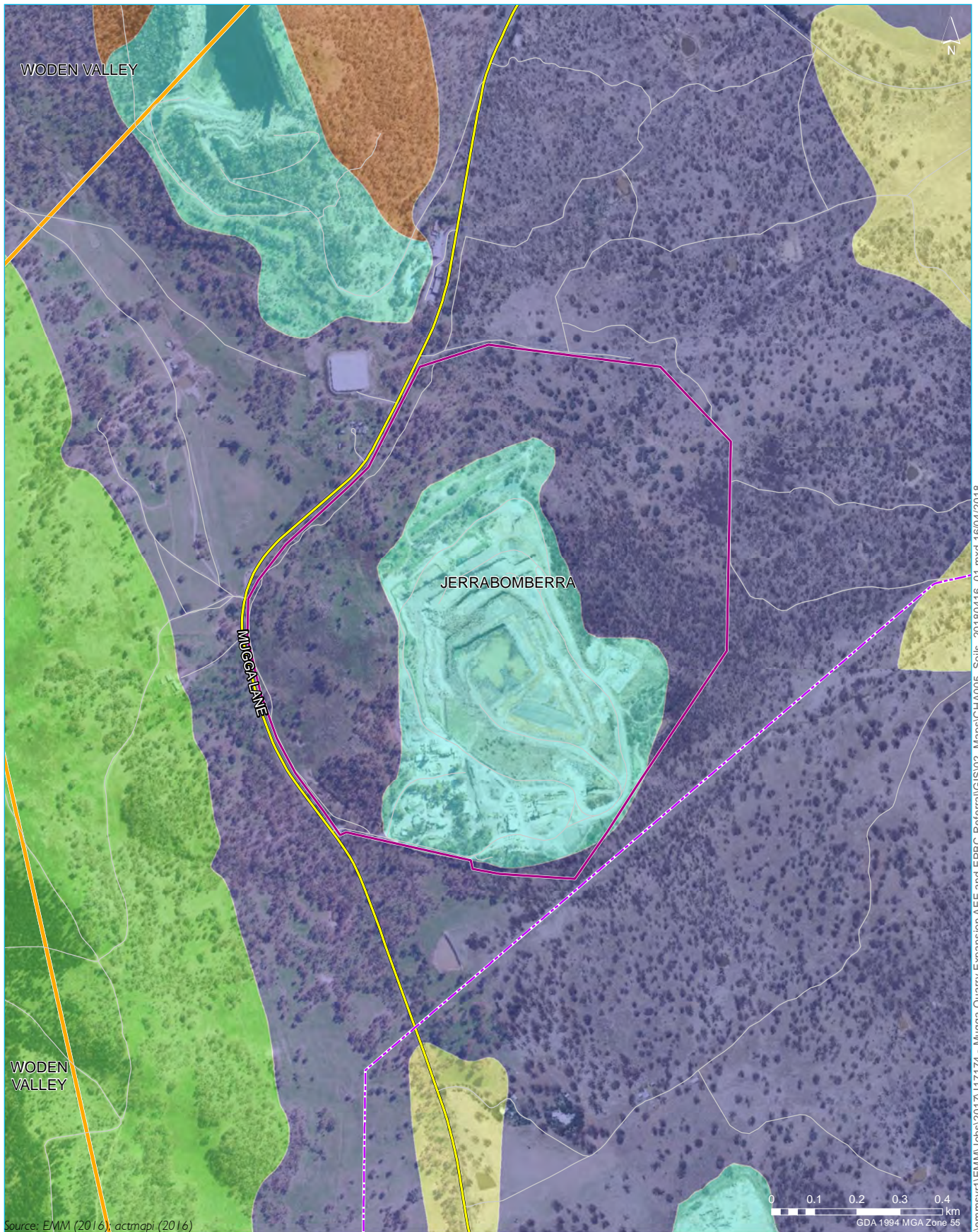
Overall, Pre-colonial biodiversity in the study area would have been greater than today and without the impact of widespread vegetation clearance. Native birds, reptiles and mammals would have occupied the landscape providing various resources for consumption by Aboriginal people.

### 3.7 Land use and disturbance

The project area is located within a broadacre rural setting and surrounded by low density land uses and established remnant native vegetation. The existing quarry immediately south of the project area has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility.

The project area specifically has been historically cleared of native vegetation but now features regrowth native vegetation distributed amongst grasses and weeds. More localised forms of disturbance include vehicle track use, intermittent areas of excavation associated with drainage diversion bunds and animal burrowing (notably by rabbits). The most obvious form of disturbance relates to a large linear overburden bund that runs along the southern boundary of the project area for an area of approximately 25 m wide and 500 m long. There is also evidence of machine grading and excavation on the boundary of the overburden bund.

Further information about disturbance is presented in the Archaeological survey section of this report (Chapter 6).



Source: EMM (2016); actmapi (2016)

KEY

- Site location - 321 Mugga Lane, Symonston
- ACT boundary
- District boundary
- Electricity transmission line
- Main road
- Local road
- Soil type
- Burra
- Campbell
- Campbell variant a
- Disturbed Terrain
- Williamsdale

Soils of the project area

Boral - Mugga Quarry overburden expansion  
 Cultural heritage assessment

Figure 3.2





## 4 Aboriginal heritage context

### 4.1 Ethno-historical overview

Information about the socio-cultural structure of Aboriginal society prior to European contact largely comes from ethno-historical accounts made by colonial settlers. These accounts and observations were made after massive social disruption due to disease and displacement. As a result, this information is often contentious, particularly in relation to language group boundaries. Therefore, it is likely that language group boundaries were far more diffuse than the arbitrary demarcations drawn by colonial observers.

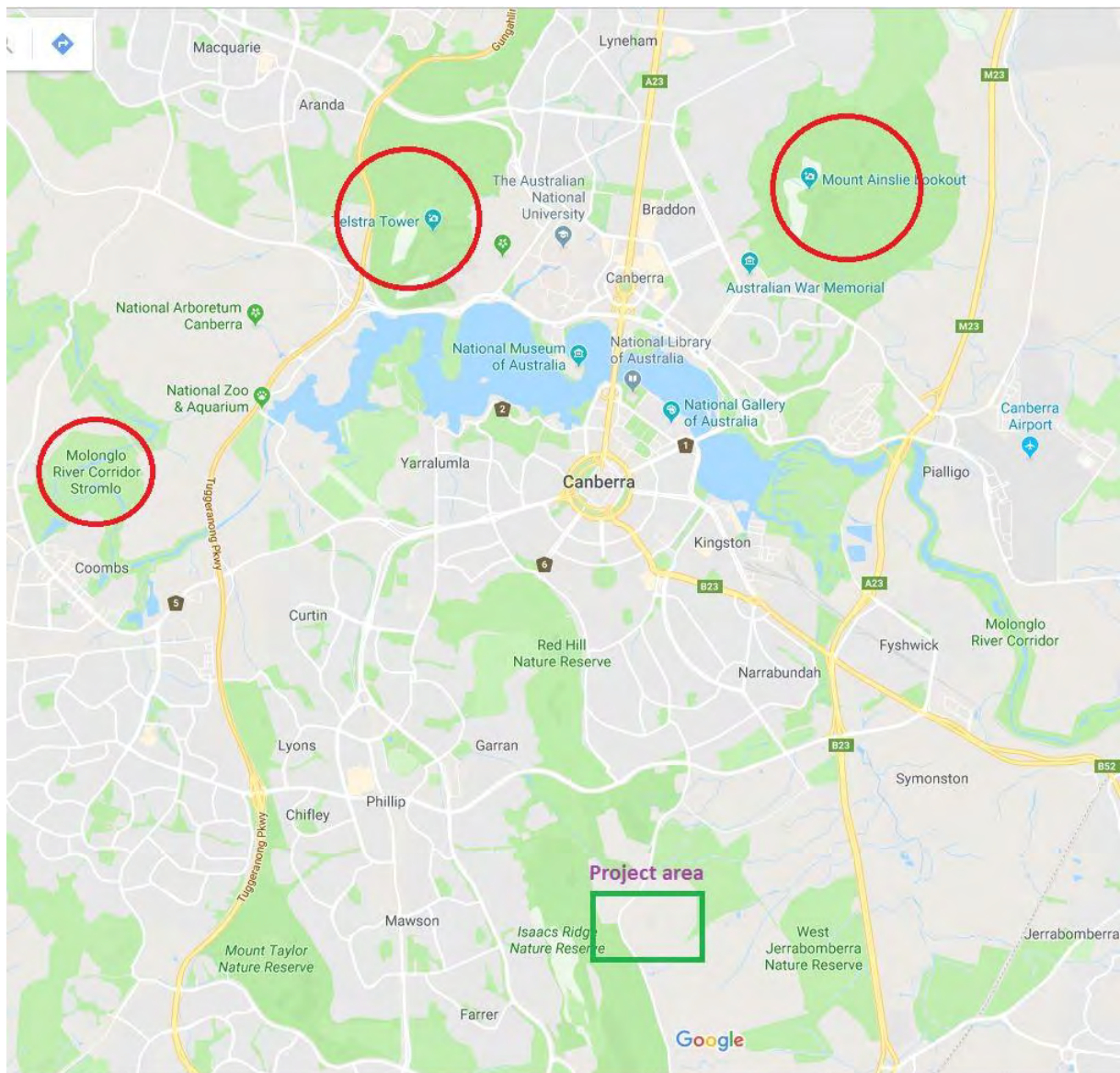
It is generally accepted that the ACT falls within the language boundary of two groups:

- Ngunawal territory which is bordered by Queanbeyan, Yass, Goulburn and the Shoalhaven River (Tindale 1974); and
- Ngarigo territory is found south of Ngunawal country. It extends north to Queanbeyan while encompasses the snowy mountains and extends south to the Bombala River (Tindale 1974).

The history of Aboriginal groups in the Alps and tablelands above is less detailed than their counterparts in more climate friendly areas (Mulvaney and Kamminga 1999, p.298), however there is a still strong cultural history which encompasses both the Ngarigo and the Ngunawal including culturally significant places, resources and dispersal after European contact. Winter brings harsh weather to the south eastern sector of Australia; which led to the movement of tribes seasonally. In the summer many other bands came to the area for “annual congregations’ (Mulvaney and Kamminga 1999, p. 290). This in part was due to the arrival of the Bogong moth, which were a great delicacy and important resource. The Bogong moth migrates from surrounding states (Queensland, NSW and Victoria) during summer to the cooler caves of the Alps. It is estimated over two billion make this migration (Australian Geographic, 2017).

#### 4.1.1 Local population

Research conducted on population densities for the area suggests that the coastal areas and low mountain valleys produced better resources year round than at higher altitudes such as the ACT (Flood 1973, p. 49). However, it is likely the larger area of the ACT was used as a meeting place for different Aboriginal bands and tribes as the seasons encouraged. This has been demonstrated by investigations of Black Mountain, Mount Ainslie and Molonglo Flats (Plate 4.1) which have been long associated with cultural and ceremonial meeting places for the tribes of the area (Ricardi et al 2016, p.38).



**Plate 4.1** Location of nearby meeting and ceremonial areas in relation to the project area

#### 4.1.2 Living arrangements and resources

Due to the severity of the weather in colder months, Aboriginal people often constructed huts (also known as gunyas) at their campsites. These were observed to be notably sturdy and extremely effective at keeping out the weather. The construction of huts varied based on weather, whereby huts constructed using bark sheets provided a wind break during colder times when compared to the use of simply boughs in better weather (Flood 1973, pp. 68–71).

Resources in the area were also dependent on the weather. In the summer and spring there were plentiful amounts of daisy yams, wombats, possums and crayfish. Winter did provide some resources in the form of mammals, reptiles and fern roots however it did force people down the Alps and into the low lying areas (Flood 1973, p 110). Some groups also migrated toward the coast and inland areas where resources were more abundant for the winter (ACT 2018). The area was also rich in volcanic tuff, quartz and chert for stone tools (Alpin, Ford and Hiscock 2010, p.200–203).

### 4.1.3 Burial customs and ceremony

The largest ceremony of the area most certainly centred on the Bogong moth, a small seasonal moth which were procured and prepared by the Aboriginal tribes who travelled to the foot of the Alps in summer often not returning until March. These moths were an important resource which provided sustenance to thousands of Aboriginal people during winter. Each year, tribes and bands from Jindabyne to Yass would gather at the foot of the mountains (both Mount Kosciuszko and Mount Bogong) in Corroboree before heading up the Alps and into the caves for moth hunting (Flood 1973, pp 82–84).

Sources indicate that the hunting and preparation of Bogong moths was a male only event. However, it is likely that women also ate the moths, but were not part of the ritualistic hunt (Flood 1973, p 79). The moths were often turned into a style of cake which could be stored for the winter and harvested in the millions (ACT Gov 2018).

Aboriginal people were buried in hollow trees, or where possible, in caves: the goal being to prevent dingoes from scavenging the corpse (Flood 1973, p. 170). Cremation followed by burial was also noted. Davis-Wright describes the ritual from 1923 of tying up the body and distributing the kidney fat before burying the body with his weapons and possessions (Flood 1973, p 125). Other known rituals including burial cairns (a stone monument occasionally used for entombing the dead) or burials in caves encased in a stone circle; this process was usually reserved for warriors (Flood 1973, p 125).

### 4.1.4 Tools, objects and weapons

Through the Alps and the tablelands Aboriginal people kept a strong arsenal, making them well prepared to take advantage of their resources as they came upon them or defend their resources as needed. Spears, nulla nulla, boomerangs, hatchets and shields were considered standard tools and weapons (Flood 1973, p.58). The area surrounding Canberra was also known for death spears; a type of spear which bears small flakes of quartz imbedded via gum in the head (Flood 1973, p 60). Despite the examples quoted in this report, there is typically a lack in ethon-historical accounts of smaller stone tools used in daily life. However, the use of a variety of stone tool types in many areas of daily life is well demonstrated in the archaeological record.

Baskets and bags were made from dried grass and Kurrajong bark native to the area, while Pimelea fibre nets were produced for the singular purpose of moth hunting (Flood 1973, p 62).

### 4.1.5 Apparel and adornments

A common mark of Aboriginals in the southern part of Australia is possum and kangaroo cloaks. The process for cloak making involves cleaning and drying the skin before it is artfully stitched with sinews from kangaroos. The inside of the skin is often adorned with pictures which serves two purposes: for decoration and to create pliability. Another common adornment in the area was possum tails, and belts made from possum skin (Flood 1973, p.65–68). Possum skin cloaks were prized through the years and have been handed down through families.

### 4.1.6 Ethno-historical implications for archaeology

Aboriginal archaeology is a unique field as the Aboriginal people were highly effective with very little. Tools which were made using wood and resin such as canoes, spears, shields and coolamons do not last long after being discarded unless in exceptional circumstances. This means stone tools, hearths, burials and occasionally culturally modified trees are the predominant materials left in the archaeological record.

Aboriginal toolkits indicate that organic materials like wood, bark, shell, bone and fur were integral to subsistence. However, these are not likely to have survived to form part of the archaeological record. Although smaller stone tools are rarely mentioned in historical accounts, many of these were made when modern materials, such as iron and glass, would have been preferred over stone. However, considering the significant pre-historical timeframe of stone tool manufacture, stone Aboriginal objects would be the materials most likely to have survived in the archaeological record.

Carved trees may remain in uncleared areas but would be very rare considering they were ceremonially created and the ensuing widespread European vegetation clearance. In contrast, Aboriginal scarring practices were generally far more widespread and utilitarian, which makes them far more likely to remain in uncleared areas. The Alps and tablelands encompass the coldest parts of Australia and this had a significant impact on how people lived. An example of this is the bark huts discussed in section 4.1.2; a more substantial hut then found further north. This type of work may leave more of a record than less substantially built bough lean-tos though it is still very unlikely any still stand today. Also the death spears which were referenced in section 4.1.4 would have deteriorated through the years but the quartz flakes used to create the head of the spear may have survived.

## 4.2 European historical context

Europeans made their way south in 1820 when Charles Thorsby exploring Goulburn and down to the Breadalbane plains. March 1821 saw Thorsby penetrate further south when he crossed the Molonglo and Queanbeyan rivers (Parsons 2018). This expedition was followed by many others but it was Captain Mark Currie who in 1825 mapped the surrounding area. Isabella's Plains were named after Sir Thomas Brisbane's daughter and still retains its use today (Canberra history 2018). The location of the project area on Currie's map is indicated by a red arrow on Plate 4.2.

By 1835 stations were established around Tuggeranong and the school house soon followed in 1845. By this time many grants had been handed out including to Martin Byrne and George Campbell who owned the land which the quarry currently resides on (Plate 4.3). The post office had its first postmaster in the form of local teacher Andrew Wotherspoon in 1863 and by 1887 the railway to Queanbeyan had commenced. In 1908 the area of Yass-Canberra was chosen as the capital of Australia and on 1 January 1911 was the birth of the Australian Capital Territory (Canberra history 2018).



Plate 4.2 Source: Murray, J 1825



Plate 4.3 Source: ACTmapi historic plans (1830-1910) 2018

## 4.3 Archaeological context

### 4.3.1 ACT heritage council register search

EMM contacted the ACT Heritage Council on 5 February 2018 with a request to access restricted or sensitive information related to Rural Block 2031 Jerrabomberra (being the project area) plus a 2-3 km buffer. The ACT Heritage Council granted approval for limited access to restricted information on 5 March 2018.

The search identified a total of 20 heritage places, 15 of which were categorised as restricted information (████████████████████). Fourteen Aboriginal places were identified, all of which are classed as restricted information and are summarised in Table 4.1. The search results identified a total of three artefact scatters, five isolated artefacts, three potential artefact deposits and three possible scar trees.

One Aboriginal Place (Mugga Q1) (████████████████████). However, this site has previously been salvaged and had no further management implications. The remaining registered Aboriginal places are over 1 km from the project area. The available studies related to these Aboriginal places are reviewed in section 4.2.2.

Six of the registered heritage places are not related to Aboriginal cultural heritage and are outside the project area. Notably, an area labelled as ‘Traditional Nesting Sites of Peregrine Falcons’ is mapped approximately 70 m from the project area. EMM consulted with the ACT Heritage Council who informed that the mapped location may be incorrect and that Peregrine Falcons were noted to occupy the nearby (████████████████████). The project will not impact this area.

**Table 4.1 Site information received from ACT Heritage Council**

██████████	██████████	Type of site	██████████	Site status (P_and_O code)
██████████	██████████	Isolated artefact	██████████	3 – Registered Places or Object
██████████	██████████	Isolated artefact	██████████	3 – Registered Places or Object
██████████	██████████	Potential artefact deposit	██████████	3 – Registered Places or Object
██████████	██████████	Artefact scatter	██████████	R7 – Salvaged Aboriginal Heritage – No management implications however the place is still of significance to Aboriginal People.
██████████	██████████	Isolated artefact	██████████	3 – Registered Places or Object
██████████	██████████	Possible scar tree	██████████	3 – Registered Places or Object
██████████	██████████	Potential artefact deposit	██████████	3 – Registered Places or Object
██████████	██████████	Artefact scatter	██████████	R7 – Salvaged Aboriginal Heritage – No management implications however the place is still of significance to Aboriginal People.
██████████	██████████	Possible scar tree	██████████	3 – Registered Places or Object
██████████	██████████	Isolated artefact	██████████	3 – Registered Places or Object
██████████	██████████	Possible scar tree	██████████	1 – Nominated to the Heritage Register

**Table 4.1 Site information received from ACT Heritage Council**

[REDACTED]	[REDACTED]	Type of site	[REDACTED]	Site status (P_and_O code)
[REDACTED]	[REDACTED]	Potential artefact deposit	[REDACTED]	3 – Registered Places or Object
[REDACTED]	[REDACTED]	Artefact scatter	[REDACTED]	R7 – Salvaged Aboriginal Heritage – No management implications however the place is still of significance to Aboriginal People.
[REDACTED]	[REDACTED]	Isolated artefact	[REDACTED]	3 – Registered Places or Object

Notes: 1. Reports not received from the ACT Heritage Council

## 4.3.2 Previous investigations

### i Overview

The regions surrounding Canberra through investigation have revealed dates of occupation from 18,000 BP in Birrigai Shelter (approximately 20 km south-west of the project area) and up to 50,000 BP from excavations at Lake George (38 km north-east of the project area) (Flood 2010, pp 114-116). Evidence from these excavations demonstrates that it is likely that the climate in the ACT was similar to that of the Snowy Mountains around 21,000 years ago: cool and snow in the winter, mild but liveable in the summer.

EMM have reviewed a number of previous heritage investigations in the local area including those provided by the ACT Heritage Council. The aim of the review was to understand the archaeological character of the local area, to aid in predictions for the project area and to guide the assessment of significance for Aboriginal sites within the project area.

### ii Sullivan, M 1996 *'Mugga 1 Quarry lease'* prepared for Boral Resources (Country) Pty Ltd, prepared by Huonbrook Environment and Heritage Pty Ltd.

In 1996, Sullivan prepared an archaeological survey report for the Boral's lease renewal of Mugga Quarry which included and extended beyond the project area. The original report showing the specific survey area was not found during research for this assessment (and also not on the ACT Heritage Council Register database). Notwithstanding, summary details of the report were reviewed, which identified three isolated quartz artefacts. Notably, one site (Mugga Q1) was identified [REDACTED]. This site is recorded on the ACT Heritage Council register as being salvaged and requiring no further management. The area was considered low significance after discussions with Ngunawal Local Aboriginal Land Council and there were no known significant areas nearby (Boral, 1999).

### iii Barber, M 2000, *Cultural resource survey of Hume and adjacent areas*, prepared for Department of Urban services by Southern Cross Heritage Services

In 2000, Matthew Barber submitted a report based on his survey of Hume and the adjacent areas of [REDACTED] of the project area. It is noted that although an extensive topographic survey was conducted, the prolific level of grass covering the survey areas created severe limitations in identifying potential artefacts and the extents of each site. Barber identified nineteen Aboriginal sites comprising two possible scarred trees on lower slopes and 17 small artefact scatters of between one and six artefacts. Twelve European sites containing farm structures and equipment were also recorded.

Stone artefacts sites were identified on spurs, hill slopes, flats, and low spurs. Barber noted that most of the sites were some distance from semi permanent or permanent watercourses and also observed that permanent water would have still been easily available from [REDACTED] Creek. Most stone artefacts were small intact and broken flakes fragments made from quartz but also volcanic stone, tuff and siliceous rock. One stone axe made from volcanic material was also identified. Barber recommended test excavation for five sites due to the poor visibility caused by the extensive grass covering in the low spur areas he deemed to be of higher potential. However, the results of any further investigation was not identified during EMM's research for this report.

iv [Navin Officer 2000, East O'Malley residential estate planning study: Cultural heritage assessment, prepared for Bill Guy & Partners Pty Ltd](#)

In 2000, Navin Officer Heritage Consultants (NOHC) completed a cultural heritage assessment including an archaeological survey of land to the north and east of the Canberra suburb of O'Malley, a minimum of [REDACTED] to the north-west of the project area. The survey area was situated in the upper reaches of the [REDACTED] Creek catchment and featured moderately inclined slopes and creek flats and the upper areas of a major spur line off the [REDACTED]. The [REDACTED] forms the watershed between two major catchment areas where two streams drain north-west into the [REDACTED] River. Despite its high altitude, the surveyed area experiences some water flow fed by natural springs.

The survey identified five possible scarred trees, four isolated stone artefacts, the remains of a 19<sup>th</sup> century hut and agricultural dam. The isolated artefacts comprised black chert and quartz material and were found situated on basal slopes within 180 m of a creek line consistent with regular artefact discard in well watered catchment corridors. The assessment concluded that any further surveys or ground disturbance would be unlikely to reveal higher artefact densities.

v [Navin Officer 2001, Callum Brae: A comparative assessment of the cultural heritage values of surviving soldier settlement properties with the ACT, prepared for Purdon Associates Pty Ltd](#)

In 2001, NOHC completed a comparative study to identify any heritage significance in Symonston, Canberra for the potential development of correctional facility. This report was based on a survey that had previously been conducted by Saunders in 1999 that focused on the identification and analysis of the WW1 'Callum Brae' homestead soldier complex and settlement. The survey conducted in 1999 also assessed two areas with the potential for subsurface Aboriginal artefacts that have been documented in a separate, complimentary report (Navin Officer Heritage Consultants, 2001). The 'Callum Brae' complex was assessed to be of high significance for historical cultural values, however further information of Aboriginal cultural heritage values were not provided as part of this report.

vi [Navin Officer 2003, 1/3 Symonston assisted living development: Cultural heritage assessment, prepared for Purdon Associates Pty Ltd](#)

In 2003, NOHC completed a cultural heritage assessment including an archaeological survey of Symonston located over [REDACTED] north-east of the project area and concentrated at the site of the former Mugga Zoo. The study area covered approximately 10 ha comprising upper valley slopes and low amorphous spur crests below the steeper slopes and crest of Mugga Mugga Ridge. Ephemeral streams run both east and west joining to the north-east and flowing into Jerrabomberra Creek.

One stone artefact scatter was identified on the gentle gradient of a small spur crest that has experienced major disturbance due to the construction and modification of the former zoo. The artefacts comprised of eight chert flakes, one rhyolite flake and one rhyolite flaked piece. Due to the poor condition of the site, poor soil quality and lack of significant finds the site was assessed to be of low archaeological potential and by extension, of low significance.

vii [CHMA, S 2010, Conservation management plan for parts of Symonston, Hume and Jerrabomberra, prepared for ACTPLA by Cultural Heritage Management Australia](#)

In 2010, Cultural Heritage Management Australia (CHMA) conducted an Aboriginal and European cultural heritage survey of a number of blocks within Hume, Symonston and Jerrabomberra. All surveyed blocks are located within the Jerrabomberra Valley an area that covers large portions of rural land, protected grasslands/reserves and private property. Much of the survey area comprised Florey and Umburra landforms often dissected by Jerrabomberra Creek. The Florey landform consists mostly of basal slopes

and valley floors as well as gently sloping terrain. The Umburra landform consists of hard ridgelines and steep sided slopes in mid and upper valley areas. The subject areas have experienced human induced disturbances to varying degrees including alterations of elevations and creek lines, infilling and agricultural practices.

Surface visibility observed during the survey was generally low (between 5-10%). Notwithstanding, six isolated finds, six sites with associated Potential Archaeological Deposits (PADs), three PADs and one possible scarred tree were identified. Eight sites were also identified as European, half of which had no heritage value. Subsurface testing was recommended for PADs but it was not undertaken as part of the assessment at the time.

viii [Biosis 2010, Mugga Lane Landfill Extension – Block 2227 Hume, European and Aboriginal Heritage Assessment, prepared for ACT NOWaste Dept.](#)

In 2010, Biosis prepared a European and Aboriginal Heritage Assessment including an archaeological survey for a proposed landfill extension approximately [REDACTED] south of the project area. The survey covered lower slopes, spurs and hill slopes adjacent to ephemeral 1<sup>st</sup> order streams. The survey identified one isolated quartz flake and one isolated chert flake. No areas of archaeological potential were identified.

ix [Biosis, L 2014, Symonston quarry H67 ACT: Cultural heritage study, prepared for ACT Land Development Agency](#)

In 2014, Biosis completed a cultural heritage assessment including an archaeological test excavation for the proposed Symonston Quarry, approximately [REDACTED] north-east of the project area adjacent to the fifth order stream Jerrabomberra Creek. The test excavation was in response to potential impacts to a previously recorded Aboriginal quarry site containing the only site in the ACT that shows working of feldspar porphyry resource.

The study area and site location was situated on a northeast–southwest spur line overlooking Jerrabomberra Creek. A series of 15 test pits were excavated along the proposed road cutting of the extension of [REDACTED] in Symonston. The test pits were excavated by hand to an average depth of 30 cm at which depth interbedded rocks were located making it impossible for hand excavation to proceed. No cultural material was located in any of the test pits in a subsurface context despite it being adjacent to permanent water. This was attributed to soil over the site being shallow and with numerous rock outcrops.

## 5 Predictive model

### 5.1 Synthesis of background information

There are particular landscape features that are more likely to have been associated with Aboriginal activities than others. Some of these past activities are traceable through the archaeological evidence left behind, but this is dependent on how favourable the environmental conditions have been to preserve the remains. The main features that inform archaeological potential include the presence or absence of water, access to food and resources (including stone raw materials), the nature of the terrain and cultural or spiritual associations with a place.

Many of the previous investigations in the local area have been completed in similar landscape contexts as the project area, being on a landform pattern of low hills nearby ephemeral water sources. The Aboriginal sites identified in these contexts are consistently either isolated artefacts or low density artefact scatters of elevated landforms (such as crests, spurs and hill slopes), often overlooking drainage depressions. Previous investigations closer to the reliable water source of Jerrabomberra Creek indicates mixed results with surface stone artefact sites of similar content and value consistently found. However more PADs were identified, which is associated with the assumption that such areas would have supported more frequent and intensive Aboriginal occupation.

Interestingly one Aboriginal stone quarry was identified near Jerrabomberra Creek, but subsequent test excavation nearby found no subsurface material (Biosis 2014). This is indicative that stone artefact sites are often only represented as surface sites in areas with shallow soils such as the project area, but this is admittedly based on a small sample of results.

The environmental context of the project area, when considered in conjunction with the archaeological and ethno-historical background, indicates that stone artefacts are likely to have been deposited across the project area in elevated areas adjacent drainage depressions which are likely to hold water temporarily after rain. Previous investigations indicate that stone artefact sites likely comprise isolated artefacts or low frequency artefact scatters of locally occurring material including quartz, tuff, rhyolite and chert. Although the local geology supports these material types, Aboriginal quarry sites are rare. The outcropping porphyry in the project area and beyond is typically very weathered and unsuitable for stone tool manufacture. The frequent occurrence of quartz may indicate that any outcropping quartz veins in the broader landscape were utilised for raw materials.

The other most commonly identified Aboriginal sites are possible scarred trees, however many have not been verified to be of Aboriginal origin. These may have had the potential to occur in the project area if mature trees remained.

The historical land use and disturbance of the site would have been a main factor in the survival of certain archaeological sites. More fragile site types such as stone arrangements or hearths would have been impacted by historical land use. If present, stone artefacts in the project area are likely to have been displaced from their original location through vegetation clearance, but may reflect the general location of their original deposition.

Vegetation clearance has the potential to disturb Aboriginal sites and objects, most commonly by displacing stone artefacts from their original context and accelerating erosion which typically results in the downward movement of artefacts on sloping terrain. Vegetation clearance followed by grazing is arguably the most widespread human-made form of disturbance to Aboriginal sites in Australia. Notwithstanding, stone artefact sites are consistently found in such contexts throughout Australia.

## 5.2 Predictive model

A predictive model of potential Aboriginal site location has been devised for the project area based on the data presented in the preceding sections. In summary, the model has been formed by an analysis of:

- landscape features in the project area and its surrounds;
- pre-colonial period ecological conditions;
- advice from Aboriginal knowledge holders;
- ethno-historical information about Aboriginal life and material culture; and
- the type and distribution of Aboriginal sites described in previous reports and the ACT Heritage Councils data.

The model enabled predictions to be made about the location of Aboriginal sites within the project area and this information guided the archaeological survey.

### 5.2.1 Predictive model results

The results from the predictive model are summarised in Table 5.1.

**Table 5.1 Site type and distribution**

Site type	Predictions
Open artefact sites and isolated finds	Open stone artefact scatters and isolated finds are the site types most likely to occur in the project area. These may occur anywhere as background scatter, but are most likely to occur on hill slopes or crests near the drainage depressions in the project area.
Modified trees	Modified trees (either carved or scarred) may occur where native vegetation has been preserved. However, the project area is mostly cleared.
Grinding grooves and grind stones	It is unlikely that grinding grooves occur at the site as there are no suitable rock outcrops. However, portable grindstones could be present as these items could have been imported into the area (but would be very rare for this area).
Hearths	The extent of historical land use (primarily vegetation clearance) has led to widespread disturbance, which is likely to have removed or destroyed archaeological traces of this site type.
Burials	Burials can occur anywhere in the landscape but their identification is very rare. Generally they would be identified by mounds of earth, carved trees or stone markers. Archaeological evidence of burial sites is rare in the region.
Stone arrangements	The level of land use and disturbance in the study area is likely to have destroyed archaeological evidence of this site type.
Rock engravings	These are unlikely to occur in the study area because outcropping sandstone does not occur in the project area.
Middens	Freshwater shell middens may occur along extensive and reliable river systems. It is unlikely that middens will occur in the project area because of the distance to water and its proximity to ephemeral streams only.
Rock shelters	Rock shelters occur in areas with suitable geological formation processes and outcrops of rock.  No rock shelters have been identified in the local area and it is unlikely that any will be found in the project area as the landscape does not have suitable rock

**Table 5.1**      **Site type and distribution**

<b>Site type</b>	<b>Predictions</b>
Quarries (stone or ochre)	outcrops. The geology and soils of the site are not known to feature these site types. Only one quarry was identified during previous investigations and it is adjacent to Jerrabomberra Creek.



## 6 Archaeological survey

### 6.1 Overview

EMM Senior Archaeologist, Ryan Desic, accompanied by RAO representative Justin Bell (Buru Ngunawal Aboriginal Corporation) (the survey team), surveyed the proposed overburden expansion footprint on 14 March 2018. The three other RAOs: King Brown Tribal Group, Little Gudenby River Tribal Council and Ngarigu Currawong Clan indicated that they would each provide a representative for fieldwork, however they were unable to attend on the day.

The primary aims of the survey were to:

- identify Aboriginal sites or areas of Aboriginal cultural significance with the assistance of Aboriginal knowledge holders; and
- characterise the landscape to aid predictions of surface and sub-surface archaeological potential.

### 6.2 Survey strategy

The survey strategy was developed on the basis of the predictive model which indicated that Aboriginal sites were likely to occur in the project area in the form of stone artefact scatters or isolated finds. The project area was relatively small which allowed the survey team to cover the entire extent of the impact footprint. As such, a more strategic sampling strategy based on predicted sensitive landforms was not developed because the survey team had the opportunity to comprehensively cover all landforms within the project area.

The strategy for spacing between survey transect's was not decided until the day of the survey and was made flexible to suit the ground surface visibility conditions encountered across the project area. For example, transects were more widely spaced in more thickly grassed areas ( [REDACTED] ) as placing transects closer would have achieved the same results. In contrast, transects were spaced more closely in areas with more exposed ground surface ( [REDACTED] ) as the survey team had greater opportunity to identify Aboriginal objects.

### 6.3 General method

The survey team walked the project area according to defined landform elements. The survey team comprised two people who inspected the ground surface of each transect while spaced approximately 5 m apart. This spacing was considered appropriate as it allowed the team members to meander slightly within transects to target ground exposures.

The survey team targeted ground exposures including vehicle and animal tracks, eroded scalds, eroded halos around trees caused by animals, ant nests and animal burrows, all of which provided good ground surface visibility for identifying stone artefacts. However, ground surface visibility was limited in small areas of thick grass and nettles, gravelly surfaces and leaf litter.

The survey team inspected all mature trees in the project area for signs of Aboriginal scarring or carving, but these were very limited in number and easily identifiable from a distance. Outcropping rock was inspected for Aboriginal modification, however it was noted that rock material type and quality (granite boulders) was generally unsuitable for modification.

## 6.4 Identification and recording of Aboriginal sites

### 6.4.1 Site and survey recording methods

Archaeological site recording was completed using a hand-held non-differential GPS unit (GDA94 Zone 56). Site locations were checked using ArcGIS software. Survey transects were accurately mapped by downloading tracks recorded on GPS.

Site data recording and naming protocols were completed in accordance with the *ACT Heritage Council Cultural Heritage Reporting Policy* (2015). Survey transects were recorded using the *Australian Soil and Land Survey Field Book* (CSIRO 2009) to define landform elements. Representative photographs of both the survey transects and site features were taken throughout the survey.

Open stone artefact sites were defined by the presence of one (isolated find) or more (artefact scatter) Aboriginal objects on the ground surface. The boundaries of a site ( [REDACTED] ) are limited to the spatial extent of the visible Aboriginal objects. Stone artefacts more than 50 m apart were recorded as separate sites. The 50 m rule is an arbitrary distinction and is mainly used as a tool for consistency in recording techniques.

Modified trees (either carved or scarred) can be difficult to identify. Scars commonly occur on trees through natural processes such as branch tears, insect damage, storm and fire damage and faunal damage. Scars can also occur from mechanical damage from vehicles or farming equipment. However, Aboriginal people were recorded using bark and cambium for canoes, containers, shelters and implements amongst other uses.

Overall, no possible scar trees were identified and therefore no further evaluation of trees within the project area was required.

## 6.5 Survey coverage results

### 6.5.1 Rationale

The aim of recording and analysing survey coverage data is to determine the effectiveness of the survey. It is evaluated for its effectiveness in identifying the distribution of Aboriginal objects across the landscape, taking into account the potential for archaeological deposits. The percentage of the ground surface exposed in each landform and the visible ground surface within exposures (as ground exposures are often obscured by vegetation, gravels, etc) influences the survey results.

For example, an archaeologically sensitive landform surface that is highly exposed by erosion is likely to reveal Aboriginal artefacts, whereas a similar landform that is thickly grassed will obscure surface artefacts if they are present. Overall, calculation of effective survey coverage is used to estimate not only how much area was physically surveyed, but also how favourable the survey conditions were for the identification of Aboriginal sites.

### 6.5.2 Survey coverage results

The survey comprised eight transects covering hill crest, hill slope and drainage depression landform types. Each survey team member walked approximately 7 km across the project area [REDACTED]. [REDACTED] presents the survey transects logged by the GPS but represents only where the GPS holder walked during the survey. It does not represent the true transect width covered by the additional team member.

Landform coverage data is summarised in Table 6.1. Examples of the varying ground surface exposure and visibility conditions are shown in Plate 6.2 to Plate 6.10.

**Table 6.1 Effective survey coverage results of the project area**

Transect	Landform element	Length (m)	Width (m)	Area (m <sup>2</sup> )	Exposure	Visibility	Effective coverage area (m <sup>2</sup> )	Effective coverage %	Rock outcrop form	Rock outcrop %	Ground cover types	Exposure types	Vegetation	Sites Disturbance
T1	Hill slope	1057	10	10572	30%	60%	1903	18	Boulder, cobbles and gravels.	2	Grass; thistle; gravel	Tree halos; animal tracks; scalds.	Grass; isolated mature trees	1 Localised excavation for drainage bunds at eastern edge of transect; clearing; animal burrowing
T2	Drainage depression	313	10	3128	10%	50%	156	5	N/A	0	Grass; regrowth trees; leaf litter	Animal burrows; ant hills	Grass; isolated mature trees; regrowth	Animal burrowing; drainage bund excavation; clearing
T3	Hill crest	1054	10	10543	50%	70%	3690	35	Boulder, cobbles and gravels.	5	Grass; regrowth trees; leaf litter	Vehicle track; ant hills; scalds; animal tracks; animal burrows.	Grass; isolated mature trees; regrowth	2 Vehicle track erosion; clearing; animal burrowing
T4	Hill slope	702	10	7023	30%	80%	1686	24	Cobbles and gravels	1	Grass; regrowth trees; leaf litter	Vehicle track; ant hills; scalds; animal tracks; animal burrows.	Grass; isolated mature trees; regrowth	2 Vehicle track erosion; clearing; animal burrowing
T5	Drainage depression	424	10	4245	20%	60%	509	12	Bedrock; gravels	1	Grass; regrowth trees; leaf litter	Ant hills; scalds; animal tracks; animal burrows.	Grass; regrowth	Scalds; vehicle track ruts;
T6	Hill slope	2078	10	20779	40%	70%	5818	28	Gravels	1	Grass; regrowth trees; leaf litter	Vehicle track; ant hills; scalds; animal tracks; animal burrows.	Grass; isolated mature trees; regrowth	2 Large highly eroded vehicle track; large stockpile bund along southern border
T7	Hill crest	620	10	6198	40%	70%	1735	28	Bedrock; boulders	2	Grass; regrowth trees; leaf	Cattle tracks; scalds; tree halos;	Grass; isolated mature trees; regrowth	1 Vehicle track erosion; clearing; animal burrowing

**Table 6.1**      **Effective survey coverage results of the project area**

Transect	Landform element	Length (m)	Width (m)	Area (m <sup>2</sup> )	Exposure	Visibility	Effective coverage area (m <sup>2</sup> )	Effective coverage %	Rock outcrop form	Rock outcrop %	Ground cover types	Exposure types	Vegetation	Sites Disturbance
											litter			
T8	Hill slope	569	10	5690	30%	70%	1195	21	Gravels	1	Grass; regrowth trees; leaf litter	Vehicle tracks; scalds	Grass; isolated mature trees; regrowth	1 Vehicle track erosion; clearing; animal burrowing

Table 6.1 shows that effective coverage percentages of the project area was relatively high and ranged from between 12% and 35%, with an average of 21%. Lower than average ground surface visibility was primarily observed on the hill slope landform of Transect 1 and within drainage depressions (Transect 2 and Transect 5). Grasses and thistles obscured much of the ground surface in Transect 1, whereby the main sources of exposure were localised to halos around trees (Plate 6.1), disturbed areas for drainage bunds and sporadic scalds. Drainage depressions generally had a thicker ground cover of grasses and regrowth eucalypts (Plate 6.2 and Plate 6.3) because of concentrated water flow, but the side slopes of the depressions had greater exposures, sometimes exposing bedrock (Plate 6.7). Only 10% of the survey covered drainage depression landforms.

The highest ground surface visibility conditions were observed on the two broad hill crest landforms surveyed in the project area (Transect 3 and Transect 7). Approximately 25% of the survey covered hill crests. The western portion of Transect 3 had large continuous exposures amongst tufted grass, leaf litter and gravels. These conditions allowed for easy identification of stone artefact materials (Plate 6.4). Regrowth vegetation increases towards the eastern extent of Transect 3 where the crest becomes narrow and outcropping bedrock becomes abundant amongst large scald exposures (Plate 6.5). The crest at the north-eastern extent of the project area (Transect 7) had similarly high levels of exposure but had only sporadic occurrences of outcropping bedrock.

Hill slopes were the most surveyed landforms as this landform type dominates the project area. Approximately 70% of the survey covered hill slopes. Ground surface visibility was generally high across hill slopes (effective coverage ranging from 18% to 28%) with the exception of tracts of thistle in Transect 1. The survey team encountered continuous scalds, animal tracks, vehicle tracks with varying levels of grass, gravels, regrowth and leaf litter. Notably, the south-eastern edge of Transect 6 borders on the modified terrain of a large earth bund whereby previous machine excavation, grading and imported soil has occurred (Plate 6.8). Apart from this larger area of disturbance, other forms of disturbance were more localised to animal burrows and drainage bunds.

REMOVED

**Plate 6.1** [REDACTED] (hill slope) showing exposure halo around a tree leading into thicker grasses and thistles in the background. Also showing the location of site [REDACTED] (orange flag) (view north-east).



**Plate 6.2** Transect 2 (drainage depression) showing thick grass on the bed of the depression (view north-west).



**Plate 6.3** Transect 2 (drainage depression) showing exposures on the side slopes of the depression and localised animal burrowing (view north-west).



**Plate 6.4** Transect 3 (hill crest) showing continuous exposures amongst tufted grass, leaf litter and gravels (view north-east).



**Plate 6.5** Transect 3 showing outcropping boulders and larger scalds amongst regrowth vegetation (view east)

REMOVED

**Plate 6.6** [REDACTED] (hill slope) showing exposed hill slope with higher concentrations of leaf litter. Stony hill crest is visible in top-left of photograph. Orange flag marks isolated artefact [REDACTED].



**Plate 6.7** Transect 5 (drainage depression) showing exposed bedrock and nearby exposures on the side slopes of the depression landform (view north-east)



**Plate 6.8** Transect 6 (hill slope) showing scalds and vehicle tracks amongst vegetation. Disturbance from a large soil bund is visible to the top-left of the photograph (view south-west)



**Plate 6.9** Transect 7 (hill crest) showing continuous exposure on broad crest (view north)



**Plate 6.10** Transect 8 (hill slope) adjacent to quarry stockpile bund (view south-east)

## 6.6 Aboriginal site results

### 6.6.1 Overview

The survey team identified nine stone artefact sites in the project area, comprising five isolated artefacts and four artefact scatters. The locations of the sites are shown on [REDACTED] and a summary description for each site is provided in Table 6.2.

### 6.6.2 Landscape associations

The stone artefact sites were identified on hill crest and hill slope landforms. Three isolated [REDACTED] and three artefact scatters [REDACTED] were identified on hill slope landforms. One artefact scatter [REDACTED] and two isolated artefacts [REDACTED] were identified on hill crest landforms. No sites were identified within drainage depressions, but this is not surprising given that areas adjacent to creeks or drainage depressions typically represent where stone tools were made whereas the depressions alone represent the source of water.

All of the sites were identified on the level to gently inclined terrain that characterises the project area. They were also identified in areas with favourable outlook over the landscape, being either on crests or the upper portions of hill slopes (eg Plate 6.1) instead of down slope closer to the more enclosed nature of drainage depressions.

All of the sites are considered to be associated with Aboriginal occupation adjacent to ephemeral sources of water. Six of the nine sites are within 50 m of first order headwater streams and the remaining three sites are within 150 m. None of the sites are considered to be near perennial water, as Jerrabomberra Creek is the nearest reliable stream and is over 3.5 km east of the project area.

### 6.6.3 Site characteristics

Sites were identified across a number of different exposure types including vehicle tracks, erosion scalds and animal tracks. A total of 30 artefacts were counted during the survey. Artefact frequencies within sites ranged from 1 to 12, with an average artefact frequency of 3. Quartz is the most commonly occurring raw stone artefact material (n=24) and was identified at all sites except [REDACTED]. Other stone artefact raw materials comprise indurated mudstone/tuff (IMT) (n=2), silcrete (n=3) and chert (n=1) (eg Plate 6.11).

Artefact types were typically stone flakes or flaked pieces (n=27). Additionally, one quartz core, one IMT core and one retouched silcrete flake (Plate 6.12) were identified.

Site disturbance levels were also recorded for each site. Over half of the sites (n=5) were considered to have a low to moderate level of which was typified by historical vegetation clearance, minor erosion and/or animal activity (eg Plate 6.6). Three sites had moderate levels of disturbance caused by more obvious localised disturbance such as animal burrowing or fallen trees where it was obvious the artefacts had moved somewhat from their original location (eg Plate 6.14). Two sites were considered to have moderate to high levels of disturbance: [REDACTED] which was identified near a fallen stump and intensive animal activity, [REDACTED] that was identified between an existing [REDACTED] [REDACTED]). Notably, [REDACTED] had the highest artefact frequency (n=12) but had little to no site integrity.



Plate 6.11 [redacted] showing chert flake (right) and two quartz flaked pieces (left)



Plate 6.12 [redacted] showing silcrete flake retouched along one lateral margin



**Plate 6.13** [REDACTED] showing silcrete flake (left) and quartz flakes (right)

REMOVED

**Plate 6.14** [REDACTED] showing its location amongst outcropping bedrock and animal burrowing

REMOVED

**Plate 6.15** [REDACTED] showing its location on modified terrain (view south).

## 6.7 Discussion of survey coverage and Aboriginal site results

The relatively comprehensive survey coverage of the project area and the good ground surface visibility conditions has allowed for the archaeological resource to be characterised. This is supported by the fairly consistent occurrence of isolated stone artefacts and low frequency artefact scatters distributed along hill slopes and crests nearby drainage depressions. Although it is acknowledged that some stone artefacts are likely to have been obscured by vegetation and not therefore identified, the sites that were identified provide a characteristic and representative sample for the project area.

The site contents feature materials and artefact types common to the area. Notably, the dominant material type of quartz in the project area is very common locally and wider Southern Tablelands. The primary artefact types of flakes and flaked pieces are also the most commonly identified site components as they represent debitage of the stone tool manufacture process. Only one retouched flake was identified, but it is only partially worked and does not represent a diagnostic tool type.

Although the project area provided good exposures for identifying Aboriginal objects, the extensiveness of these exposures indicate that erosion through sheet wash and scalding has caused accelerated erosion and that topsoil profiles (those that have potential to retain stone artefacts) are very thin.

As the project area is at the very headwaters and only features drainage depressions, it is unlikely that intensive occupation would have occurred in this area, and therefore significant subsurface material is unlikely to exist. In addition, recent test excavations by Biosis (2014) next to Jerrabomberra Creek did not identify subsurface objects despite being adjacent to an Aboriginal quarry. As such, the surface archaeological record is likely to be a good representation of the nature and extent of Aboriginal occupation in the project area.

**Table 6.2** Aboriginal site results summary

Site Name	Easting	Northing	Site Type	Description	Artefact count	Landform element	Exposure type	Disturbance to deposit	Site area (m <sup>2</sup> )	Distance to temporary water	Name of temporary watercourse	Distance to perennial water (m)	Name of perennial watercourse
█	█	█	Isolated artefact	The site comprises a single light brown silcrete distal flake located on the mid-slope of a hill. The site was identified in an approximate 20 m x 20 m tree halo exposure caused by animals.	1	Hill slope	Animal track	Moderate: animal tracking and burrowing	1	150	N/A	3900	Jerrabomberra Creek
█	█	█	Isolated artefact	The site comprises a single milk quartz flake located on a broad; low crest approximately 10 m north-east of an ephemeral 1st order (Strahler) drainage depression. The site was identified within a large and continuous scald exposure that extends beyond 50 m x 50 m; however no further artefacts were identified nearby despite the high ground surface visibility.	1	Hill crest	Scald: continuous amongst patchy grass	Low to moderate: vegetation clearance and animal activity	1	10	N/A	4100	Jerrabomberra Creek
█	█	█	Artefact scatter	The site is an artefact scatter comprising 5 stone artefacts distributed along a stony hill crest within a 40 x 15 m area. The artefacts were recorded at four GPS waypoint locations which are described below: -a (693715 E; 6084838 N) = 1 milky quartz distal flake -b (693714 E; 6084838 N) = 1 quartz flaked piece -c (693734 E; 6084859 N) = 1 grey IMT distal flake and 1 grey IMT multidirectional core with evidence of platform preparation -d (693715 E; 6084819N) = 1 quartz flake. The site has a high level of outcropping granite and also features numerous rabbit burrows.	5	Hill crest	Scalds; animal burrows; fallen trees	Moderate: animal tracking and burrowing	600	50	N/A	3800	Jerrabomberra Creek

**Table 6.2 Aboriginal site results summary**

Site Name	Easting	Northing	Site Type	Description	Artefact count	Landform element	Exposure type	Disturbance to deposit	Site area (m <sup>2</sup> )	Distance to temporary water	Name of temporary watercourse	Distance to perennial water (m)	Name of perennial watercourse
				Outcropping sandstone levels indicate very skeletal soils.									
[REDACTED]	[REDACTED]	[REDACTED]	Artefact scatter	The site comprises three stone artefacts within an approximate 5 m x 5 m area located on a gentle hill slope within an area disturbed by animal burrowing and a fallen tree. The artefacts comprise: - 1 dark grey chert flake - 2 milky quartz flaked pieces	3	Hill slope	Fallen tree; animal burrowing	Moderate to high: intensive burrowing and fallen tree	25	20	N/A	3700	Jerrabomberra Creek
[REDACTED]	[REDACTED]	[REDACTED]	Isolated artefact	The site comprises one quartz flaked piece identified within an erosion scald on a lower hill slope adjacent to an ephemeral drainage depression.	1	Hill slope	Scald: continuous amongst patchy grass	Low to moderate: vegetation clearance and animal activity	1	30	N/A	3600	Jerrabomberra Creek
[REDACTED]	[REDACTED]	[REDACTED]	Artefact scatter	The site comprises a scatter of five quartz artefacts identified within an approximate 10 m x 10 m area on the mid slope of a hill adjacent to an ephemeral drainage depression. The artefacts comprise: - 1 quartz core - 4 quartz flaked pieces.	5	Hill slope	Scald: continuous amongst patchy grass	Low to moderate: vegetation clearance and animal activity	100	40	N/A	3500	Jerrabomberra Creek
[REDACTED]	[REDACTED]	[REDACTED]	Artefact scatter	The site comprises a scatter of 12 artefacts associated with large and graded exposure along a vehicle track on a gentle hill slope. The artefacts comprise: - 7 quartz flakes - 3 quartz flaked pieces - 1 grey silcrete flake	12	Hill slope	[REDACTED]	[REDACTED]	450	50	N/A	3500	Jerrabomberra Creek

**Table 6.2 Aboriginal site results summary**

Site Name	Easting	Northing	Site Type	Description	Artefact count	Landform element	Exposure type	Disturbance to deposit	Site area (m <sup>2</sup> )	Distance to temporary water	Name of temporary watercourse	Distance to perennial water (m)	Name of perennial watercourse
				- 1 grey retouched silcrete flake with three retouch scars along its left lateral margin. The site is also abutting a large mining bund/stockpile which is a further sign of local ground disturbance.									
█	█	█	Isolated artefact	The site comprises one quartz flake identified within an erosion scald on hill crest approximately 10 m from a mining stockpile/bund	1	Hill crest	Scald: continuous amongst patchy grass	Low to moderate: vegetation clearance and animal activity	1	125	N/A	3400	Jerrabomberra Creek
█	█	█	Isolated artefact	The site comprises one quartz flake identified within an erosion scald on hill slope.	1	Hill slope	Scald: continuous amongst patchy grass	Low to moderate: vegetation clearance and animal activity	1	140	N/A	3500	Jerrabomberra Creek

## 7 Significance assessment

### 7.1 Defining heritage significance

Heritage sites, objects and places hold value for communities in many different ways. The nature of those heritage values is an important consideration when deciding on how to manage a heritage site, object or place, and balance competing land-use options.

The main heritage values assessed are summed up in an assessment of ‘Cultural Significance’.

The primary guide to the management of heritage places is the Australia International Council on Monuments and Sites (ICOMOS) *Burra Charter* (ICOMOS 2013). The *Burra Charter* defines cultural significance as follows:

Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects. Places may have a range of values for different individuals or groups (ICOMOS 2013).

The purpose of this assessment is to examine various aspects of Aboriginal heritage for the purpose of assessing possible development impacts.

### 7.2 ACT Heritage Act 2004 criteria

The *Heritage Act 2004* (amended in 2014) specifies that a place or object has *heritage significance* if that place or object meets one or more of eight heritage significance criteria. Furthermore, a place or object has *cultural heritage significance* if it is created or modified by human action or is associated with human activity or a human event and has *heritage significance*. The ACT Heritage Council *Heritage Assessment Policy* (2015b) provides guidelines for assessing places and objects against the criteria.

Although there are many levels of significance for which a heritage place or object may be important, it may only be entered in the ACT Heritage Register if it has Territory-level heritage significance or higher under the *Heritage Act 2004*. Table 7.1 provides the assessment of significance for the Aboriginal places recorded in the project area [REDACTED] against the ACT Heritage Act significance criteria. As these places all comprise surface stone artefacts of similar nature and context and are not considered to meet the threshold for the ACT Heritage Register, they have been assessed collectively against the criteria to avoid repetition. Notwithstanding, specific sites are discussed against the criteria where relevant to demonstrate how they relate to the criteria.

RAOs were offered with the opportunity to provide information about the Aboriginal cultural and social significance of the identified places. However no comments were received were received by RAPs within the 18 day time frame or to date.

**Table 7.1 Assessment of significance**

Criteria	Assessment of significance for [REDACTED]
Criterion (a) – importance to the course or pattern of the ACT’s cultural	Although the sites represent an association with the past Aboriginal way of life and stone tool making traditions, the association is not clearly established to any particular event or tradition that would make it distinctive from other sites in the ACT of a similar nature. Moreover, the period of site deposition cannot be clearly

**Table 7.1 Assessment of significance**

Criteria	Assessment of significance for [REDACTED]
or natural history	<p>identified as the sites are surface finds which would not provide opportunities for dating and no specific stone implements were identified other than a partially retouched flaked in [REDACTED].</p> <p>The Aboriginal places in the project do not meet the threshold to fulfil this criterion.</p>
Criterion (b) — has uncommon, rare or endangered aspects of the ACT’s cultural or natural history	<p>All of the Aboriginal places identified in the project area are commonly recorded Aboriginal site types consisting of low density stone artefacts on elevated landforms in proximity ephemeral watercourses. Although an above average number of artefacts were identified in site [REDACTED] (n=12), the site’s integrity has been highly compromised which precludes further assumptions and meaningful analysis.</p> <p>Overall, the places locations, raw materials and artefact types are all common for the ACT and therefore do not meet the threshold to fulfil this criterion.</p>
Criterion (c) — potential to yield information that will contribute to an understanding of the ACT’s cultural or natural history	<p>This criterion is most commonly interpreted as archaeological or scientific significance when applied to archaeological sites. It primarily relates to the research potential related to the site. This is commonly linked to rarity and representativeness, site integrity, research themes and the potential extent of data retrievable for further analysis.</p> <p>The sites within the project area are unlikely to represent windows into more extensive subsurface artefact concentrations. Moreover, the surface material is somewhat disturbed and unlikely to provide further information (eg dating or reliable site context information).</p> <p>The sites within the project area would arguably only provide a further example of sites that are well studied and documented in the ACT already. Furthermore, they provide information that is readily available from other archaeological sites in the region.</p> <p>The Aboriginal places in the project do not meet the threshold to fulfil this criterion.</p>
Criterion (d) — importance in demonstrating the principal characteristics of a class of cultural or natural places or objects	<p>In general terms, Aboriginal stone artefact sites vary greatly in content, extensiveness, and research potential. As stone artefact sites are arguably the most commonly occurring sites, for a site to reach this threshold it would need to be a pivotal example of its class.</p> <p>The sites within the project area are a collection that represents one of many low frequency stone artefact sites. The very common artefact types and high frequency of quartz flaked pieces which have attributes that are difficult to define, makes the sites common or poor examples of its class.</p> <p>The Aboriginal places in the project do not meet the threshold to fulfil this criterion.</p>
Criterion (e) — important in exhibiting particular aesthetic characteristics valued by the ACT community or a cultural group in the ACT	<p>The sites within the project area do not have aesthetically distinctive or iconic qualities. It is acknowledged that Aboriginal stone artefact have aesthetic appeal, particularly to the Aboriginal community and artefact specialists. However the aesthetic qualities of the sites within the project area would not be regarded more highly than of other places of a similar nature.</p> <p>The landscape context of the sites are in an historically cleared area bordering on an existing quarry, and although certain landscape features are likely to have remained similar during Aboriginal occupation of the area, the area in the present day does not provide an ideal example of an Aboriginal landscape.</p> <p>The Aboriginal places in the project do not meet the threshold to fulfil this criterion.</p>
Criterion (f) — importance in demonstrating a high degree of	<p>Aboriginal stone artefact sites generally provide an example of the creative adaptation of available raw material and stone tool technology. However, the</p>

**Table 7.1 Assessment of significance**

Criteria	Assessment of significance for [REDACTED]
creative or technical achievement for a particular period	<p>sites in the project area do not provide distinctive examples of technical achievement due to the lack of diagnostic implements (tools) or use of rare materials that may have represented distinct trade routes.</p> <p>The Aboriginal places in the project do not meet the threshold to fulfil this criterion.</p>
Criterion (g) — has a strong or special association with the ACT community, or a cultural group in the ACT for social, cultural or spiritual reason	<p>EMM requested RAOs comment on this criterion in relation to social, cultural or spiritual reasons; however no comments were received before or during fieldwork or during the CHA review period.</p>
Criterion (h) — has a special association with the life or work of a person, or people, important to the history of the ACT	<p>The sites within the project area are not known to be associated with the life or work of a person or people important to the history of the ACT.</p> <p>The Aboriginal places in the project do not meet the threshold to fulfil this criterion.</p>



## 8 Statement of Heritage Effect

### 8.1 Impact assessment

#### 8.1.1 Overview

The primary aim of a Statement of Heritage Effect (SHE) is to demonstrate that the impacts of an activity on any identified heritage significance values have been carefully addressed and appropriate conservation or mitigation strategies have been developed.

This section provides a discussion of impacts on heritage items resulting from the project and provides appropriate mitigation strategies in response to the proposed impacts.

#### 8.1.2 Sources of impact

The project design and construction elements are described and mapped in section 1.

The following ground disturbance activities proposed as part of the project have the potential to disturb Aboriginal places in the development footprint:

- the covering of areas by overburden emplacements; and
- construction of infrastructure, including access roads and water management structures.

#### 8.1.3 Definition of impact type

Aboriginal sites can be impacted to varying degrees, including disturbance where artefacts are moved locally from their original setting as distinguished from loss where artefacts would be removed or destroyed.

Loss entails complete removal of a site's elements, such as large scale earthworks. The total modification of a landscape can also constitute loss, even if artefacts are collected and later returned to the modified surface in their original positions, because the context (an integral part of archaeological site value) is irretrievably lost. Total loss is when the entirety of a site will be lost as a result of the proposed modification. Partial loss describes the loss of a section of a site. It may also experience some loss of significance as a result of the loss of some of its components.

This report has defined the impacts from emplacement areas as loss. The creation of an emplacement involves truck movements, the deposition of large amounts of overburden material, landscaping and landform rehabilitation. Artefacts below the surface will not be retrievable once the emplacement is created.

Previous investigations on the short term impacts of emplacement areas (in cases where the topsoil is not stripped prior to emplacement) (KNC 2012 and 2013) indicate that while some compaction of the ground is evident, the artefact themselves remain intact beneath layers of soil if separated by a synthetic barrier. However, without using a barrier it was anticipated that the deposit would degenerate and devalue over time as bioturbation causes the stockpile soils to mix with the archaeological deposit. This loss of a secure context would reduce the scientific value of the site and make the original site almost irretrievable.

The impacts associated with the proposed overburden expansion are considered to constitute total loss for all of the Aboriginal places within the project area.

#### 8.1.4 Impacts to sites

All nine sites identified within the project area will be impacted by the project: [REDACTED]. The impacts will constitute total loss for all of the sites.

#### 8.1.5 Consideration of alternatives

The project alternatives explored by Boral are described in section 1.4 of this report. Based on the range of factors discussed in that section, the current project area, which has been reduced from its original design, has little room for movement as the most viable solution is to have emplacement out of pit on adjoining quarry land. As the project area is representative of the surrounding landscape (ie rolling hills interspersed by ephemeral drainage) it is very likely that a different project area layout would have similar impacts on Aboriginal places (although additional survey would have to confirm this prediction).

#### 8.1.6 Ecologically sustainable development

Aboriginal heritage management is based on the principle of intergenerational equity which has the intention to ensure present generations consider future generations when making management decisions. This principle is possibly the most relevant part of the notion of ecologically sustainable development (ESD) when considering Aboriginal heritage management.

The proposed management measures for the project area (refer section 8.2) include collection of all surface sites to provide a record of the Aboriginal heritage items and to ensure all information about the Aboriginal history of the area is not lost. This will contribute to intergenerational equity by allowing retention of cultural materials for the enjoyment and education of future generations.

### 8.2 Mitigation strategies

#### 8.2.1 Aboriginal heritage management framework

This section describes the management measures for identified Aboriginal places in the project area. The management measures proposed in this section respond to:

- the impacts identified in the preceding section's;
- the assessed significance of the Aboriginal places;
- the views of the Aboriginal community as represented by the RAOs;
- the need to address intergenerational equity in the values of Aboriginal heritage; and
- the need to mitigate the loss Aboriginal places.

The following mitigation measures are proposed in response to the project related impacts and comprise the following:

- archaeological collection of the contents of the Aboriginal places within the project area;
- repatriation protocols for the collected archaeological material;

- reporting requirements; and
- procedures that specify actions to be taken in the unlikely event of discovery of human skeletal remains and discovery of new Aboriginal places or objects.

An overview of the proposed management for each site is provided in Table 8.1.

**Table 8.1 Site management summary**

Site name	Site type	Project Impact	Significance	Mitigation measure
██████████	Isolated artefact	Total loss	Does not meet ACT Heritage register threshold.	Surface collection
██████████	Isolated artefact	Total loss	Does not meet ACT Heritage register threshold.	Surface collection
██████████	Artefact scatter	Total loss	Does not meet ACT Heritage register threshold.	Surface collection
██████████	Artefact scatter	Total loss	Does not meet ACT Heritage register threshold.	Surface collection
██████████	Isolated artefact	Total loss	Does not meet ACT Heritage register threshold.	Surface collection
██████████	Artefact scatter	Total loss	Does not meet ACT Heritage register threshold.	Surface collection
██████████	Artefact scatter	Total loss	Does not meet ACT Heritage register threshold.	Surface collection
██████████	Isolated artefact	Total loss	Does not meet ACT Heritage register threshold.	Surface collection
██████████	Isolated artefact	Total loss	Does not meet ACT Heritage register threshold.	Surface collection

## 8.2.2 Aboriginal site collection

### i Overview

The surface contents of all stone artefact sites in the project area will be collected by a qualified project archaeologist and RAO representative(s). This will be undertaken prior to any ground disturbance related to the project area in the vicinity of the Aboriginal sites.

A salvage team will collect the complete extent of the Aboriginal sites that would have been destroyed by project related impacts. Nine sites will be collected, comprising ██████████. A summary of the mitigation measures is provided below.

### ii Scope

Each stone artefact will be collected into labelled bags recording the project name, site name and collection date. The location of all collected artefacts will be recorded by hand-held GPS units to create distribution maps.

The ACT Heritage Council register will be updated to reflect the status of each place once impacted.

### iii Collection fieldwork method

The collection fieldwork will involve collecting the nine places identified in the project area. Any stone artefacts identified outside of the demarcated site areas but within the project area will be collected and attributed to existing sites if within 50 m of an existing site, or recorded as a new site if found outside 50 m of the nearest site.

The method for collection is as follows:

- each artefact will be pin flagged;
- the flagged area will be photographed;
- a central location for the site will be taken along with a number of points to delineate the edges of the site;
- each artefact within each site will be collected in a zip-lock plastic bag labelled as follows:
  - “MQOB SURFACE COLLECTION” (short for Mugga Quarry Overburden Project)
  - SITE NAME
  - DATE
  - “BAG N OF N” (eg Bag 1 of 3 – if there is more than one bag from the same site); and
- Each bag will have a Tyvek tag with the same label information as the bag.

### 8.3 Post-Approval Works Report

Subsequent to project approval, a salvage report will be prepared describing the work and including a catalogue of all recovered Aboriginal objects. The post-approval works report will be prepared in accordance with the requirements set out in section 3.7 of the Cultural Heritage Reporting Policy (ACT Heritage Council 2015).

Collected artefacts will be catalogued in a database with the basic attributes of each artefact recorded. Analysis of collected stone artefacts will include:

- initial sorting and cleaning of salvaged material;
- establishment of a computer database to record artefact provenance; and
- measuring and recording basic artefact attributes, comprising:
  - artefact type;
  - raw material type;
  - maximum length;
  - weight; and
  - implement type (if applicable).

The analysis team will comprise of the qualified project archaeologist and assisting archaeologist(s).

## 8.4 Return to Country - disposition of recovered artefacts

### 8.4.1 Overview

Short and long term management is needed for the stone artefact assemblage (recovered artefacts) collected during the salvage in the project area. Returning collected materials to Country is widely considered as an appropriate cultural outcome and therefore RAO direction on this matter is paramount.

### 8.4.2 Temporary storage of recovered artefacts

Following the salvage fieldwork, the collected artefacts will be taken to EMM's Sydney Office for cataloguing and temporary storage prior to their final deposition. The artefacts will be kept in a secure and locked room.

### 8.4.3 Return to Country

RAOs will be consulted regarding a suitable place for the collected artefacts. Key considerations will include:

- identifying an appropriate area close to the collection area;
- ensuring that the place selected will be protected in the long term and setting out the methods that need to be implemented to ensure long term protection;
- setting out how the artefacts will be deposited (eg burial or surface) using culturally appropriate methods;
- following cultural protocols during the return to country (eg ceremonial practices); and
- RAO accessibility considerations.

A Return to Country proposal will be prepared post-project approval and will be provided to RAOs for their feedback. Once the Return to Country proposal is finalised and RAO feedback has been incorporated into the proposal, an application will be made under Section 61J of the *Heritage Act 2004* for ACT Heritage Council approval of a Conservation Management Plan for the Return to Country.

## 8.5 New discovery protocol

### 8.5.1 Aboriginal ancestral remains

It is important that all personnel working on the project during construction be briefed on the possibility and the appropriate protocols to follow if human remains are found, as well as, what to do if other Aboriginal cultural material is encountered.

In the event that known or suspected human remains are encountered during the project's construction, the following procedure will be followed as soon as the suspected remains are discovered:

- all work in the immediate vicinity will cease and the find will be reported to the work supervisor who will advise the site supervisor or other nominated senior staff member (eg environmental manager);

- the site supervisor or other nominated senior staff member will promptly notify the Police and the State Coroner (as required for all human remains discoveries);
- the site supervisor or other nominated senior staff member will contact the ACT Heritage Council for advice on identification and management of Aboriginal skeletal material; and
- if it is determined that the skeletal material is of Aboriginal ancestry, the RAOs will be contacted and consultative arrangements will be made to discuss ongoing care or reinterment of the remains.

## 8.5.2 Discovery of new Aboriginal places or objects

### i Procedure

In the event of discovery of new Aboriginal places or objects within the project area, the following procedure will be followed:

- the immediate vicinity (an approximate 20 m buffer from the visible extent of the site) will be secured to protect the find and the find will be reported to the work supervisor who will immediately advise the environmental manager or other nominated senior staff member;
- an archaeologist and members of the RAOs must be contacted to validate the find and determine the significance of the objects(s); and
- any new sites will be registered with the ACT Heritage Council.

### ii Management of new Aboriginal sites

Newly identified sites that are not at risk of impact (ie over 50 m from the approved development footprint) will be avoided through passive protection. Sites that are within 50 m of the approved disturbance footprint will be managed through active protection measures including fencing and signage.

In the event that newly identified sites will be impacted by the construction of the project and cannot be avoided, they will be managed in a manner commensurate with their assessed significance, consistent with the management measures provided for similar sites in this section, meaning:

- stone artefact sites that do not reach the significance threshold to be included on the ACT Heritage Register will be collected prior to ground disturbance or be subject to unmitigated impacts, based on the outcomes of consultation with the RAOs and the ACT Heritage Council.
- decisions about stone artefact sites of higher significance will require further consultation with the RAOs and the ACT Heritage Council to determine an appropriate salvage methodology or conservation if appropriate.
- although other Aboriginal site types are unlikely to occur in the project area (eg grinding stones or stone arrangements), the following steps will be followed if they are identified:
  - a suitably qualified archaeologist and RAO representative(s) will be contacted to verify and assess the evidence;
  - if the find is not an Aboriginal object then the works can continue without further investigation; and

- if the find is verified as being an Aboriginal place or object, the RAOs and ACT Heritage Council will be contacted to discuss appropriate management measures proportionate to the significance of the find.

## 8.6 Recommendations

### 8.6.1 Recommendation 1 – Approval of Statement of Heritage Effect

An application to have the Statement of Heritage Effect set out in section 8 of this report should be submitted to the ACT Heritage Council for approval under s61H of the *Heritage Act 2004*.

### 8.6.2 Recommendation 2 – Implement mitigation strategy

Subject to approval of the Statement of Heritage Effect by the ACT Heritage Council, the Aboriginal site collection method as set out in section 8.2.2 of this report should be undertaken prior ground disturbance activities within the project area.

### 8.6.3 Recommendation 3 – Prepare post-approval works report

Subsequent to the collection of the Aboriginal sites in the project area, a post-approval works report should be prepared in accordance with section 8.3 of this report.

### 8.6.4 Recommendation 4 – Return to Country

The collected artefacts should be returned to Country in consultation with RAOs. A Return to Country proposal will be prepared post-approval which will be provided to RAOs for their feedback. Once the Return to Country proposal is finalised and RAO feedback has been incorporated into the proposal, an application will be made under Section 61J of the *Heritage Act 2004*, for ACT Heritage Council approval of a Conservation Management Plan for the Return to Country.

### 8.6.5 Recommendation 4 – New discovery protocol

In the event of discovery of new Aboriginal places or objects within the project area, the new discovery collection protocol should be implemented in accordance with section 8.5 of this report.



## 9 Related reports and information

### 9.1 Previous reports

To EMM's knowledge, only one cultural heritage investigation has been completed over the project area, being Sullivan, M 1996, *'Mugga 1 Quarry lease' prepared for Boral Resources (Country) Pty Ltd*, prepared by Huonbrook Environment and Heritage Pty Ltd.

This report was not obtainable from Boral or the ACT Heritage Council. However, a summary of its findings are provided in the following document: Boral Resources (Country) Pty Limited (Boral), *Mugga 1 Quarry Block 2031 Jerrabomberra ACT, preliminary assessment in support of Lease Renewal Application*. As such EMM reviewed this information along with the digital content related to the Aboriginal sites identified during Sullivan's assessment. The information is summarised in section 4.2.2 of this report.

### 9.2 Digital content

The Aboriginal places identified as part of this assessment were reported to the ACT Heritage Council on 16 March 2018 (two days after their discovery) by an MS Excel table providing a summary of the sites and their locations.

In accordance with section 4 of the *Cultural Heritage Reporting Policy – Specific Further Requirements for Key Digital Data*, EMM have submitted the following data to supplement this report:

- A Cultural Heritage Site Assessment template provided in an MS excel document; and
- A package of GIS shape files providing including:
  - survey transect data;
  - site point data;and
  - site area data;
- Digital copies of site photos.



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## Appendix A

ACT Heritage Council and Aboriginal consultation documentation

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## Aboriginal consultation Log: Mugga Quarry Expansion

Organisation	Contact type	Date	Comment
<b>RAO notification letter</b>			
Buru Ngunawal Aboriginal Corporation	Registered post	26-Feb-18	Automatically registered
King Brown Tribal Group	Registered post	26-Feb-18	Automatically registered
Little Gudgenby River Tribal Council	Registered post	26-Feb-18	Automatically registered
Ngarigu Currawong Clan	Registered post	26-Feb-18	Automatically registered
<b>Stage 2 – Issue of draft report</b>			
Buru Ngunawal Aboriginal Corporation	Registered post	08-Jun-18	Tracking number 605 35627527 095
King Brown Tribal Group	Registered post	08-Jun-18	Tracking number 605 35627528 092
Little Gudgenby River Tribal Council	Registered post	08-Jun-18	Tracking number 605 35627529 099
Ngarigu Currawong Clan	Registered post	08-Jun-18	Tracking number 605 35627530 095
<b>Follow up phone calls</b>			
Buru Ngunawal Aboriginal Corporation	Phone call	21-Jun-18	Left message on 0419 425 347
King Brown Tribal Group	Phone call	21-Jun-18	Spoke to Carl - Carl was happy with the report; no comments to add
Little Gudgenby River Tribal Council	Phone call	21-Jun-18	Not able to leave message on 0406 074 492
Ngarigu Currawong Clan	Phone call	21-Jun-18	Left message on 0424 025 527
Buru Ngunawal Aboriginal Corporation	Phone call	21-Jun-18	Left message on 0419 425 347
Little Gudgenby River Tribal Council	Phone call	27-Jun-18	Not able to leave message on 0406 074 492
Ngarigu Currawong Clan	Phone call	27-Jun-18	Left message on 0424 025 527



ACT Heritage Council

## Approval for Limited Access to Restricted Information

Under Section 57 of the *Heritage Act 2004*

File Reference: Jerrabomberra RB  
2031  
Contact Officer: Euroka Gilbert  
Date Received: 5 February 2018

**TO: EMM Consulting**  
Kerryn Armstrong  
[karmstrong@emmconsulting.com.au](mailto:karmstrong@emmconsulting.com.au)

Rural Block:	Division:	Heritage Places:
2031	Jerrabomberra	20 total, 15 Restricted Information

Council Advice provided by: Team Leader (Advice)

Pursuant to Section 57 of the *Heritage Act 2004*, the ACT Heritage Council advises that:

Limited access to restricted information is approved, subject to the conditions described below.

### Background:

On 10 January 2018, the ACT Heritage Council (the Council) received an application from EMM Consulting (EMM) seeking approval to access restricted or sensitive information on Aboriginal places and objects relating to Rural Block 2031 Jerrabomberra plus a 2 kilometre buffer.

Restricted and sensitive information is sought to inform a comparative research for the block. Access to the publication will therefore be limited to EMM and the proponent whose staff are directly involved in the project.

### Advice:

Pursuant to Section 57 of the *Heritage Act 2004*, and in accordance with Council's '*Information management of Aboriginal places and objects*' policy, the Council advises that approval is given to the publication of the above information, subject to the following conditions:

- Publication is restricted to the information and nature as stated above; and
- Information is not to be made available for the general public or an audience broader than that described above.
- If the information is to be disseminated more broadly than EMM and the proponent, a Section 56 application under the *Heritage Act 2004* will be required, and endorsement provided prior to dissemination.

**Note:** Under Section 55(1) of the *Heritage Act 2004*, a person commits an offence if the person publishes restricted information about a place or object, and knows the information is restricted information. The maximum penalty for this offence is 50 penalty units.

A handwritten signature in black ink that reads "MRussell". The letters are cursive and somewhat stylized.

Meaghan Russell  
**Team Leader (Advice) (as delegate for),**  
**ACT Heritage Council**

5 March 2018



26 February 2018

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Re: Mugga Quarry Overburden Expansion Project: Presentation of information and request for cultural knowledge and information

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Dear Wally,

## 1 Introduction

Thank you for registering your interest in being consulted on Aboriginal cultural heritage matters for the Mugga Quarry Overburden Expansion Project (the Project).

EMM Consulting Pty Ltd (EMM), on behalf of Boral Resources (Country) Pty Ltd (Boral), is preparing a cultural heritage assessment for the Project.

The aim of this letter is to:

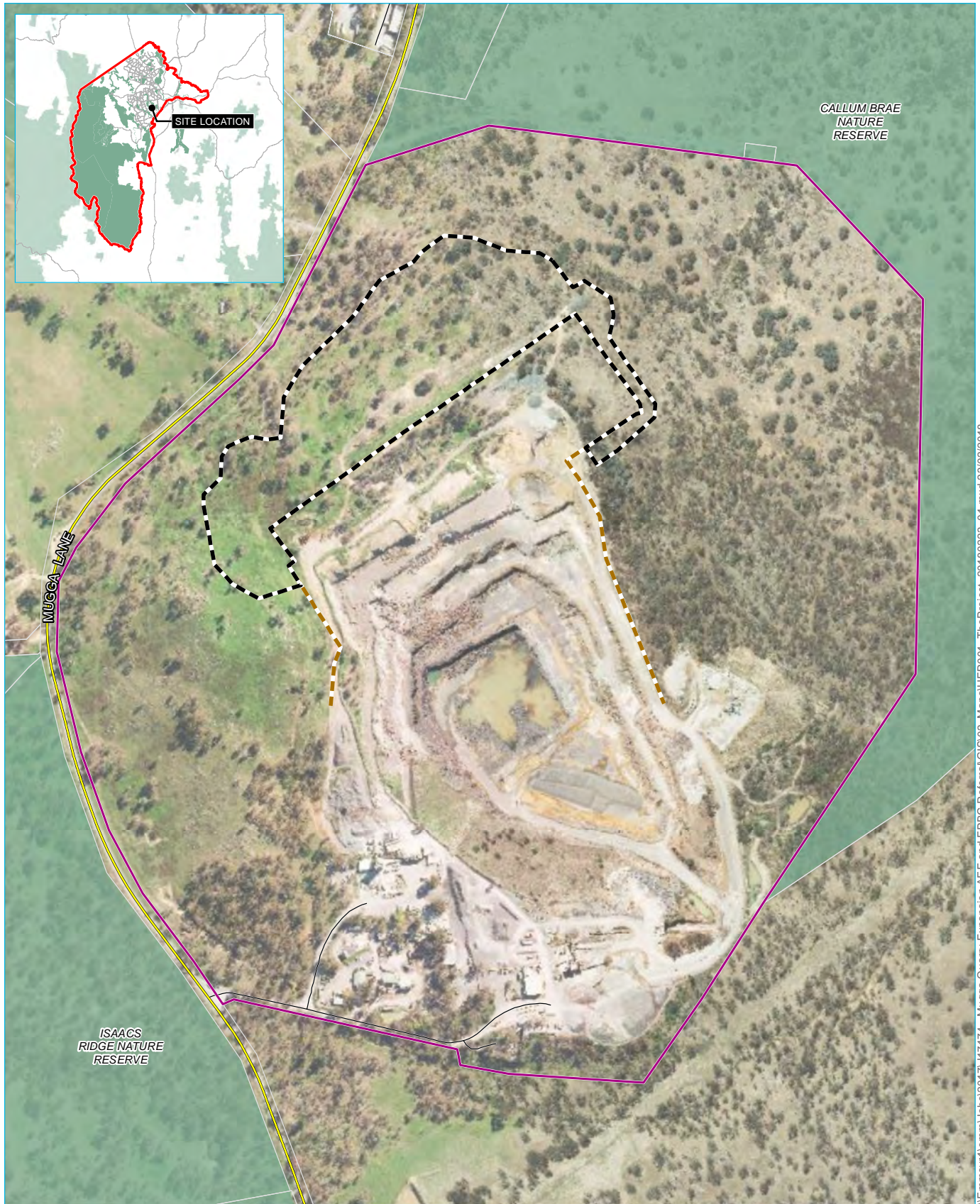
- provide a brief description of the project;
- establish the purpose and aims of the Aboriginal consultation process;
- provide your organisation with an opportunity to inform EMM about any Aboriginal cultural heritage values associated with the Project;
- present the intended cultural heritage assessment method; and
- notify your organisation of the upcoming fieldwork.

## 2 The project

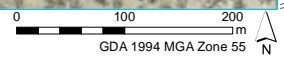
### 2.1 Project description

Boral currently operates a hard rock quarry at its Mugga Quarry site at 321 Mugga Lane, Jerrabomberra, Australian Capital Territory (ACT).

Boral proposes to establish a new permanent bund and temporary emplacement area to store up to 620,000 cubic metres (m<sup>3</sup>) of quarried overburden and weathered rock material from Mugga Quarry. The additional bund and stockpile areas will be located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road) and resides within an extractive industry lease area of 106.4 hectares (ha) – refer to Figure 1.



Source: EMM (2018); Boral (2018); actmap (2016); GA (2016)



**KEY**

- ACT boundary
- Site location - 321 Mugga Lane, Symonston
- Proposed total disturbance area
- Approved pit extent
- Block boundary
- Main road
- Local Road
- ACT reserve

The project

Boral  
Mugga Quarry overburden expansion  
Figure 1



## 3 Draft assessment method

### 3.1 Assessment methods

The cultural heritage assessment for the Project will be prepared in accordance with *Cultural Heritage Reporting Policy* (ACT Heritage Council, 2015) and the *Heritage Assessment Policy* (ACT Heritage Council, 2015). EMM is contacting Registered Aboriginal Organisation (RAO) identified by the ACT Heritage Council to enquire whether they would like to be consulted for the assessment.

Although there is no formal policy governing the consultation method in the ACT; EMM will follow best practice methods similar to the NSW *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010).

### 3.2 Aboriginal consultation

#### 3.2.1 Overview of consultation

The roles, functions and responsibilities of all parties involved in the consultation process are outlined in Table 3.1.

**Table 3.1 Roles, functions and responsibilities**

Stakeholder	Roles and responsibilities
RAOs	Provide cultural perspectives, views, knowledge and advice to EMM. Indicate areas of cultural significance. Provide Aboriginal site officers for archaeological fieldwork. Have an awareness and understanding of the commercial environment and constraints in which the proponent operates. Demonstrate awareness and understanding of the opportunities to input into the cultural heritage assessment and management recommendations.
EMM (on behalf of Boral)	Undertake the cultural heritage assessment, including coordinating and directing the fieldwork. Facilitate the Aboriginal consultation process. Consider the cultural perspectives, views, knowledge and advice of the RAOs in assessing cultural significance and developing management measures.
All stakeholders	Mutual respect (each person has the right to have a say and be heard). Communicate with professional code of conduct.

#### 3.2.2 Providing cultural information

Aboriginal heritage incorporates a wide range of values such as stories, traditions and cultural practices. EMM welcomes any advice from the Aboriginal community about any form of Aboriginal cultural heritage values (which might include archaeological sites or other types of values) relevant to the project area and its surrounds.

Knowledge of areas of cultural significance may include, but are not limited to:

- sites or places associated with ceremonies, spiritual/mythological beliefs and traditional knowledge, which date from pre-contact period; these activities do not have to have persisted until the present time;
- sites or places associated with historical associations, which date from the post-contact period and are remembered today (eg plant and animal resource use areas and known camp sites); and

- sites or places of contemporary significance, for which the significance has been acquired in recent times.

EMM is seeking cultural information about the project area from registered RAOs. If you are aware of any form of Aboriginal cultural heritage values, which might include archaeological sites or other types of values, please let us know so that we can take these values into account in the assessment.

### 3.3 Preliminary desktop assessment

#### 3.3.1 Overview

The following information is provided so that your organisation is familiar with the site and to allow areas of potential cultural importance to be identified during the early stages so that it can be considered for the upcoming fieldwork.

#### 3.3.2 Landscape overview

The project area is north of the existing quarry and within a landscape pattern of rolling hills. The project area is on undulating terrain features gentle crests, hill slopes and ephemeral drainage depressions.

The topography is undulating with a slope across the proposed extension area from the south-west to the north-east. Elevation varies from approximately 730 m Australian Height Datum (AHD) in the south-west to approximately 690 m AHD in the north-east.

Located within a broadacre rural setting and surrounded by low density land uses and established remnant native vegetation, the site has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility. Vehicular access to the site is via an existing entry off Mugga Lane, adjacent to the site's south-western boundary.

The project area lies on the south-east edge of the Murray Darling water basin. The Murray Darling basin is a catchment for both the Murray and the Darling River's. It covers a large part of New South Wales, and connects with the Queensland, Victoria, Australian Capital Territory and South Australia borders. The Murrumbidgee River flows approximately 10 km west of the project area and along with the Queanbeyan River (5.7 km north-west) which supplies much of the ACT with water.

### 3.4 Proposed field survey

EMM, with the assistance of RAOs, proposes to conduct an archaeological survey of the site over the course of one day. The survey will be recorded in transects based on the landform elements within the project area. The survey will aim to cover the extent of the proposed overburden expansion area on foot.

The survey will inspect all areas of ground within survey transects which will be covered by survey participants. Any Aboriginal sites will be marked through flagging and then GPS waypoint recording by an archaeologist.

The survey transects will be undertaken with reference to a survey plan that will be prepared prior to fieldwork. There will however be provision for changes to the survey plan once on-site to account for any inaccessible areas or where areas of disturbance make further inspection unwarranted.

### 3.5 Post-fieldwork

Following the fieldwork, a draft report will be prepared by EMM. Each RAO will be invited to submit relevant information on Aboriginal heritage values which will be addressed in the report. Each group (or individual if not part of a group) will be issued with a copy of the draft report for review and comment within two weeks of receiving. All comments will be addressed in the final report.

## 4 What's next?

EMM are currently expecting information from the ACT Heritage Council, including current heritage mapping of the project area and surrounds (including Aboriginal heritage item locations). Our aim is to provide a map to RAOs showing heritage items prior to the survey.

The proposed date for fieldwork is **Wednesday 14 March 2018**.

If you would like to participate in the field survey please contact Ryan Desic at [rdesic@emmconsulting.com.au](mailto:rdesic@emmconsulting.com.au). Please include your hourly and daily fieldwork fees in the email.

## 5 Any questions?

Please feel free to contact me with any questions or queries about the project via email (provided below) or telephone on 02 9493 9539 / 0411 329 712.

Yours sincerely



Ryan Desic  
0411 329 712  
[rdesic@emmconsulting.com.au](mailto:rdesic@emmconsulting.com.au)



7 June 2018

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[www.emmconsulting.com.au](http://www.emmconsulting.com.au)

Re: Mugga Quarry Overburden Expansion Project: Draft Cultural Heritage Assessment

---

Dear Wally,

Thank you for registering your interest in being consulted on Aboriginal cultural heritage matters for the Mugga Quarry Overburden Expansion Project (the Project).

EMM Consulting Pty Ltd (EMM), on behalf of Boral Resources (Country) Pty Ltd (Boral), would like to present you with the draft Cultural Heritage assessment

If you have any comments you would like to submit for consideration please contact Kerryn Armstrong at [karmstrong@emmconsulting.com.au](mailto:karmstrong@emmconsulting.com.au) by the 26 June 2018.

Please feel free to contact me with any questions or queries about the project via email (provided below) or telephone on 02 9493 9523/0429 889 415

Yours sincerely

A handwritten signature in blue ink, appearing to be 'KA' with a flourish underneath.

Kerryn Armstrong  
Consultant archaeologist  
[karmstrong@emmconsulting.com.au](mailto:karmstrong@emmconsulting.com.au)



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Appendix J

# Statement of heritage effect approval

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Appendix J

# Statement of heritage effect approval

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ACT Heritage Council

# Statement of Heritage Effect Approval

Under Section 61H of the *Heritage Act 2004*

Applicant Reference: J17174RP1  
Heritage Reference: Jerrabomberra RB2031  
Contact Officer: Gabrielle Caddy  
Received by Council: 3 August 2018

**TO: EMM Consulting**  
Kerryn Armstrong  
info@emmconsulting.com.au

Block:	Division / District:	Heritage Places:
2031	Jerrabomberra	Mugga Q 1 and JE-JED-001 to JE-JED-009

Status of Place: Aboriginal Places and Objects  
Description of Works: New Overburden Storage Area for existing Quarry  
Report Details: “*Mugga Quarry Expansion Cultural Heritage Assessment*”  
(EMM/July 2018)  
Council Advice provided by: Secretary / ACT Heritage Senior Manager

---

Pursuant to Section 61H of the *Heritage Act 2004*, the ACT Heritage Council advises that:

- The Statement of Heritage Effect is approved, with conditions as set out below, on the basis that:
- (a) the proposed activity is justifiable at, or near, the place; and
  - (b) there are no reasonably practicable alternative ways to carry out the proposed activity at the place; and
  - (c) that reasonable steps have been identified to reduce the risk of diminishing the heritage significance of or damage to the place.
- 

## Background:

On 3 August 2018, the ACT Heritage Council (the Council) received a Statement of Heritage Effect (SHE) application relating to a proposal to create a new overburden storage area at the Mugga Quarry, run by Boral Resources (Country) Pty Ltd, at 321 Mugga Lane Jerrabomberra.

The Mugga Quarry is located within Block 2031 Jerrabomberra, and contains one Aboriginal place registered on the ACT Heritage Register (Mugga Q1) which would be affected by the proposal. In previous advice dated 16 February 2018, the Council noted the existence of this place in the affected area and also advised that further heritage assessment would be required to evaluate the potential heritage impacts of the proposal.

The SHE application submitted on 3 August 2018 was informed by the results of a heritage survey of the site and a Cultural Heritage Assessment (CHA) report. The survey found nine previously unrecorded Aboriginal places within the study area (labelled “JE-JED-001” to

“JE-JED-009” inclusive) and the CHA report identifies that the proposed development would directly impact these places as well as the previously recorded one.

Under Section 61(G)(1)(e) of the Act, a SHE application must describe whether other reasonably practicable ways of carrying out the activity at the heritage site are available. The proposed storage of overburden in the area studied is the outcome which will both permit the best use of the quarried material (thereby limiting impact of further quarrying); and best limit the impact of storage on the area around the quarry, for both natural and heritage values. The SHE considers that this is the most practicable way to carry out the proposed activity, and other alternatives are not as practicable.

The SHE proposes the salvage (surface artefact collection) of Aboriginal objects found within the study area, to permit the area’s use for overburden; while also preserving the heritage objects for future generations.

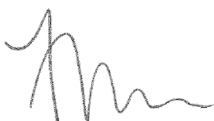
For this reason, the applicant recommends the salvage of Aboriginal places within the study area, on which basis the SHE application has been made under s61(G) of the *Heritage Act 2004* (the Act).

### **Decision and Conditions:**

The Council approves the Statement of Heritage Effect application subject to the following conditions:

1. All heritage management actions are to be undertaken in accordance with the “*Mugga Quarry Expansion Cultural Heritage Assessment*” (EMM/July 2018);
2. A copy of the Statement of Heritage Effect approval, including the “*Mugga Quarry Expansion Cultural Heritage Assessment*” (EMM/July 2018), is to be provided to Representative Aboriginal Organisations (RAOs) prior to the commencement of the salvage works;
3. A report on the salvage of Aboriginal objects is to be provided to the Council within 60 days of the salvage taking place;
4. The salvaged objects shall be transferred to the custody of ACT Heritage for storage in accordance with s53 of the *Heritage Act 2004*;
5. A ‘Return to Country’ (RTC) protocol shall be:
  - a. developed in consultation with RAOs for the salvaged objects; and
  - b. submitted to the Council for approval 12 months of the salvage occurring; and
6. The SHE is approved for a period of two years.

It is also noted that the term ‘Registered Aboriginal Organisation’ (RAPs) is used throughout the CHA and SHE application, and the Council understands that all such references relate to ongoing consultation with RAOs as declared under the *Heritage Act 2004*.



Fiona Moore  
**Secretary (as delegate for),  
ACT Heritage Council**

3 October 2018

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Appendix K

# Visual impact assessment

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# Visual Impact Assessment

Mugga Quarry Overburden Expansion Project | 321 Mugga Lane, Symondston, ACT

Prepared for Boral Resources (Country) Pty Ltd  
April 2019

---

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# Visual Impact Assessment

Mugga Quarry Overburden Expansion Project | 321 Mugga Lane, Symondston, ACT

## Report Number

---

J17174 RP1

## Client

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Boral Resources (Country) Pty Ltd

## Date

---

9 April 2019

## Version

---

v3 Final

## Prepared by

## Approved by

---



**Andrew Woidt**  
Associate Environmental Planner  
9 April 2019



**Paul Gibbons**  
Associate Environmental Planner  
9 April 2019

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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# 1 Introduction

Boral Resources (Country) Pty Ltd (Boral), a wholly owned subsidiary of Boral Ltd, proposes to establish a new permanent bund and temporary emplacement area to store quarried overburden and weathered rock material from its Mugga Quarry operations (the project) at 321 Mugga Lane, Symonston (the site).

EMM Consulting Pty Ltd (EMM) has been engaged by Boral to prepare a Visual Impact Assessment (VIA) for the project. This VIA forms part of an Environment Impact Statement (EIS) and documents the methods, results and management measures proposed for visual amenity values associated with the project area.

The VIA provides a qualitative assessment of existing views, visual amenity and proposed location and height of the overburden bund and temporary emplacement area. The assessment confirms:

- the sensitivity of the existing landscape to accommodate change;
- the likely visual impact of the project on the specific and wider landscape;
- the likely visual impact of the project against the Non-Urban Zones Development Code criterion; and
- recommendations on mitigation measures to address visual impacts.

## 1.1 Assessment overview

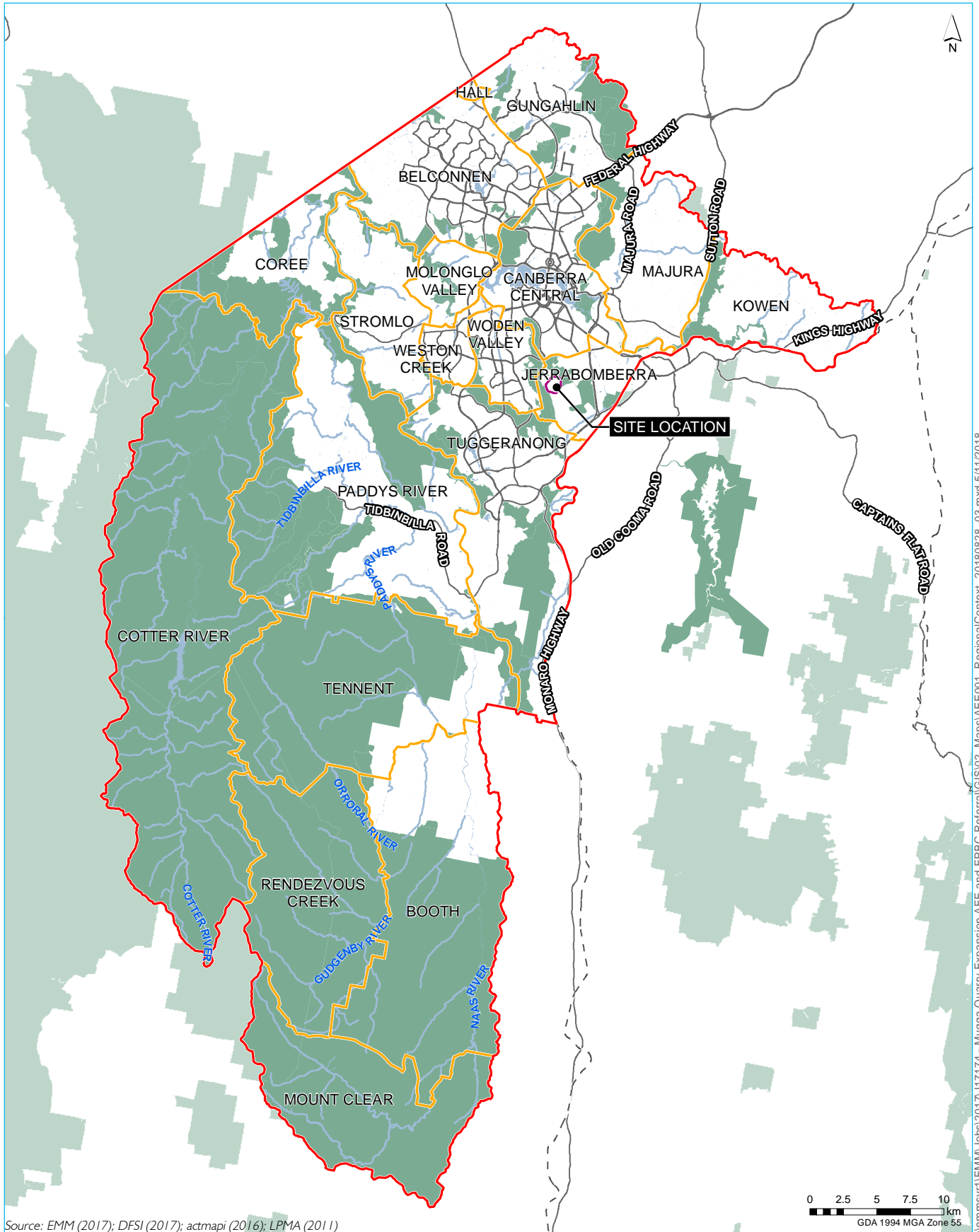
The project is required to enable the ongoing extraction operations of the quarry and supply of aggregate and quarry products to the construction market within the Australian Capital Territory (ACT) and surrounding New South Wales (NSW) regional areas.

The site in its regional and local context can be seen in Figure 1.1 and Figure 1.2.

Pursuant to the EIS Scoping Requirements issued for the project by ACT Environment, Planning and Sustainable Development Directorate - Planning (EPSDD) pursuant to Section 212(2) of the ACT *Planning and Development Act 2007* (P&D Act), this VIA:

- details the predicted impacts the project may have on the landscape character of the site and surrounds;
- provides photomontages and visual analysis of the project from local vantage points;
- outlines rehabilitation methods for disturbed areas to ensure the area is restored to pre-existing conditions.

In preparing this VIA, the relevant codes and statutory considerations have been addressed in accordance with the requirements of the P&D Act and the *Territory Plan 2008* (Territory Plan).



Source: EMM (2017); DFSI (2017); actmapi (2016); LPMA (2011)

KEY

- Site location - 321 Mugga Lane, Symonston
- ACT boundary
- District boundary
- Railway
- Main road
- Watercourse
- Waterbody
- ACT reserve
- NPWS reserve

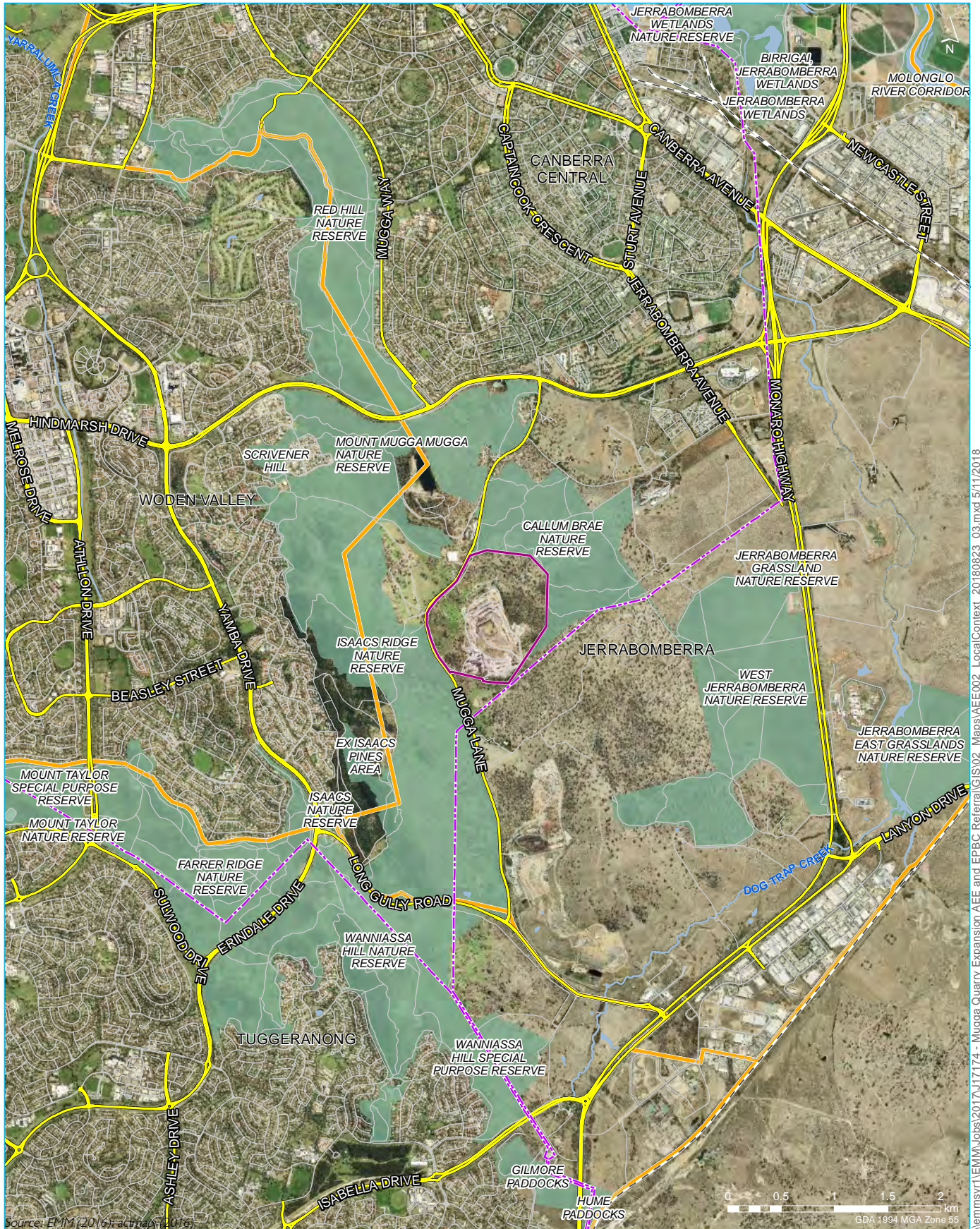
Location of the Mugga Quarry

Boral - Mugga Quarry overburden expansion  
Visual impact assessment

Figure 1.1



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**KEY**

- Site location - 321 Mugga Lane, Symonston
- District boundary
- Electricity transmission line
- Main road
- Local road
- Rail line
- Watercourse
- Waterbody
- ACT reserve

Local context

Boral - Mugga Quarry overburden expansion  
Visual impact assessment

Figure 1.2



## 2 Project description

This project includes the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 cubic metres (m<sup>3</sup>) of quarried overburden and weathered rock material from Mugga Quarry.

The new permanent bund and temporary emplacement area will be located north and east of the quarry's existing operations, respectively between the pit face and Mugga Lane (public road) and resides within an extractive industry lease area of 106.4 hectares (ha).

The site has a long history of supporting construction materials manufacturing and contains four Boral operations, namely an asphalt plant, a concrete batching plant (CBP), a recycling facility and the hard rock quarry that is associated with the proposed emplacement area (see Figure 1.2).

Mugga Quarry is located in the central portion of the site and currently produces crushed rock products with a capacity to produce up to 1,000,000 tonnes per annum (tpa). The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities.

The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00 am to 6:00 pm Monday to Saturday. As total production of the quarry will not be increasing, there will be no change to current operating hours, external traffic movements, groundwater management or employment.

No changes are proposed to the other operations at the site.

### 2.1.1 Objectives

The objective of the project is to enable the extraction of high-quality hard rock within the approved extraction area which is currently located beneath overburden and weathered rock material. Weathered rock on its own is not suitable for making concrete and asphalt aggregates and needs to be blended with other quarry products. Therefore, it needs to be removed and emplaced to enable the continued extraction of higher quality rock beneath.

The project will provide for ongoing extraction operations at Mugga Quarry and enable the supply of aggregates and quarry products to the construction market within the ACT and surrounding NSW regional areas. The establishment of overburden emplacement would be in accordance with Mugga Quarry environmental management requirements and is located within an existing approved industrial setting. An approval for a new permanent bund and temporary emplacement area means Boral would be able to maintain and enhance its level of service for their customers, comply with environmental standards, ensure optimal utilisation of their asset and maintain local employment opportunities.



**KEY**

- Site location - 321 Mugga Lane, Symonston
- Total disturbance area
- Approved pit extent
- Proposed new permanent overburden bund
- Proposed temporary emplacement area
- 1 Asphalt plant
- 2 Concrete batching plant
- 3 Quarry
- 4 Recycling facility
- Electricity transmission line
- Main road
- Local Road
- Block boundary
- ACT reserve

The site

Boral - Mugga Quarry overburden expansion  
 Visual impact assessment  
 Figure 2.1



The project will have a range of economic, environmental and social benefits including:

- continued production and operations of Mugga Quarry without comprising the amenity of the surrounding area;
- continued supply of aggregates and quarry products to major road and infrastructure projects, including specialty products;
- meet the ACT Government’s demand for high quality asphalt produced at the site; and
- maintain employment opportunities that continue to benefit the local and regional economy.

## 2.2 The site and surrounds

### 2.2.1 The site

The site is leased ACT land, identified as Block 2031 Jerrabomberra District, and is located approximately 10 kilometres (km) to the south-east of Canberra Central. The site is generally known as 321 Mugga Lane, Symonston.

Located within a broadacre rural setting and surrounded by low density land uses and established remnant native vegetation, the site has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, CBP and recycling facility. Vehicular access to the site is via an existing entry off Mugga Lane, adjacent to the site’s south-western boundary.

An overview of the existing site operations is provided in Table 2.1.

**Table 2.1 Overview of site operations**

Operational element	Production rate	Details
Hard rock quarry	Up to 1,000,000 tpa Average production rate approximately 500,000 tpa	Located in the central portion of the site and currently produces crush rock products with a production rate at times up to 1,000,000 tpa. The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities. The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00am to 6:00pm Monday to Saturday.
Asphalt plant	Up to 75,000 tpa Average 145 tons per day (tpd) production rate, with maximum 1,000 tpd	The asphalt plant produces up to 75,000 tpa of asphalt, with an average of 145 tpd to a peak of 1,000 tpd. The asphalt plant is approved to operate 24 hours a day, seven days a week.
CBP	36,000 m <sup>3</sup> per annum Maximum capacity to produce up to 60,000m <sup>3</sup>	Located to the north of the asphalt plant. It currently produces 36,000 m <sup>3</sup> per annum and has a maximum capacity to produce up to 60,000 m <sup>3</sup> . Elements of the existing CBP include cement and flyash silos, aggregate storage bins, concrete production and loading facilities, offices and amenities. The CBP operates 24 hours a day, seven days a week.

**Table 2.1 Overview of site operations**

Operational element	Production rate	Details
Recycling facility	Up to 100,000 tpa	<p>The recycling facility is located on the central western edge of the quarry and currently processes up to 100,000 tpa of recycled construction and demolition waste.</p> <p>Elements of the recycling facility include raw and finished material stockpiles, a mobile crushing plant, offices and amenities.</p> <p>The recycling facility can operate 24 hours a day, seven days a week however deliveries generally occur between 7:00am and 4:30pm with production occurring overnight when needed to meet market demand.</p>

The topography of the site is undulating with a slope across the proposed extension area from the south-west to the north-east. Elevation within the project area varies from approximately 730m Australian Height Datum (AHD) in the south-west to approximately 690m AHD in the north-east.

### 2.2.2 Zoning

The site is zoned Non-Urban NUZ1 Broadacre under the Territory Plan.

The Territory Plan is the key statutory planning document in the ACT, providing the policy framework for the administration of planning in the Territory. The purpose of the Territory Plan is to manage land use change and development in a manner consistent with strategic directions set by the ACT Government, Legislative Assembly and the community.

The following objectives apply to the Non-Urban NUZ1 Broadacre zone:

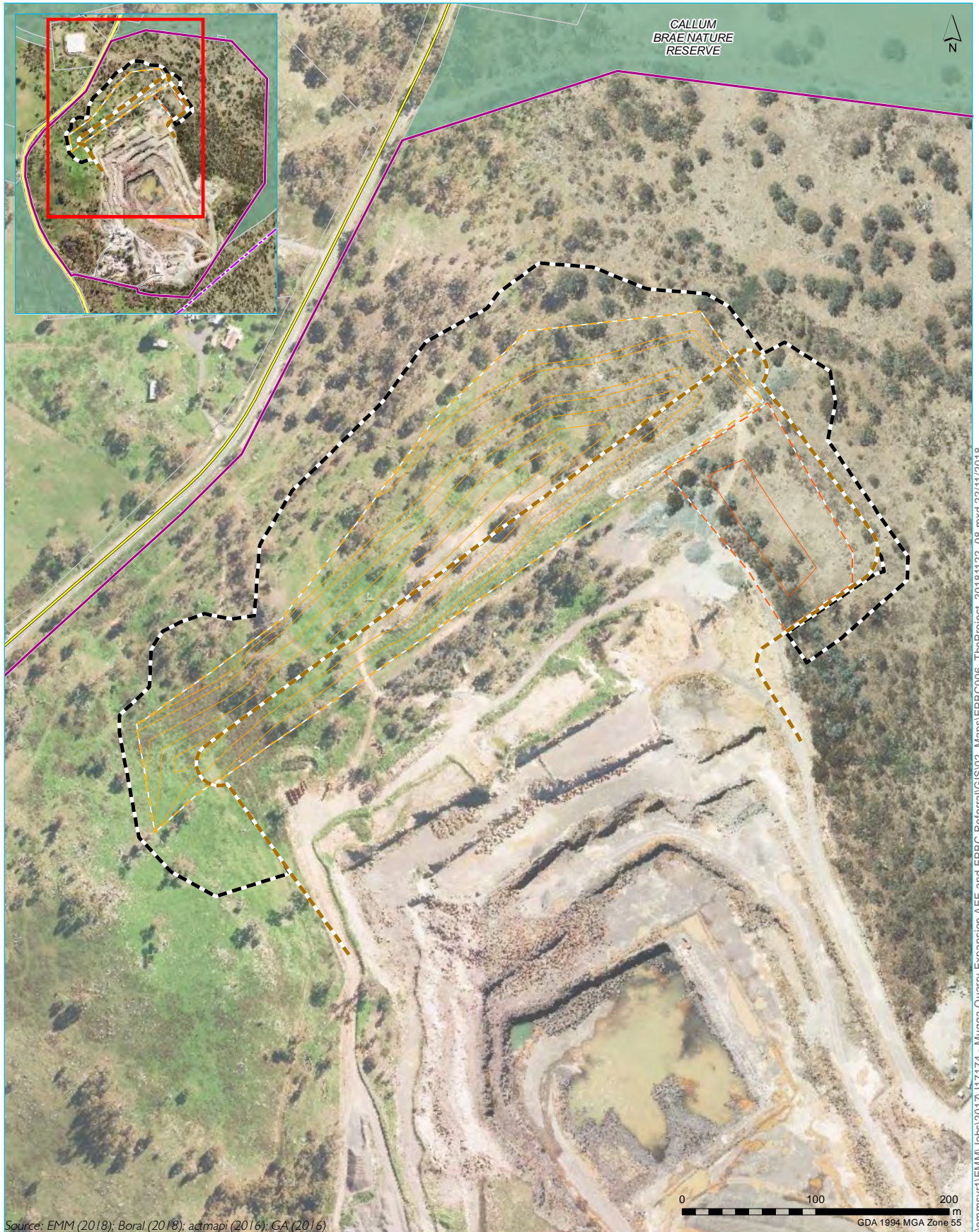
- making provision in a predominantly rural landscape setting for a range of uses which require larger sites and/or a location outside urban area;
- making provision for activities requiring clearance zones or protection from conflicting development;
- ensuring that development does not adversely impact or visually intrude on the landscape and environmental quality of the locality; and
- ensuring, where appropriate, that development and the use of land does not undermine the future use of land which may be required for urban and other purposes.

The Non-Urban Zone specifically allows for the use of ‘mining industry’ on Block 2031 Jerrabomberra and the project is considered consistent with the Territory Plan definition for ‘mining industry’.

### 2.2.3 The project area

This project includes the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 m<sup>3</sup> of quarried overburden and weathered rock material located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road).

A plan of the project area can be seen in Figure 2.2 and Figure 2.3.



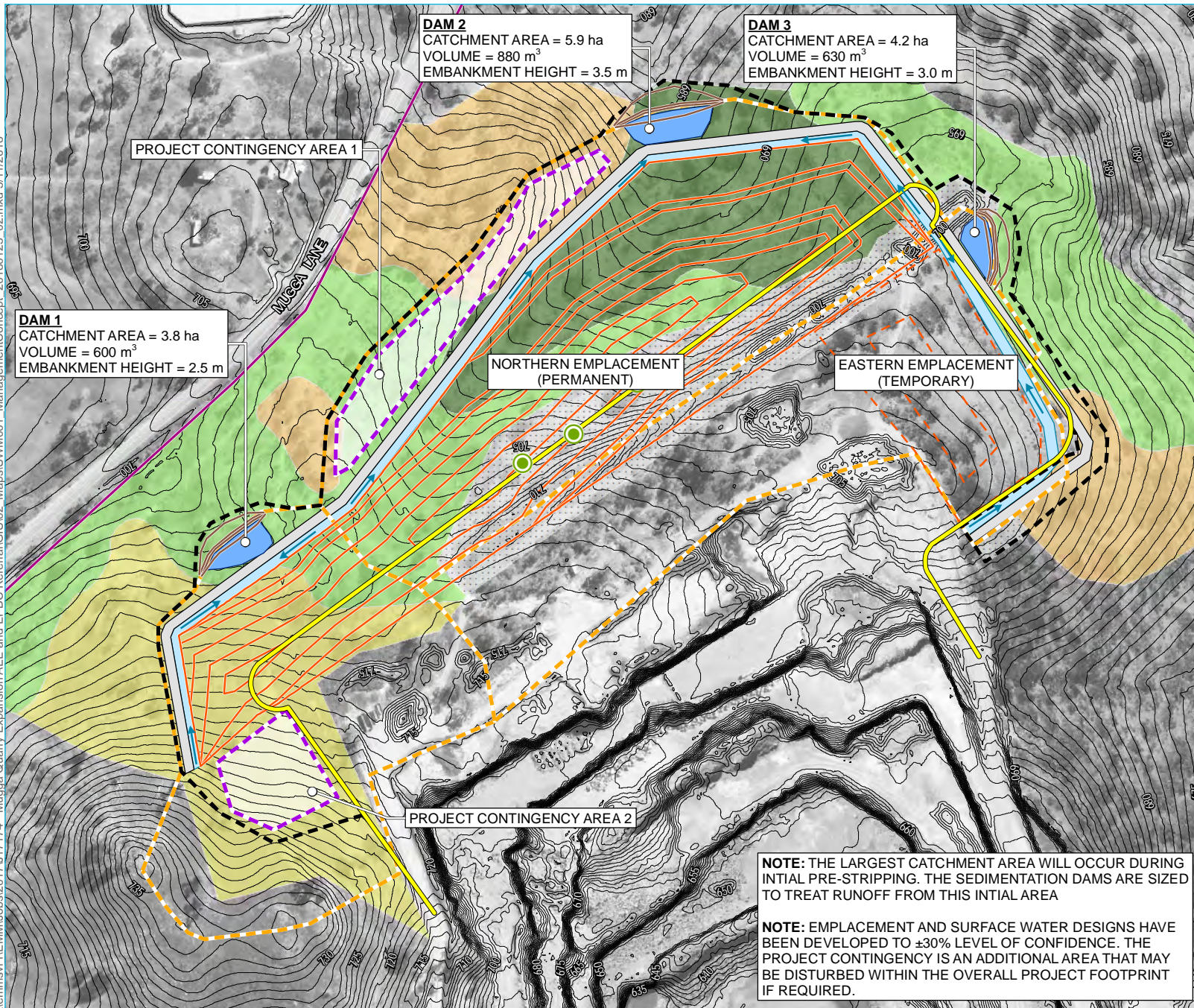
**KEY**

- Site location - 321 Mugga Lane, Symonston
- Total disturbance area
- Approved pit extent
- Proposed new permanent overburden bund
- Proposed temporary emplacement area
- Electricity transmission line
- Main road
- Block boundary
- ACT reserve

The project area  
Boral - Mugga Quarry overburden expansion  
Visual impact assessment

Figure 2.2

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- KEY**
- Site location - 321 Mugga Lane, Symonston
  - Total disturbance area
  - Approved pit extent
  - Emplacement contours (Boral)
  - Proposed eastern emplacement contours (EMM)
  - Dam embankment
  - Sedimentation dam
  - Perimeter road (6 m width, including batters)
  - Toe drain (5 m width, including batters)
  - Project contingency area
  - Sedimentation dam catchment area
  - Contour (LiDAR - 1m)
  - Cleared area
  - Native vegetation**
  - Grass/shrub forest
  - Yellow Box - Red Gum Grassy Woodland (very low condition)
  - Yellow Box - Red Gum Grassy Woodland (low condition)
  - Yellow Box - Red Gum Grassy Woodland (moderate condition)
  - Red Box

Proposed surface water management concept

Boral - Mugga Quarry overburden expansion

Visual impact assessment

Figure 2.3



Source: EMM (2018); Boral (2018); actmap1 (2016); LPI (2015)



GDA 1994 MGA Zone 55

## i Geology and soils

The project area is part of the Burra (bau) Soil Landscape which is a transferral soil profile. Soils on upper slopes typically comprise an A1 soil horizon of sandy loam from 0–8 centimetres (cm) followed by a subsoil (A2 or AB soil horizon) of sandy loam from 8–30 cm. Clay forms at approximately 30 cm as a B soil horizon (Jenkins 2000). The topsoil has moderate erodibility which is accelerated in cleared areas. Bedrock of various tuffs tends to outcrop on crests and upper slopes but also in other landforms with high levels of erosion (eg stream channels).

## ii Biodiversity

The project area contains patches of the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community (ACTMAPI 2018). This area includes both native grasses which occur when the woodland itself has been removed, and a strong eucalypt community where the trees still stand.

The grassland consists of Kangaroo Grass (*Themeda triandra/australis*), Snow Grass (*Poa sieberiana*) and daisies. The woodland consists of numerous species of eucalypt including western grey box (*Eucalyptus macrocarpa*), red stringybark (*E. Macrorhyncha*) and long leaved box (*E. goniocalyx*). Both white (*Callitris glaucophylla*) and black cypress pine (*C. enderlicheri*) can be found in the area along with the Kurrajong (*Brachychiton populneus*) (DEH 2006).

### 2.2.4 Land use and disturbance

The project area is located within a broadacre rural setting and surrounded by low density land uses and established remnant native vegetation. The project area has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility.

The project area specifically has been historically cleared of native vegetation but now features regrowth native vegetation distributed amongst grasses and weeds. More localised forms of disturbance include vehicle track use and intermittent areas of excavation associated with drainage diversion bunds. The most obvious form of disturbance relates to a large linear overburden bund that runs along the southern boundary of the project area for an area of approximately 25 m wide and 500 m long. There is also evidence of machine grading and excavation on the boundary of the overburden bund.

The existing overburden bund effectively blends into the natural landscape when viewed from Mugga Lane (to the north) due to the establishment of native grasses and revegetation overtime – refer Photograph 2.1.



**Photograph 2.1** Shows the terrain in the area to the north of the existing pit when viewed from Mugga Lane

#### 2.2.5 The surrounds

The site is situated within a broadacre rural setting surrounded by low density land uses and established remnant native vegetation.

The land use zoning for the site has made provisions requiring a 1 km clearance buffer around the site to afford protection to adjacent development. The nearest rural residence is located approximately 500 m to the north and north-west and approximately 300 m to the south of the site (refer Section 3).

Land uses surrounding the site include:

- **north** – Mugga Lane (public road), vacant broadacre land, reservoir, bus depot, one rural residence and the ACT Government’s Mugga 2 quarry (currently disused);
- **east** - vacant broadacre land;
- **south** – vacant broadacre land and one rural residence; and
- **west** – Mugga Lane, vacant broadacre land and one rural residence.

## 2.3 The project

### 2.3.1 Design considerations

The site topography and technical assessments prepared for the EIS informed the design and layout of the project to minimise environmental impacts. Specifically, the design process investigated different on-site layouts to consider:

- minimising ecological impacts;
- avoiding Mugga Quarry's approved pit extent;
- utilising topography and site contours;
- managing surface water runoff;
- designing overburden contours to blend into the surrounding natural topography; and
- investigating alternative overburden areas.

The proposal outlined in this VIA will enable Boral to minimise environmental impacts and maintain the amenity of the surrounding area, whilst continuing production and operations of Mugga Quarry's approved pit extent.

### 2.3.2 Overburden bund and temporary emplacement area

As previously stated, Boral proposes to establish a new permanent bund and temporary emplacement area to store quarried overburden and weathered rock material from its Mugga Quarry operations.

This project is proposed to remove and emplace overburden and unsuitable weathered rock from the approved quarry footprint to enable the continued extraction of higher quality hard rock beneath. The overburden material will be emplaced into a permanent bund, while the weathered rock material will temporarily be emplaced and progressively blended into other quarry products to produce concrete and asphalt aggregates.

The new bund and emplacement area will be located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road) and resides within an approved extractive industry lease area of 106.4 ha. The total disturbance area for the project is 7.28 ha.

### 2.3.3 Construction

Construction of the project would broadly comprise the following:

- topsoil would be removed and stockpiled for use as the top layer of the permanent noise and visual bund; a new access road and surface water infrastructure (ie surface drains, sedimentation dams) will be established to manage runoff;
- excavated overburden and weathered rock material from the approved quarry footprint would be loaded onto trucks for haulage and unloading at the project area;
- overburden material would be emplaced progressively by bulldozer and excavator to establish the permanent bund. The permanent overburden bund will be constructed over 14 - 16 months to establish a finished height of 725 m Australian Height Datum (AHD);

- weathered rock would be emplaced by excavator to establish the temporary emplacement area for a period of 12 months while the permanent overburden bund is being established. The temporary emplacement will be established to a finished height of 710 m AHD;
- topsoil will be spread over the permanent bund and seeded to stabilise and blend the final landform with the surrounding landscape.

#### 2.3.4 Production and operational aspects

As total production of the quarry will not be increasing, there will be no change to current production, operating hours, external traffic movements, groundwater management or employment.

The project does not propose any lighting or modification to existing lighting on site. On this basis there would be no change to ambient light conditions or the night time environment.

No changes are proposed to the other operations at the site.

### 2.4 Project alternatives

The following alternatives for the project were considered by Boral:

1. Emplacement within the Mugga Quarry pit – Boral is already planning to emplace approximately 270,000 m<sup>3</sup> of overburden and weathered rock within the pit, for possible processing or relocation. Total overburden material in-pit emplacement is not considered viable as it would begin to sterilise approved resource and shorten the lifespan of the quarry.
2. Emplacement within the ACT Government’s disused Mugga 2 Quarry pit – Inquiries are currently being made with the ACT Government to determine whether this is a possibility and whether it would be commercially viable. However, based on haulage costs, even without a tipping fee, it is unlikely to be a commercially viable option. Emplacement within the Mugga 2 pit would also prevent later re-use and blending of the weathered rock material.
3. Emplacement at another Boral quarry – the closest Boral quarry is at Hall Quarry at Jeir NSW, approximately 55 km to the north. Hall Quarry does not have development approval to receive overburden from external sites, and the cost involved in trucking material over such a long distance is not commercially viable. It would also prevent later re-use and blending of the weathered rock material.
4. Not proceed – Should the project not proceed, and a suitable alternative location unable to be found, Boral would be unable to extract the remaining resource within the approved quarry pit. This would mean that the quarry would cease to operate once all accessible resources were extracted unless the pit boundary is modified to access additional resources. Modification of the pit boundary would likely have environmental impacts of a greater scale than the project. Cessation of quarry operations would reduce the availability of supply to the quarry’s customers, resulting in reduced competition for the ACT and surrounding areas in quality, service and price. Cessation of quarry operations would also adversely affect other Boral operations on the site (asphalt plant and CBP) and result in a loss of employment.

After evaluating their current and preferred future exposure, Boral determined the existing Mugga Quarry site continues to provide the most efficient and strategic location for the project. The site provides sufficient available land within an existing Boral leased site that is appropriately zoned for the nature and scale of development. The project is also considered the most viable option from a commercial perspective, given it would involve the shortest haulage distance. It also means the weathered rock material can be later blended and re-used, instead of simply being applied to land.

The project's location was also found to satisfy the following strategic criteria set for the comparison of alternate locations:

- secure continuity of operations in ACT;
- meet all present environmental standards; anticipate expectations regarding future standards; and
- comply with all relevant statutory requirements.

## 3 Visual impact assessment

This VIA provides an assessment of the potential visual impact of the project from public vantage points and private receptors. Photographs and photomontages have been prepared to determine the visual absorption capacity and visual sensitivity of the locality.

### 3.1 Methodology

The visual assessment methodology comprises the following:

- a review of a VIA by JEA Pty Ltd (JEA) in 2010;
- a review of a VIA by EMM in March 2017;
- an assessment of the regional and local landscape settings;
- identification of public vantage points and private receptors;
- a site inspection undertaken on 18 September 2018 with photographs and information from six (6) representative public viewpoints and private receptors collected;
- an assessment of the visibility of the proposed overburden expansion from public vantage points and private receptors; and
- determination of the potential visual impacts of the project based upon an analysis of the visual absorption capacity and visual sensitivity of the locality.

### 3.2 Previous assessments

JEA was commissioned by Boral in 2010 to provide a visual assessment of a proposed asphalt plant (not constructed) on the site. The site of the asphalt plant is 500 m to the south-west of the proposed new permanent bund and temporary emplacement area.

The JEA VIA showed that there was very limited to no visual access to built structures from Mugga Lane and concluded that the asphalt plant would not have a significant visual impact on the surrounding character of the area.

EMM was commissioned by Boral in 2017 to undertake a VIA of the proposed asphalt plant that has been subsequently constructed on the site. Due to the surrounding natural landscape, established trees and vegetation and topography, the site was considered to be effectively screened from both the public and private viewpoints, including the proposed asphalt plants tallest structures (ie silos).

EMM concluded that the area's character had a high capacity to absorb development of the asphalt plant and the development would not have any significant impact on the nearest sensitive receptors.

### 3.3 Land use and disturbance

The project area is located within a broadacre rural setting and surrounded by low density land uses and established remnant native vegetation. The existing quarry immediately south of the project area has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility (see Photograph 3.1).



**Photograph 3.1** View to the Mugga Quarry pit and surrounds looking south-east from the new permanent bund

The project area has been historically cleared of native vegetation but now features regrowth native vegetation distributed amongst grasslands.

More localised forms of disturbance include vehicle track use and intermittent areas of excavation associated with drainage diversion bunds. The most obvious forms of disturbance relate to a large linear existing overburden bund that runs along the southern boundary of the project area for an area of approximately 25 m wide and 500 m long and an existing temporary emplacement area situated to the east of the quarry pit.

### 3.4 Flora and fauna

The project area contains patches of the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community (ACTMAPI 2018). This area includes both native grasses which occur when the woodland itself has been removed, and a strong eucalypt community where the trees still stand.

The grassland consists of Kangaroo Grass (*Themeda triandra/australis*), Snow Grass (*Poa sieberiana*) and daisies. The woodland consists of numerous species of eucalypt including western grey box (*Eucalyptus macrocarpa*), red stringybark (*E. Macrorhyncha*) and long leaved box (*E. goniocalyx*). Both white (*Callitris glaucophylla*) and black cypress pine (*C. enderlicheri*) can be found in the area along with the Kurrajong (*Brachychiton populneus*) (DEH 2006).

### 3.5 Site visibility

The project is sited within Boral's established Mugga Quarry which consists of an established operating hard rock quarry (open pit), operating asphalt plant facility, CBP, recycling facility and associated structures enclosed by established native vegetation, natural topography and eucalypt-covered grasslands.

The site is effectively screened from public vantage points and private receptors along Mugga Lane, Narrabundah Lane, Jerrabomberra Avenue and Monaro Highway (portion) due to the established trees and vegetation surrounding the site and locality, as well as the natural topography to the south and west which provides a physical barrier effectively screening the site.

Existing open cleared paddocks and flatter topography towards the Monaro Highway to the west and south-west provide views towards the existing quarry and site structures, with the asphalt plant and CBP silos and existing temporary emplacement area visible due to their contrasting material composition and soil profile set against the natural surrounds.

Upon completion of the new permanent bund and temporary emplacement area, the final landform is intended to be rehabilitated with topsoil and reseeded to promote revegetation to minimise visual impact overtime and ensure the permanent overburden bund blends into the surrounding natural landscape.

Adjacent rural residences to the site are located approximately 300-500 m away and are all orientated away from the proposed overburden emplacement area (ie they do not look directly towards the site). To confirm site visibility of the project, photographs and photomontages have been prepared looking towards the site from Mugga Lane (to the north and west), Narrabundah Lane (to the north-east) and the Monaro Highway (to the east and south) - refer Photograph 3.2 to Photograph 3.12 and Photomontages 3.2 to 3.4.

The photographs and photomontages assist in the identification of the visual character, visual absorption capacity and visual sensitivity of the locality and have been used to assess to what degree existing built structures, landform and new permanent bund and temporary emplacement area would be visible from these public vantage points and private receptors.

### 3.6 Viewpoint analysis

A site inspection was undertaken on 18 September 2018 with photographs and information from representative public and private viewpoints collected (refer Photograph 3.2 to Photograph 3.12) and photomontages developed where visual impact would occur (refer Figure 3.1 to Figure 3.4).

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Source: EMM (2018); DFSI (2017); GA (2015)

**KEY**

- Private receptor viewpoint (demonstrate no visual impact)
- Public viewpoint (demonstrate no visual impact)
- Public viewpoint (visual impact - refer to photomontage)
- Proposed new permanent overburden bund
- Proposed temporary emplacement area
- Rail line
- Main road
- Local road

Photo locations

Boral - Mugga Quarry overburden expansion  
Visual impact assessment  
Figure 3.1



### 3.6.1 Private receptor viewpoint 1

Private receptor 1 is located on Mugga Lane immediately north of the project area. This adjacent rural residence is located approximately 150 m away and is orientated away from the new permanent bund and temporary emplacement area (ie it does not look directly towards the site).

Existing established trees and vegetation both within the site provide a partial visual screen towards the project area from this location. The project would be visible amongst the trees and vegetation as the initial overburden material would contrast with the natural vegetation and ground cover – see Photograph 3.3.

The final landform for the permanent overburden bund is intended to blend and integrate into the natural topography with the final elevation (ie 725m AHD) consistent with the 730m AHD elevation to the south-west of project area.

The visual impact would further diminish overtime as the final landform is intended to be rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape.

The temporary emplacement area would not be visible from this private receptor viewpoint.



**Photograph 3.2** View to the site from Mugga Lane looking south towards the site (private receptor viewpoint 1)

### 3.6.2 Public viewpoints 2 and 3

Public viewpoints 2 and 3 are located on Mugga Lane approximately 150 m and 250 m north and north-east of the project area respectively.

Existing established trees and vegetation within the site would provide a visual screen towards the project area from these locations. Distance views of the permanent overburden bund and temporary emplacement area may be visible amongst the trees and vegetation as the material is likely to contrast with the natural vegetation and ground cover – see Photograph 3.3.

These views would be transient views for motorists travelling north or south along Mugga Lane and diminish overtime as the final landform for the new permanent bund is intended to be rehabilitated with topsoil and reseeded to promote revegetation and ensure it blends into the surrounding natural landscape.

The temporary emplacement area only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations.



**Photograph 3.3** View to the site from Mugga Lane looking south towards the site (public viewpoint 2)



**Photograph 3.4** View to the site from Mugga Lane looking south-east towards the site (public viewpoint 3)

### 3.6.3 Public viewpoint 4

Public viewpoint 4 is located on Narrabundah Lane approximately 1km to the north-west of the project area.

Existing established trees and vegetation and natural topography at this locality prevent views to the site from these location (see Photograph 3.5 and Photograph 3.6). The project is not considered to be visible or present a visual impact from public viewpoint 4.



**Photograph 3.5** View to the site from Narrabundah Lane looking south-west (public viewpoint 4)



**Photograph 3.6** View to the site from Narrabundah Lane looking south-west (public viewpoint 4)

### 3.6.4 Public viewpoint 5

Public viewpoint 5 is located on Jerrabomberra Avenue approximately 2.5 km to the north-west of the project area. The existing visual character of the locality is interrupted by an existing industrial structure, transmission line and Mugga Quarry's site structures, with the asphalt plant and CBP silos partially visible due to their contrasting material composition against the natural surrounds – see Photograph 3.7.

Whilst the project would be visible from this location the existing visual character is interrupted by industrial built form and given distance the new permanent overburden bund and temporary emplacement area would effectively blend into the natural landscape overtime. The final landform for the permanent overburden bund is intended to blend and integrate into the natural topography with the final elevation (ie 725m AHD) consistent with the 730m AHD elevation to the south-west of project area.

These views would be transient views for motorists travelling north or south along Jerrabomberra Avenue and would further diminish overtime as the final landform is intended to be rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape.

The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates.

The project is not considered to significantly alter or increase the current level of visual impact when viewed from this public vantage point (refer Figure 3.2).



**Photograph 3.7** View to the site from Monaro Highway looking north-west (public viewpoint 5)



Source: EMM (2018)

Photomontage - Public viewpoint 5

Boral - Mugga Quarry overburden expansion  
Visual impact assessment  
Figure 3.2

### 3.6.5 Public viewpoints 6 and 7

Public viewpoints 6 & 7 are located on Monaro Highway approximately 2.5 km and 3 km to the west of the project area (see Photograph 3.8 and Photograph 3.9).

The existing visual character of the locality is dominated by cleared pastoral land in the foreground with distant views interrupted by existing industrial structure, transmission line and Mugga Quarry's site structures, with the asphalt plant and CBP silos and an existing emplacement area visible due to their contrasting material composition against the natural surrounds.

Whilst the project would be visible from these locations the existing visual character is interrupted by industrial built form and given distance the new permanent overburden bund and temporary emplacement area would effectively blend into the natural landscape overtime. The final landform for the permanent overburden bund is intended to blend and integrate into the natural topography with the final elevation (ie 725m AHD) consistent with the 730m AHD elevation to the south-west of project area.

These views would also be transient views for motorists travelling north or south along the Monaro Highway and would further diminish overtime as the final landform is intended to be rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape.

The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates.

The project is not considered to significantly alter or increase the current level of visual impact when viewed from this public vantage point. A photomontage from Public viewpoint 6, which is considered to have the higher level of visual impact, is provided in Figure 3.3.



**Photograph 3.8** View to the site from Monaro Highway looking north-west (public viewpoint 6)



**Photograph 3.9** View to the site from Monaro Highway looking north-west (public viewpoint 7)



Source: EMM (2018)

Photomontage - Public viewpoint 6

Boral - Mugga Quarry overburden expansion  
Visual impact assessment  
Figure 3.3

### 3.6.6 Public viewpoint 8

Public viewpoint 8 is located on Monaro Highway approximately 4 km to the south of the project area. Existing established trees and vegetation and natural topography at this locality prevent views to the site from this location (refer Photograph 3.10).

The project is not considered to be visible or present a visual impact from public viewpoint 8 with the natural landscape and existing municipal landfill being the dominant visual features.



**Photograph 3.10 View to the site from Monaro Highway looking north (public viewpoint 8)**

### 3.6.7 Private receptor viewpoint 9

Private receptor viewpoint 9 is located on Mugga Lane approximately 1.2 km to the south-west of the project area. This adjacent rural residence is located approximately 300 m away and is orientated away from the proposed overburden emplacement area (ie it does not look directly towards the site).

Existing established trees and vegetation and natural topography at this locality prevent views to the site from this location (refer Photograph 3.11). The project is not considered to be visible or present a visual impact from private receptor viewpoint 9.



**Photograph 3.11** View to the site from Mugga Lane looking north (private receptor viewpoint 9)

### 3.6.8 Public viewpoint 10

Public viewpoint 10 is located on Mugga Lane approximately 300 m to west of the project area. Existing established trees and vegetation and natural topography at this locality prevent views to the site from this location (refer Photograph 3.12).

The project is not considered to be visible or present a visual impact from public viewpoint 10.



**Photograph 3.12** View to the site from Mugga Lane looking west (public viewpoint 10)

### 3.6.9 Public viewpoint 11

Public viewpoint 11 is located on Mugga Lane approximately 200 m to west of the project area. Existing established trees and vegetation at this locality partially screen views to the site from this location (refer Photograph 3.13).

Distant views of the permanent overburden bund would be visible amongst the trees and vegetation as the material is likely to contrast with the natural vegetation and ground cover. Notwithstanding this, the final landform for the permanent overburden bund is intended to blend and integrate into the natural topography with the final elevation (ie 725m AHD) consistent with the 730m AHD elevation to the south-west of project area. These views would be transient views for motorists travelling north or south along Mugga Lane and diminish overtime as the final landform is intended to be rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape.

The temporary emplacement area would not be visible from this public viewpoint.

The proposed emplacement of new overburden material would not significantly alter or increase the current level of visual impact when viewed from this public vantage point (refer Figure 3.4).



**Photograph 3.13** View to the site from Mugga Lane looking west (public viewpoint 11)

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Source: EMM (2018)

Photomontage - Public viewpoint 11

Boral - Mugga Quarry overburden expansion  
Visual impact assessment  
Figure 3.4

### 3.7 Visual absorption of the site

The visual absorption capacity of the site can be expressed as the level of visual contrast (ie form, shape, pattern, line, texture and colour) to the visual setting within which it is placed. There would be a high visual absorption capacity if there is minimal contrast and a high level of integration between the project and the existing visual setting. Conversely, a low absorption capacity would occur when the site has a high visual contrast to the visual setting and there is no or little visual screening.

The existing Mugga Quarry has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility. The site is effectively screened from public vantage points and private receptors along Mugga Lane, Narrabundah Lane, Jerrabomberra Avenue and Monaro Highway (portion) due to the established trees and vegetation surrounding the site and locality, as well as the natural topography and landform to the south and west which provides a physical barrier effectively screening the majority of the site.

The proposed new overburden bund and temporary emplacement area has the potential to be initially visually intrusive and result in a moderate degree of visual contrast with the surrounding landscape as the material is likely to contrast with the natural vegetation and ground cover. However, based upon an analysis of the potential private and public viewpoints, views to the project would be obscured by the surrounding natural landscape, topography and established trees and vegetation to a high degree with limited, to no views of the project likely to be visible from the north, west and south.

The visual impact of the project when viewed from the west and south-west are considered temporary in nature as the final landform for the permanent overburden bund is intended to blend and integrate into the natural topography with the final elevation (ie 725m AHD) consistent with the 730m AHD elevation to the south-west of project area. In this regard the permanent bund would be established to form an extension of the natural landform.

Upon completion of the new permanent bund within 14 - 16 months, the final landform is also intended to be rehabilitated with topsoil and reseeded to promote revegetation to minimise visual impact overtime and ensure the permanent landform blends into the surrounding natural landscape.

The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations.

### 3.8 Visual sensitivity to the project

Visual sensitivity is a measure of the potential level of concern attached by surrounding land users to a change in the existing landscape or visual setting. It is largely based upon visibility and distance from viewing areas, but is also influenced by the land use, current degree of exposure to the type of development proposed and the length of viewing time.

Generally, the sensitivity of the receptor would increase the closer they are and with any change in the landscape or visual setting. Similarly, the greater the viewing time or period of exposure, the more sensitive the receptor would be to the change. The type of land use also influences the visual sensitivity. Land uses such as residential or recreational land generally have a higher sensitivity to change than industrial land uses, as the receptors at these locations place a greater emphasis on scenic quality and visual amenity and are likely to view the change for a longer period of time.

Public and private vantage points on Mugga Lane and the Monaro Highway would have low visual sensitivity due to limited to no views into the site, while any potential transient views by motorists would be mitigated by the temporary nature of the impact and is not considered to adversely impact on the amenity of surrounding land uses, the role and character of the hills and ridges as a visual backdrop or the on rural character of the area.

### 3.9 Summary of visual impact

Table 3.1 summarises the visual impact of the project.

**Table 3.1 Viewpoint analysis summary**

ID#	Viewpoint details	Visual sensitivity	Magnitude of change	Significance assessment
1	Private receptor - Mugga Lane, 150 m north of project site access	<b>Moderate</b> – due to adjacent rural residence being orientated away from the proposed overburden emplacement area (ie it does not look directly towards the site) and the surrounding established trees and vegetation and topography providing a partial visual screen to the project area.	Views of the project would be largely screened by existing established trees and vegetation and topography. Some residual views of the new permanent overburden and temporary emplacement area may remain visible however they would diminish overtime as the final landform is rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape. The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations. The project is not considered to significantly alter or increase the current level of visual impact when viewed from this private vantage point.	<b>Moderate</b> – existing vegetation and topography would partially screen the majority of the project, while residual views would be temporary in nature. Proposed mitigation measure to rehabilitate the site would further reduce impacts with the new permanent overburden bund blending into the natural landscape setting to improve the amenity appearance overtime. The temporary emplacement area would diminish over time as it is progressively blended into other quarry products.

**Table 3.1 Viewpoint analysis summary**

ID#	Viewpoint details	Visual sensitivity	Magnitude of change	Significance assessment
2 & 3	Public viewpoints - Mugga Lane, 150 m and 250 m north and north-east of project	<b>Low - Moderate</b> – due to the surrounding established trees and vegetation and topography providing a visual screen to the project area.	Views of the project would be effectively screened by existing established trees and vegetation and topography. Some residual views of the new permanent overburden and temporary emplacement area may remain visible however they would diminish overtime as the final landform is rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape. The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations.	<b>Low - Moderate</b> – existing vegetation and topography would partially screen the majority of the project, while residual views would be temporary in nature. Proposed mitigation measure to rehabilitate the site would further reduce impacts with the new permanent overburden bund blending into the natural landscape setting to improve the amenity appearance overtime. The temporary emplacement area would diminish over time as it is progressively blended into other quarry products.
4	Public viewpoints - Narrabundah Lane, 1 km north-west of the project	<b>Nil</b> – due to surrounding established native vegetation and topography preventing views to the site.	Views of the project would be screened by existing established native vegetation and topography.	<b>Nil</b> – existing established native vegetation and topography inhibit views towards the site.
5	Public viewpoints – Jerrabomberra Avenue 2.5 km north-west of the project	<b>Low</b> – due to the surrounding established trees and vegetation and topography providing a visual screen to the project area, while the existing visual character is interrupted by industrial built form.	Views of the project would be effectively screened by existing established trees and vegetation and topography. Some residual views of the new permanent overburden and temporary emplacement area may remain visible however they would diminish overtime as the final landform is rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape. The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations.	<b>Low</b> – existing vegetation and topography would partially screen the majority of the project, while residual views would be temporary in nature. Proposed mitigation measure to rehabilitate the site would further reduce impacts with the new permanent overburden bund blending into the natural landscape setting to improve the amenity appearance overtime. The temporary emplacement area would diminish over time as it is progressively blended into other quarry products.

**Table 3.1 Viewpoint analysis summary**

ID#	Viewpoint details	Visual sensitivity	Magnitude of change	Significance assessment
6	Public viewpoint - Monaro Highway, 2.5 km north-west of the project	<b>Moderate</b> – due to the existing visual character of the locality is interrupted by Mugga Quarry’s site structures, with the asphalt plant and CBP silos and an existing overburden stockpiles visible due to their contrasting material composition against the natural surrounds. Views would be of a transient nature by motorists on the Monaro Highway	Whilst the site is visible from this location the existing visual character is interrupted by industrial built form and stockpile associated with the quarry. Views of the project would be partially screened by existing established trees and vegetation and topography. Some residual views of the new permanent overburden and temporary emplacement area may remain visible however they would diminish overtime as the final landform is rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape. The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations. The project is not considered to significantly alter or increase the current level of visual impact when viewed from this public vantage point.	<b>Moderate</b> – The project would not significantly alter or increase the current level of visual impact when viewed from this public vantage point. These views would be transient views for motorists travelling north or south along Monaro Highway. Proposed mitigation measure to rehabilitate the site would further reduce impacts with the proposed new overburden bund blending into the natural landscape setting to improve the amenity appearance overtime. The temporary emplacement area would diminish over time as it is progressively blended into other quarry products.

**Table 3.1 Viewpoint analysis summary**

ID#	Viewpoint details	Visual sensitivity	Magnitude of change	Significance assessment
7	Public viewpoint - Monaro Highway, 3 km west of the project	<b>Moderate</b> – due to the existing visual character of the locality is interrupted by Mugga Quarry’s site structures, with the asphalt plant and CBP silos and an existing overburden stockpiles visible due to their contrasting material composition against the natural surrounds. Views would be of a transient nature by motorists on the Monaro Highway	Whilst the site is visible from this location the existing visual character is interrupted by industrial built form and stockpile associated with the quarry. Views of the project would be partially screened by existing established trees and vegetation and topography. Some residual views of the new permanent overburden and temporary emplacement area may remain visible however they would diminish overtime as the final landform is rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape. The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations. The project is not considered to significantly alter or increase the current level of visual impact when viewed from this public vantage point.	<b>Moderate</b> – The project would not significantly alter or increase the current level of visual impact when viewed from this public vantage point. These views would be transient views for motorists travelling north or south along Monaro Highway. Proposed mitigation measure to rehabilitate the site would further reduce impacts with the proposed new overburden bund blending into the natural landscape setting to improve the amenity appearance overtime. The temporary emplacement area would diminish over time as it is progressively blended into other quarry products.
8	Public viewpoint - Monaro Highway, 4 km south of the project	<b>Nil</b> – due to surrounding established native vegetation and topography preventing views to the site.	Views of the project would be screened by existing established native vegetation and topography.	<b>Nil</b> – existing established native vegetation and topography inhibit views towards the site.
9	Private receptor - Mugga Lane, 1.2 km south-west of the project	<b>Nil</b> – due to adjacent rural residence being orientated away from the proposed overburden emplacement area (ie it does not look directly towards the site) and the surrounding established trees and vegetation and topography providing an effective visual screen to the project area.	Views of the project would be screened by existing established native vegetation and topography.	<b>Nil</b> – existing established native vegetation and topography inhibit views towards the site.
10	Public viewpoint - Mugga Lane, 300 m west of project	<b>Nil</b> – due to surrounding established native vegetation and topography preventing views to the site.	Views of the project would be screened by existing established native vegetation and topography.	<b>Nil</b> – existing established native vegetation and topography inhibit views towards the site.

**Table 3.1 Viewpoint analysis summary**

ID#	Viewpoint details	Visual sensitivity	Magnitude of change	Significance assessment
11	Public viewpoint - Mugga Lane, 200 m west of project	<b>Moderate</b> – due the surrounding established trees and vegetation and topography only partially visually screening the project area. Views would be of a transient nature by motorists on the Mugga Lane	Views of the project would be partially screened by existing established trees and vegetation. Some residual views of the new permanent overburden and temporary emplacement area may remain visible however they would diminish overtime as the final landform is rehabilitated with topsoil and reseeded to promote revegetation and ensure the permanent overburden bund blends into the surrounding natural landscape. The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations. The project is not considered to significantly alter or increase the current level of visual impact when viewed from this public vantage point.	<b>Moderate</b> – existing vegetation and topography would partially screen the majority of the project, while residual views would be temporary in nature. Proposed mitigation measure to rehabilitate the site would further reduce impacts with the new permanent overburden bund blending into the natural landscape setting to improve the amenity appearance overtime. The temporary emplacement area would diminish over time as it is progressively blended into other quarry products.

# 4 Conclusions and recommendations

## 4.1 Conclusions

The visual assessment has been conducted from a number of public and private receptor viewpoints surrounding the site from Mugga Lane (to the north and west), Narrabundah Lane (to the north-east), Jerrabomberra Avenue (to the north-east) and Monaro Highway (to the east and south).

The existing Mugga Quarry has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility.

The site is effectively screened from public vantage points and private receptors along Mugga Lane, Narrabundah Lane, Jerrabomberra Avenue and Monaro Highway (portion) due to the established trees and vegetation surrounding the site and locality, as well as the natural topography and landform to the south and west which provides a physical barrier effectively screening the majority of the site.

Due to the surrounding natural landscape, established trees and vegetation and topography, the site is largely screened from both the public and private viewpoints, with transient views for motorists along Mugga Lane (to the north and east) and from the Monaro Highway (to the east).

The scenic quality of the site and surrounding area is considered to be moderate with the visual character when viewed from the Monaro Highway (to the east) interrupted by industrial built form, transmission line and Mugga Quarry's existing site structures, with the asphalt plant and CBP silos and an existing stockpile visible due to their contrasting material composition against the natural surrounds.

The proposed new permanent overburden bund and temporary emplacement area would be most visually dominant when viewed from Mugga Lane to the north (ie near views) and from the Monaro Highway to the east (ie distant views). The visual impact for Mugga Lane is mitigated by existing established trees and vegetation and topography within the site with only partial and transient views towards the project area from this location.

Views from the Monaro Highway are currently interrupted by industrial built form and infrastructure contrasting against the natural surrounds and skyline. The visual impact of the project from this viewpoint is reduced by distance, while the final landform for the permanent overburden bund is intended to blend and integrate into the natural topography with the final elevation (ie 725m AHD) consistent with the 730m AHD elevation to the south-west of project area. These views are also transient for motorists travelling north or south along Monaro Highway.

Given the new permanent overburden bund and emplacement area would be completed within 14 - 16 months the visual impact is considered temporary in nature and would diminish overtime as the final landform is intended to be rehabilitated with topsoil and reseeded to promote revegetation (eg native groundcover) and ensure the permanent overburden bund blends into the surrounding natural landscape.

The temporary emplacement area would only be in place for a period of 12 months and would diminish over time as the material is progressively blended into other quarry products to produce concrete and asphalt aggregates during operations.

The proposed new permanent overburden bund and temporary emplacement area at Mugga Quarry are not considered to significantly transform the visual character of the locality, nor does it represent a major change to the local perception of the surrounding area.

The project is not considered to significantly alter or increase the current level of visual impact when viewed from public vantage points and private receptors.

#### 4.1.1 Recommendations

The following management measures are recommended to minimise visual impacts from the project and improve visual amenity in the area:

- existing native vegetation is vital to preserving natural aesthetics and it is recommended that existing vegetation be protected and preserved in order to uphold the visual integrity of the locality with only vegetation required for the project disturbance footprint to be removed; and
- upon completion of the new permanent overburden bund within 14 - 16 months, the final landform should be rehabilitated with topsoil and reseeded to promote revegetation (eg native groundcover) and ensure the permanent overburden bund blends into the surrounding natural landscape.



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Appendix L

# Surface Water assessment

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# Mugga Quarry Overburden Expansion Project

## Surface Water Assessment

Prepared for Boral Resources (Country) Pty Ltd | 12 April 2019





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# Mugga Quarry Overburden Expansion Project

Surface Water Assessment

Prepared for Boral Resources (Country) Pty Ltd | 12 April 2019

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## Mugga Quarry Overburden Expansion Project

Final

Report J17174RP1 | Prepared for Boral Resources (Country) Pty Ltd | 12 April 2018

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Prepared by	<b>Chris Kuczera</b>	Approved by	<b>Paul Gibbons</b>
Position	Associate Water Resources Engineer	Position	Associate Director Environmental Planner
Signature		Signature	
Date	12 April 2019	Date	12 April 2019

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This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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### Document Control

Version	Date	Prepared by	Reviewed by
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# 1 Introduction

A Draft Environmental Impact Statement (Draft EIS) has been prepared on behalf of Boral Resources (Country) Pty Ltd (Boral) for the Mugga Quarry Overburden Expansion Project (the project). The Draft EIS has been prepared in accordance with the Scoping Document [201800033] issued by ACT Environment, Planning and Sustainable Development Directorate (ACT EPSDD – Planning) on 19 October 2018 under Division 8.2.2 of the ACT *Planning and Development Act 2007* (P&D Act). This surface water assessment has been prepared to support the Draft EIS for the project.

The project involves expansion of Boral's Mugga Quarry operations through establishment of a new permanent bund as well as a temporary emplacement area to store quarried overburden and weathered rock material. Overburden and unsuitable weathered rock will be removed from within the approved quarry footprint to enable extraction of higher quality hard rock beneath.

The overburden material will be emplaced into the permanent bund, while the weathered rock material will be temporarily stockpiled and progressively blended into other quarry products to produce concrete and asphalt aggregates. The new bund will be located to the north of the approved quarry pit extent, while the temporary emplacement will be located within the eastern extent of the approved quarry pit extent. All works will be within the approved extractive industry lease area of 106.4 hectares (ha).

The project is required to enable the ongoing operation of the quarry, which supplies gravel and construction materials to the construction market within the Australian Capital Territory (ACT) and surrounding New South Wales (NSW) regional areas.

## 1.1 Report overview

This report documents the surface water assessment that has been prepared for the project. The report is structured as follows:

- Section 2 describes the existing operation and the project;
- Section 3 provides an overview of the EIS scoping document, existing consent conditions, relevant legislation and industry and government guidelines;
- Section 4 reviews the existing surface water environment at the site;
- Section 5 describes the proposed water management system, including contingency measures;
- Section 6 describes a monitoring, inspection and maintenance plan;
- Section 7 describes residual impacts; and
- Section 8 provides a summary of this assessment.



## 2 Existing operation and project description

This section describes the existing site operations and the proposed bund and emplacement.

### 2.1 Existing site and quarry operation

The site is leased Territory Land, identified as Block 2031 in the Jerrabomberra District. The site, generally known as 321 Mugga Lane Symonston, is located approximately 6 kilometres (km) to the south of the parliament house and central Canberra. The site is located within a broad-acre rural setting and is surrounded by low density land uses and established native vegetation. Vehicular access to the site is via an existing entry off Mugga Lane, adjacent to the site's south-western boundary.

The site has a long history of supporting construction materials manufacturing and contains four Boral operations, namely an asphalt plant, a concrete batching plant, a waste management facility and the hard rock quarry that is associated with the proposed emplacement area.

The quarry is in the central portion of the site and currently produces crushed rock products with a production rate of up to 1,000,000 tonnes per annum (tpa). The average production rate is approximately 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities. The quarry has consent to operate 24 hours a day, seven days a week. However, typical operating times are from 6:00 am to 6:00 pm Monday to Saturday.

Refer to Chapter 2 of the EIS for a detailed description of the existing operation.

### 2.2 Project description

The project involves expansion of Boral's Mugga Quarry operations through establishment of a new permanent bund (referred to as the northern emplacement) as well as a temporary emplacement area to store quarried overburden and weathered rock material (referred to as the eastern emplacement). Overburden and unsuitable weathered rock will be removed from within the approved quarry footprint to enable extraction of higher quality hard rock beneath. The overburden material will be emplaced into a permanent bund (the northern emplacement), while the weathered rock material will be temporarily stockpiled (in the eastern emplacement) and progressively blended into other quarry products to produce concrete and asphalt aggregates. The northern emplacement will be located to the north of the approved quarry pit extent, while the eastern emplacement will be located within the approved quarry pit extent. All works will be within the approved extractive industry lease area of 106.4 ha.

The project comprises the following:

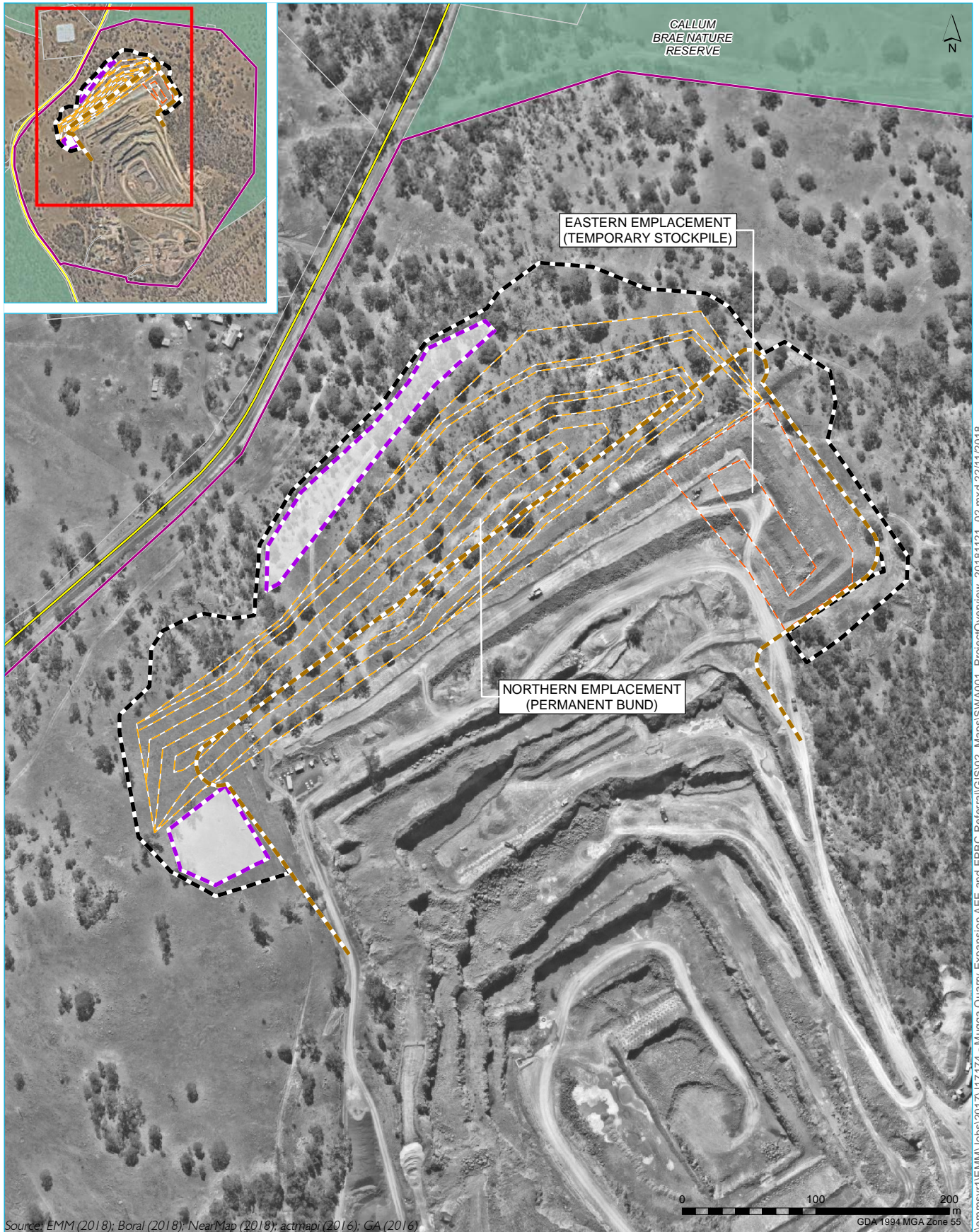
- removal of 7.28 ha of native vegetation;
- removal and stockpiling of topsoil for use as the top layer of the permanent overburden emplacement area;
- establishment of a new access road and surface water infrastructure (ie surface drains, sedimentation dams) to manage runoff;
- excavation of 620,000 cubic metres (m<sup>3</sup>) of overburden and weathered rock material from the approved quarry footprint;

- excavated overburden material will be emplaced by a bulldozer and excavator to establish a permanent bund (the northern emplacement) that will be approximately 500 m x 80 m wide and 15 - 20 m high. The northern emplacement will be constructed in three stages over 12 months to establish a finished height of 725 metres Australian Height Datum (m AHD);
- excavated weathered rock will be stockpiled to establish a temporary emplacement (the eastern emplacement) for a period of 12 months while the permanent overburden bund is being established. The temporary stockpile will be established to a finished height of 710 m AHD; and
- spreading of topsoil and rehabilitation of the permanent bund.

No changes to production rates or the pit extent or depth are proposed.

The total disturbance area has been established based on the expected layout with additional areas set aside for construction. The area defined as project contingency area is an additional area that may be disturbed within the overall project footprint if required. Disturbance of the contingency area will only be required if the emplacement footprint is larger than expected.

Figure 2.1 provides an overview of the project.



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**KEY**

- Site location - 321 Mugga Lane, Symonston
- Total disturbance area
- Project contingency area
- Approved pit extent
- Emplacement contours (Boral)
- Proposed eastern emplacement contours (EMM)
- Main road
- Block boundary
- ACT reserve

**Project overview**

Boral Mugga Quarry overburden expansion  
Surface Water Assessment

Figure 2.1





## 3 Assessment framework

This surface water assessment has been prepared in accordance with the EIS Scoping Document issued by the ACT Planning, as well as relevant legislation guidelines and policies. This section provides a summary of the EIS scoping document, legislation, guidelines, plans and policies which have been considered in this assessment.

### 3.1 EIS scoping document

The Draft EIS has been prepared in accordance Scoping Document [201800033] issued by ACT Environment, Planning and Sustainable Development Directorate (ACT EPSDD – Planning) on 19 October 2018 under Division 8.2.2 of the ACT *Planning and Development Act 2007* (P&D Act). The scoping document identified the following surface water risks:

- impacts to the existing surface flow regimes; and
- flooding during construction and operation.

The scoping document also provides several water related assessment requirements. Table 3.1 provides a summary of these assessment requirements and a reference to the relevant section of this report. It is noted that the Environment Protection Authority (EPA) did not provide any comments or assessment requirements.

**Table 3.1 Assessment requirements**

<b>Assessment requirements</b>	<b>Report Section</b>
<b>ACT Planning assessment requirements</b>	
Describe how groundwater runoff will be managed	Sections 4.5 and 7.3.2
Outline any potential impacts to surrounding blocks	Section 5.1
Describe how overland water flow will be managed if a significant rain event occurs during construction	Section 5.3
Describe all mitigation measures that will be implemented to reduce the impact from construction runoff into surrounding areas	Section 5
Provide information on stormwater/ waste water management during construction	Section 5
<b>ICON Water</b>	
Provide information on any proposed trade waste requirements	No connection to trade waste is proposed
<b>Health</b>	
The design and construction of all water bodies to minimise the potential for them to become a local mosquito nuisance	Section 7.3.4

### 3.2 Relevant legislation

#### 3.2.1 Environment Protection Act 1997

The *Environment Protection Act 1997* (EPA Act) provides the regulatory framework to help reduce and eliminate the discharge of pollutants into the air, land and water. The EPA Act establishes the EPA as the statutory decision maker for environmental regulation and policy.

Boral currently holds Environmental Authorisation number 0422, authorising the extraction and subsequent crushing, grinding or separating of extracted materials. Conditions of the authorisation relevant to the water management include:

- Clause 15 Discharge of stormwater:
  - 15.1 There should be no discharges to the stormwater systems from the site without prior approval from the Authority. Approved stormwater discharges are only permitted from Settling Dam No.2.
- Clause 18 Monitoring requirements:
  - 18.1 Stormwater Settling Dam Monitoring:
    - a) Settling Dam No.2 shall be monitored for the parameters and frequencies set out in Schedule 3 Table 3.2 (Environmental Authorisation number 0422).
- Clause 19 Water quality standards:
  - Water quality in Settling Dam No.2 shall be managed with the object of being within the limits for the parameters listed in Schedule 3, Table 3.8 (Environmental Authorisation number 0422).

### 3.2.2 Water Resources Act 2007

The *Water Resources Act 2007* is administered by the EPA and regulates all water use in the ACT. Under this Act a licence is required to:

- carry out works in a waterway that will affect the flow or may affect water quality;
- construct a dam greater than 2 ML in volume; and
- extract water from surface and groundwater sources.

The ephemeral drainage lines within the project area do not meet the definition of waterway under Section 10 of the *Water Resources Act 2007* and the project will not involve the construction of a dam greater than 2 ML in size or the extraction of surface or groundwater. Licensing under this Act is therefore not required.

### 3.2.3 The Territory Plan

The Territory Plan is the key statutory planning document in the ACT, providing the policy framework for the administration of planning in the Territory. The statutory requirements for the Territory Plan are set out in the *Planning and Development Act 2007* primarily in Part 5. The purpose of the Territory Plan is to manage land use change and development in a manner consistent with strategic directions set by the ACT Government, Legislative Assembly and the community

The Water Use and Catchment General Code (The Code) within The Territory Plan, identifies waters of the ACT in terms of permitted water uses and environmental values. The Code further identifies the water quality and streamflow criteria related to the full protection of these uses and values.

Waters of the ACT and their catchments are classified into three Water Use Catchment categories:

- conservation;
- water supply; and
- drainage and open space.

The classification of the catchment relates to the predominant water use or environmental value within the catchment. Mugga Quarry is located within the drainage and open space catchment of Jerrabomberra. Water uses and environmental values identified in the Code for drainage and open space catchments are:

- aquatic habitat – urban drains and streams;
- discharge – wastewater and stormwater;
- stock water supply; and
- irrigation water supply.

Water quality protection directives outlined in the Code, relevant for the project include:

- land and water uses and protection measures shall be consistent with maintaining the water quality appropriate to the identified water uses and environmental values;
- land development and construction activities shall be consistent with minimising erosion and discharge of sediments;
- provisions shall be made for the collection and treatment of domestic and industrial wastewater;
- total discharge (loading) of various streamflow constituents emanating from the catchments shall not exceed the sustainable loading on receiving waters; and
- discharge of wastewater shall not be permitted to groundwater resources.

### 3.3 Relevant policies and guidelines

#### 3.3.1 Environment Protection Guidelines for Construction and Land Development in the ACT

The Environment Protection Guidelines for Construction and Land Development in the Act (Environment Protection Guidelines) (EPA 2011), provide guidance on the EPA's preferred methods for pollution control design, construction, operation and maintenance.

These guidelines have been produced to assist developers and operators in meeting their responsibilities under the Environment Protection Act 1997 and the Environment Protection Regulation 2005. Condition 5.1 of the existing Environmental Authorisation for the site requires compliance with the Environmental Protection Guidelines provided that the provisions are not in conflict with the conditions of the Environmental Authority or provisions contained in EPA policies.

### 3.3.2 ACT Water Strategy 2014-44: Striking the Balance

The ACT Water Strategy 2014-44: Striking the Balance (ACT Water Strategy) sets out how the ACT Government will manage the ACT's water resources to meet urban and environmental needs and regional responsibilities. It covers all water management activities in the ACT, including catchment management, stormwater and flood management.

Target 1 of the ACT Water Strategy aims at maintaining or improving the quality of water across all sub-catchments within the ACT.

### 3.3.3 Water Quality Environment Protection Policy

The Water Quality Environment Protection Policy 2008 provides guidance on meeting the legislative requirements under the EPA Act and Environmental Protection Regulation 2005 as they apply to water.

### 3.3.4 Australian Rainfall and Runoff

Australian Rainfall and Runoff (Commonwealth of Australia, 2016) provides practitioners with the best available information on design flood estimation and is widely accepted as a design guideline for all flood and stormwater related investigation and design in Australia.

### 3.3.5 Australian Guidelines for Water Quality Monitoring and Reporting

The Australian and New Zealand Environment Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australian and New Zealand (ARMCANZ) published the revised Australian and New Zealand guidelines for fresh and marine water quality in 2000. These guidelines provide a framework for:

- assessing and managing water quality for environmental values;
- establishing water quality objectives; and
- establishing protection levels, water quality indicators and trigger values.

## 4 Existing environment

This section describes the existing surface water environment at the site as relevant to this surface water assessment.

### 4.1 Rainfall data

There are several Bureau of Meteorology (BoM) operated rainfall gauges in vicinity to the project area. Table 4.1 presents key information and statistical data from three local gauges that have long term records.

**Table 4.1 Local rainfall statistics**

Statistics	Units	Canberra Parliament House (70246)	Torrens (Darke St) (70308)	Canberra Airport (70014)
Rainfall Record		1968 - present	1971 - present	1939 - 2010
Distance from the site	(km)	6 km to the north	5 km to the west	8.5 km to the north-east
Elevation	(m AHD)	585	653	578
Average Rainfall	(mm/year)	637	607	615
Lowest Annual Rainfall	(mm/year)	314	376	262
5 <sup>th</sup> Percentile Rainfall	(mm/year)	383	468	357
10 <sup>th</sup> Percentile Rainfall	(mm/year)	402	490	392
50 <sup>th</sup> Percentile Rainfall	(mm/year)	647	668	617
90 <sup>th</sup> Percentile Rainfall	(mm/year)	837	858	802
95 <sup>th</sup> Percentile Rainfall	(mm/year)	867	902	890
Highest Annual Rainfall	(mm/year)	997	983	1063
Highest daily rainfall	(mm/day)	Not available	Not available	126
Mean days of rain >10mm	(days)	Not available	Not available	18.6
Mean days of rain >25mm	(days)	Not available	Not available	4.5

Notes: 1. Data sourced from BoM

Comparison of the rainfall statistics presented in Table 4.1 indicates that rainfall records at Canberra Airport and Parliament House correlate well, while rainfall is generally higher at the Torrens (Drake Street) gauge, which is located 5 km to the west of the project area at a higher elevation (653 m AHD) to the Canberra Airport and Parliament House gauges (578 and 585 m AHD respectively). As elevations within the project area range from 680 to 730 m AHD, the Torrens (Drake Street) gauge record is considered to be the most representative of site conditions. Figure 4.1 plots the average and 10<sup>th</sup> and 90<sup>th</sup> Percentile monthly rainfall totals recorded at this gauge. The figure clearly demonstrates the high variability in monthly rainfall across all seasons.

## Monthly Rainfall Statistics: Torrens (Drake St) - 70308

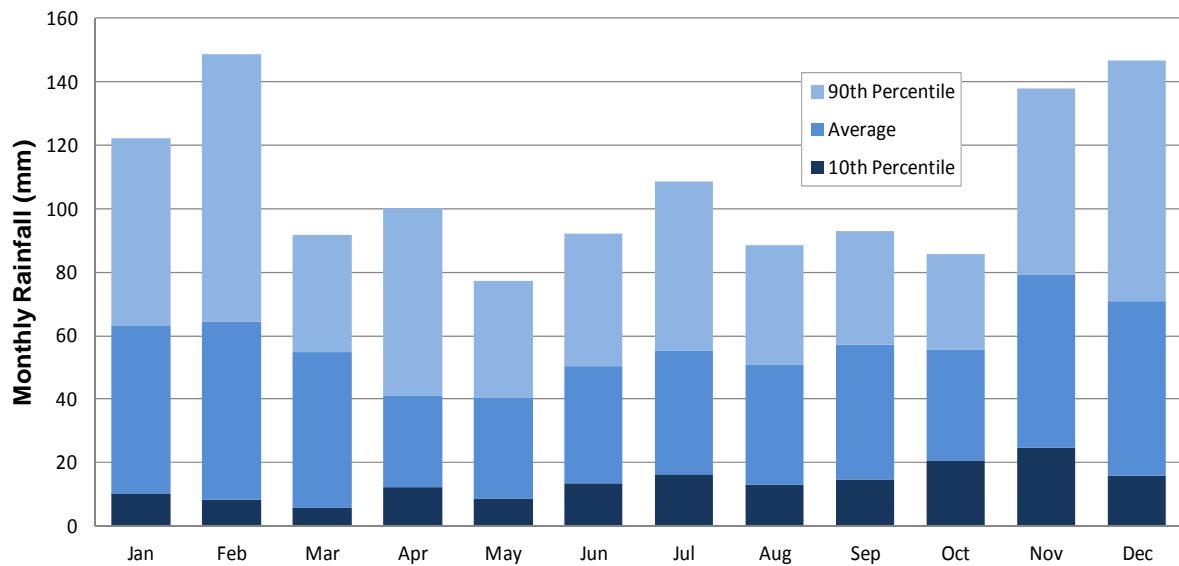


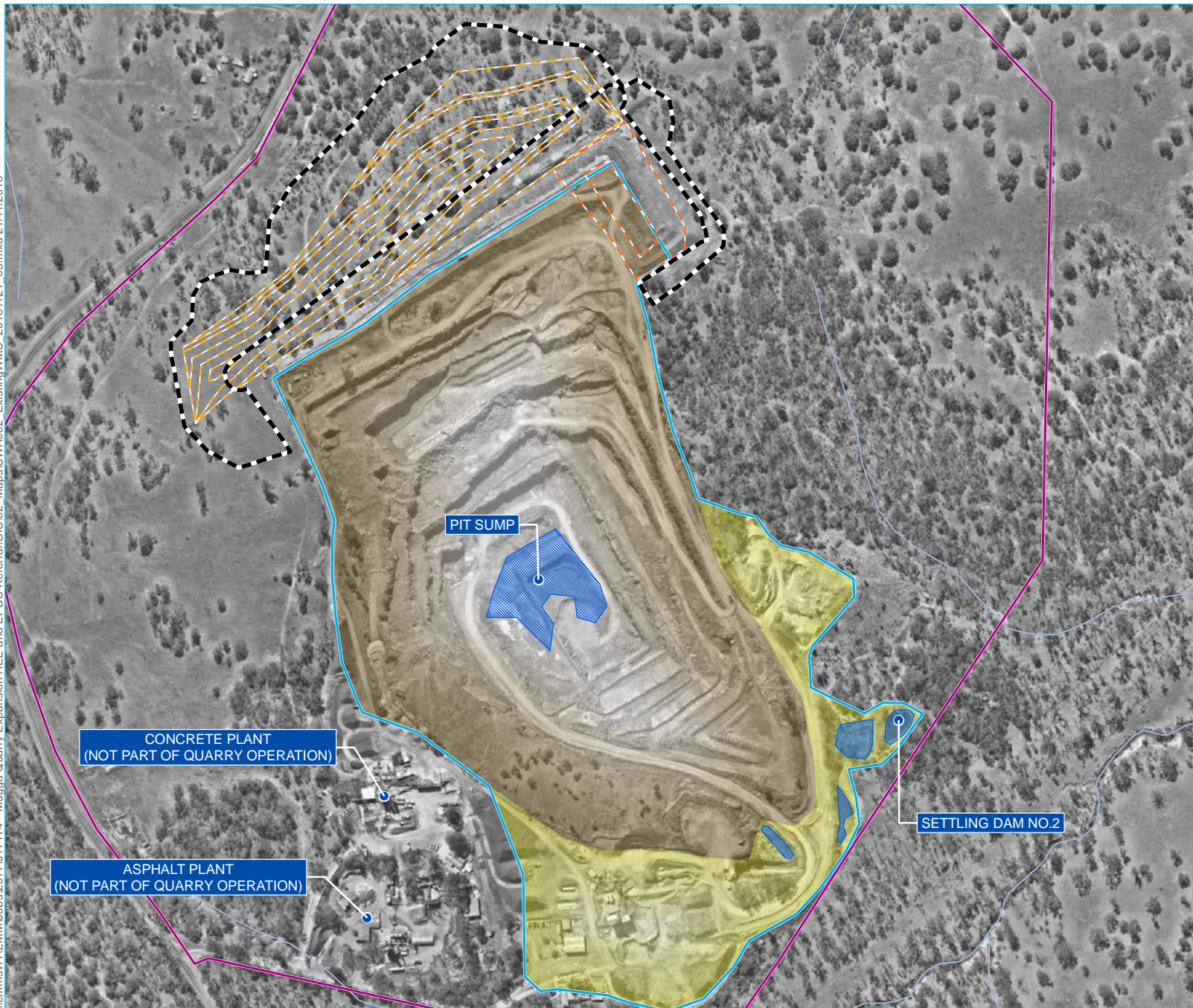
Figure 4.1 Rainfall data

### 4.2 Existing water management system

The quarry's existing water management system manages runoff from the pit, material handling and processing areas and haul roads. The total water management area is approximately 32 ha. Approximately 25 ha of the water management area encompasses the catchment to the pit. Water captured in the pit sump is used for dust suppression and material processing and is not discharged from the site. The remaining 7 ha of the water management area comprises haul roads and material handling and processing areas that are located to the south and east of the pit. This area drains to a series of water management dams. Overflows from this system will occur from Settling Dam No. 2, which is an approved discharge location (as discussed in Section 3.2.1).

Figure 4.2 shows the water management area, water management dams and approximate catchment areas to the pit and Settling Dam No. 2. The proposed emplacement area is also shown for context.

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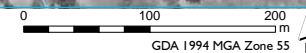
- Site location - 321 Mugga Lane, Symonston
- Total disturbance area
- Emplacement contours (Boral)
- Proposed eastern emplacement contours (EMM)
- Existing water management features
- Watercourse/drainage line
- Existing water management area
- Existing water management dams
- Catchment to the pit
- Catchment to sediment dam no. 2

Existing water management system

Boral Mugga Quarry overburden expansion  
Surface Water Assessment  
Figure 4.2



Source: EMM (2018); Boral (2018); NearMap (2018); actmap (2016); LPI (2015); LPMA (2011)



### 4.3 Local topography and waterways

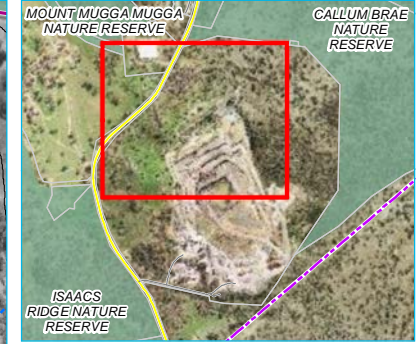
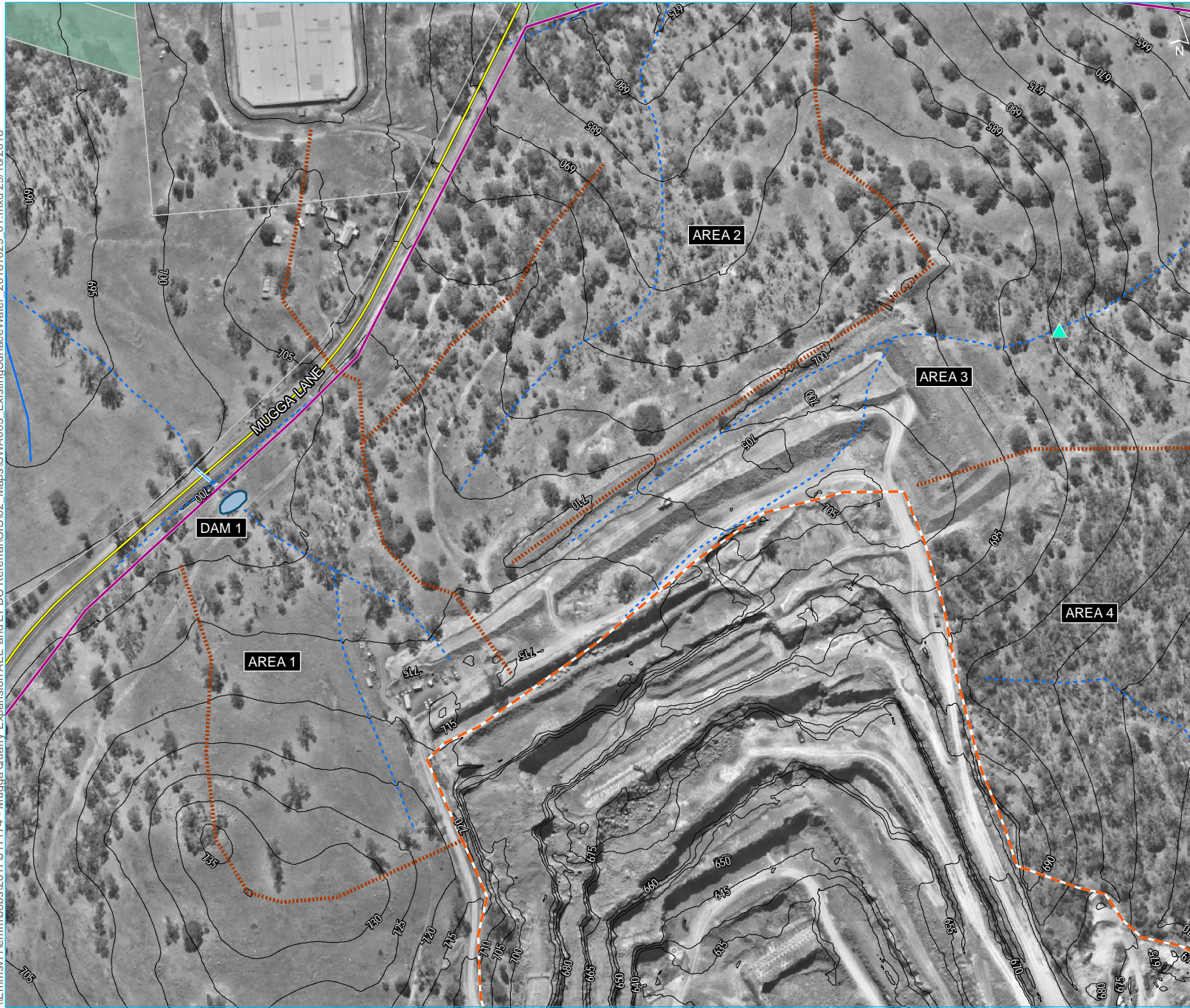
The project area is located to the north of the approved quarry pit extent. The area is characterised by moderately steep to steep terrain that drains through several discrete ephemeral drainage lines into four separate waterways. All drainage lines within the project area are ephemeral, with surface flows only occurring for short periods of time during and shortly after material rainfall. Elevations within the project area range from approximately 680 to 730 m AHD.

The existing waterways, dam locations and catchment divides (or ridge lines) relative to the proposed emplacement area and existing and proposed pit extents are shown in Figure 4.3. It is noted that the term waterway refers to waterways shown on a 1:25,000 scale topographic map. It is noted that there are no waterways shown on a 1:25,000 scale topographic map within the project area. Drainage features that are not shown as waterways on a 1:25,000 scale topographic map are referred to as drainage lines in this surface water assessment.

Waterways and drainage lines within the project area were inspected by a Water Resource Engineer on 4 December 2017. The inspection was undertaken shortly after significant rainfall, with 62 mm of rainfall recorded at the Bureau of Meteorology's (BoM) rainfall gauge at Torrens (Drake Street) (BoM gauge 70308) over 2 and 3 December 2017. The inspection observed drainage lines to be generally dry, despite the significant rainfall.

The characteristics of each of the four catchment areas are discussed further in the following sections.

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- KEY**
- ▲ Ephemeral spring (indicative location)
  - Electricity transmission line
  - Main road
  - Culvert
  - - - Minor drainage line
  - Watercourse (on a 1 to 25:00 topographic map)
  - Ridge line
  - Contour (5m)
  - Site location - 321 Mugga Lane, Symonston
  - Extent of the quarry's existing water management area
  - Existing dam
  - Block boundary
  - ACT reserve

Existing surface water environment

Boral Mugga Quarry overburden expansion  
Surface Water Assessment  
Figure 4.3



Source: EMM (2018); NearMap (2018); actmap (2016); LPI (2015)

#### 4.3.1 Area 1

Area 1 is located to the north-west of the existing pit and drains to the north via several natural and excavated drainage lines. The area drains into a small farm dam that is located on the southern side of Mugga Lane. Overflow from the dam passes under Mugga Lane through a culvert structure before continuing to flow to the north towards the O'Malley residential area. Runoff ultimately enters Yarralumla Creek, 5 km downstream of the project area.

Photograph 4.1 shows an excavated drainage line in Area 1.



**Photograph 4.1** An excavated drainage line in Area 1

#### 4.3.2 Area 2

Area 2 is located to the north of a berm that has been constructed adjacent to the final pit extent (as indicated in Figure 4.3). Runoff from this area drains into an ephemeral drainage line that is characterised by a well-defined gully that drains to the east through the Callumbrea Nature Reserve before joining Jerrabomberra Creek, 3.5 km downstream of the project area. Moderate gully and bank erosion was observed in some sections of this drainage line. Photograph 4.2 shows a typical section of the incised ephemeral drainage line that is in Area 2.



**Photograph 4.2** A typical section of the incised ephemeral drainage line that is in Area 2

#### 4.3.3 Area 3

Area 3 drains to the west and receives runoff from the area immediately to the north and north-east of the existing quarry pit. As indicated in Figure 4.3, the majority of this catchment is within the approved pit extent and will be removed as the quarry progresses. Runoff from Area 3 drains to the east via a discreet drainage line through the Callumbrea Nature Reserve before joining Jerrabomberra Creek, 3.5 km downstream of the project area. A small spring was located on this drainage line, immediately to the east of the proposed eastern emplacement area (refer to Figure 4.3 for the spring location). The spring was interpreted to be associated with the change in slope and significant rainfall that occurred prior to the inspection. The spring waters returned to subsurface flows shortly downstream of the spring location.



**Photograph 4.3** Shows the terrain in Area 3 to the east of the existing pit. Surface drainage is via subtle ephemeral drainage lines

#### 4.3.4 Area 4

Area 4 is located to the east of the existing pit. Runoff from Area 4 drains to the south in a steep ephemeral drainage line that flows through the Callumbrea Nature Reserve before joining Jerrabomberra Creek, 3.5 km downstream of the project area. Minimal disturbance is proposed in Area 4.

### 4.4 Water quality

#### 4.4.1 Sampling program

Water quality samples were collected from the following locations on 4 December 2017:

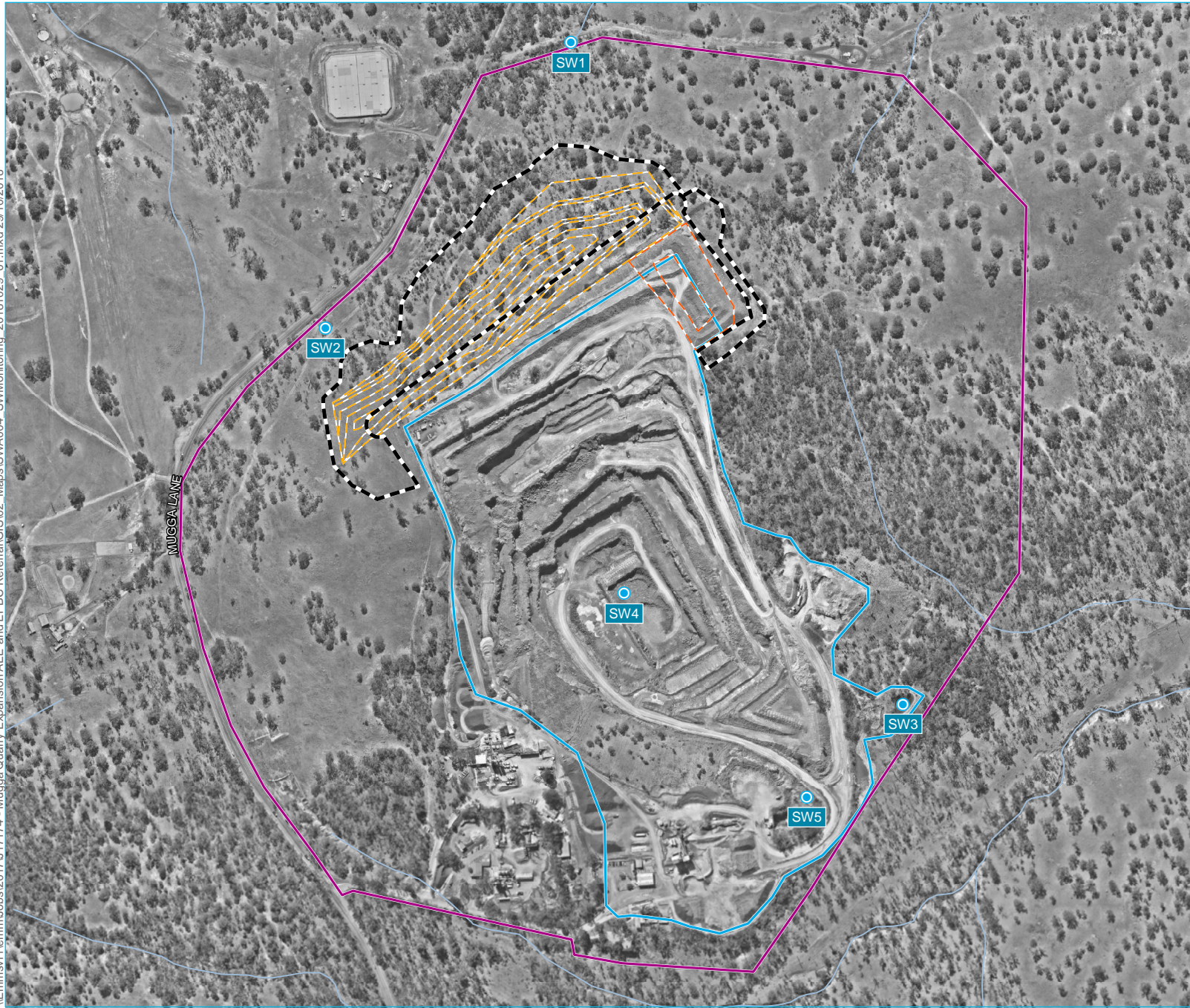
- SW 1 – downstream of the northern emplacement area (Area 1);
- SW 2 – downstream of the northern emplacement area (Area 2);
- SW 3 – Settling Dam No.2;
- SW 4 – Pit Sump; and
- SW 5 – Turkeys Nest Dam.

Figure 4.4 shows the sampling locations. It is noted that SW 3, 4 and 5 are located within the quarry's existing water management system. These results are relevant to this assessment as the proposed emplacement will comprise weathered rock excavated from the quarry. Hence, seepage from the emplacement areas may have similar water quality characteristics to water in the quarry pit sump.

The samples were collected during wet weather conditions, with approximately 60 mm of rainfall likely to have fallen 48 hours prior to sampling.

Samples were analysed for a range of physio-chemical parameters, nutrients and metals. Table 4.2 provides a summary of the analysis suite and results. Results are compared to the default trigger values provided in ANZECC/ARMCANZ (2000) guidelines for fresh water ecosystems. The default trigger values provide numerical values for physical and chemical stressors (such as pH, turbidity and nutrients) and pollutants (such as dissolved metals). The default trigger levels can be used to identify water quality risks that present a non-trivial harm to the receiving environment. However, it is noted that the values are conservative as they are based on chronic (ie long term) exposure and do not consider site specific circumstances, such as soil geochemistry. Results are discussed in Section 4.4.2.

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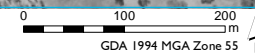
- KEY**
- Surface water sample locations
  - Watercourse/drainage line
  - Emplacement contours (Boral)
  - Proposed eastern emplacement contours (EMM)
  - Site location - 321 Mugga Lane, Symonston
  - ▬ Total disturbance area
  - ▭ Existing water management area

Surface water monitoring locations

Boral Mugga Quarry overburden expansion  
Surface Water Assessment  
Figure 4.4



Source: EMM (2018); Boral (2018); NearMap (2018); actmap (2016); LPI (2015); LPMA (2011)



**Table 4.2 Water quality results**

	Unit	Trigger value	SW 1	SW 2	SW 3	SW 4	SW 5
Location			Downstream of the northern emplacement (Area 1)	Downstream of the northern emplacement (Area 2)	Settling Dam No. 2	Pit Sump	Turkeys Nest Dam
<b>Field Parameters</b>							
pH		6.5 – 8.0 <sup>1</sup>	<b>6.2</b>	6.7	7.9	7.9	7.9
Turbidity	NTU	2 – 25 <sup>1</sup>	<b>148</b>	<b>76</b>	5	6	<b>430</b>
<b>Analytical Results - General</b>							
Suspended Solids (SS)	mg/l	-	24	31	8	5	120
Total Hardness (as CaCO <sub>3</sub> )	mg/l	-	28	26	224	244	82
<b>Analytical Results - Nutrients</b>							
Total ammonia-N	mg/l	0.013 <sup>1</sup>	<b>&lt;0.1</b>	<b>&lt;0.1</b>	<b>&lt;0.1</b>	<b>0.8</b>	<b>&lt;0.1</b>
Oxidised Nitrogen (NOx)	mg/l	0.015 <sup>1</sup>	<b>&lt;0.05</b>	<b>1.02</b>	<b>2.29</b>	<b>13.2</b>	<b>2.99</b>
Total Kjeldahl Nitrogen (TKN)	mg/l	-	1.29	1.68	0.55	1.30	0.45
Total Nitrogen (TN)	mg/l	0.25 <sup>1</sup>	<b>1.29</b>	<b>2.70</b>	<b>2.84</b>	<b>14.5</b>	<b>3.44</b>
Reactive Phosphorus (FRP)	mg/l	0.015 <sup>1</sup>	<b>0.02</b>	<b>0.06</b>	<b>0.02</b>	<b>0.02</b>	<b>0.02</b>
Total Phosphorus (TP)	mg/l	0.020 <sup>1</sup>	<b>0.11</b>	<b>0.20</b>	0.02	<0.01	<b>0.13</b>
<b>Metals (Dissolved)<sup>2</sup></b>							
Aluminium (Al)	mg/l	0.055	<b>1.11</b>	<b>1.39</b>	0.03	0.03	0.05
Arsenic (As)	mg/l	0.013 <sup>3</sup>	0.001	0.001	0.001	0.004	0.001
Boron (B)	mg/l	0.370	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium (Cd)	mg/l	0.0002	0.0001	<0.00005	<0.00005	<b>0.0016</b>	<0.00005
Total Chromium (Cr)	mg/l	0.001 <sup>4</sup>	<0.001	<0.001	<0.001	<b>0.002</b>	<b>0.002</b>
Copper (Cu)	mg/l	0.0014	<b>0.005</b>	<b>0.005</b>	0.001	<b>0.010</b>	<b>0.004</b>
Nickel (Ni)	mg/l	0.011	0.002	0.002	0.005	0.008	0.002
Lead (Pb)	mg/l	0.0034	<b>0.023</b>	0.002	<0.2	<0.2	0.003
Selenium (Se)	mg/l	0.005	<0.001	0.001	<0.001	0.001	<0.001
Silver (Ag)	mg/l	0.0005	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (V)	mg/l	0.006	0.002	0.002	0.001	0.001	<0.001

**Table 4.2**      **Water quality results**

	<b>Unit</b>	<b>Trigger value</b>	<b>SW 1</b>	<b>SW 2</b>	<b>SW 3</b>	<b>SW 4</b>	<b>SW 5</b>
Zinc (Zn)	mg/l	0.008	<b>0.043</b>	<b>0.063</b>	<b>0.030</b>	<b>0.048</b>	<0.005
Mercury (Hg)	mg/l	0.00006	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Iron (Fe)	mg/l	-	0.62	0.60	0.01	0.06	0.02

Notes: 1. The trigger values for field parameters and nutrients refer to the trigger values for physical and chemical stressors in south-east Australia (upland river) that are reported in Tables 3.3.2 and 3.3.3 of ANZECC/ARMCANZ (2000).  
 2. Trigger values for the protection of 95% of species (freshwater) that are reported in Table 3.4.1 of ANZECC/ARMCANZ (2000). It is noted that no hardness adjustments have been made.  
 3. For As (V).  
 4. For Cr (VI).

**Bold** denotes trigger value is exceeded.

#### 4.4.2 Results discussion

Sample locations SW 1 and SW 2 are located downstream of the proposed new permanent overburden bund. The contributing catchment areas to these sampling locations were relatively undisturbed by the quarry operation at the time of sampling (see aerial image in Figure 4.3).

Water quality results at SW 1 and SW 2 were similar, with elevated concentrations / levels (relative to default trigger values) of turbidity, nitrogen, phosphorus, aluminium, copper and zinc recorded at both locations. Lead was elevated at SW 1 only. These water quality characteristics are interpreted to be associated with the local soil geochemistry and are therefore likely to be persistent in any water quality sampling that is undertaken during the construction, rehabilitation and post rehabilitation of the emplacement areas.

The water quality characteristics of water in the quarry sump (SW 4) is relevant to this assessment as the overburden may comprise some weathered rock excavated from the quarry. Hence, runoff or seepage from the emplacement areas may have similar water quality characteristics to water in the quarry pit sump. Surface water in the pit sump is characterised as having elevated nitrogen (primarily in the oxidised form), cadmium, chromium, copper and zinc. These elevated concentrations are interpreted to be associated with the weathering of quarry rock that may have naturally occurring concentrations of these analytes. The pH is within the typical range indicating that there is minimal risk of acid rock drainage issues.

The water management system for the proposed emplacement areas is not expected to interact with the water management dams that are in the southern portion of the quarry. Hence, results from SW 3 and SW 5 are provided for general context only.

Section 6.1 describes a proposed water quality monitoring plan which includes a water quality review process. The water quality review process will consider the pre-disturbance water quality characteristics presented in Table 4.2 to assess potential water quality impacts associated with the project.

#### 4.5 Hydrogeology

Based on the geology of the area groundwater is likely to be present in discontinuities (i.e. fissures, fault, fractures and bedding planes) in the underlying strata. As discussed in Section 4.3, the topography within the project area generally slopes to the north, north-east and east with elevations ranging from 680 to 730 m AHD.

Monitoring wells surrounding the project area and within the broader site have recorded groundwater at elevations of 647 to 667 m AHD (noting fractured rock aquifer water levels). These wells have data loggers continuously recording groundwater levels. Groundwater quality sampling has also been undertaken. Given the minimum site elevation of 680 m AHD in the south eastern corner, groundwater is interpreted to be at least 14 m beneath the site and is unlikely to be encountered during construction or operation of the project.

## 5 Water management system

### 5.1 Identified risks

Identified water management risks include:

- discharge of sediment laden water from the disturbance area during construction and early stages of rehabilitation; and
- discharge of seepage from the emplacement areas that may contain elevated concentrations of nitrate cadmium, chromium, copper and zinc (see discussion in Section 4.4.2).

### 5.2 Water management approach

It is proposed to manage water quality risks by capturing runoff and seepage from the emplacement areas in sedimentation dams. The dams will be dewatered following rainfall events but will overflow to receiving waters when full.

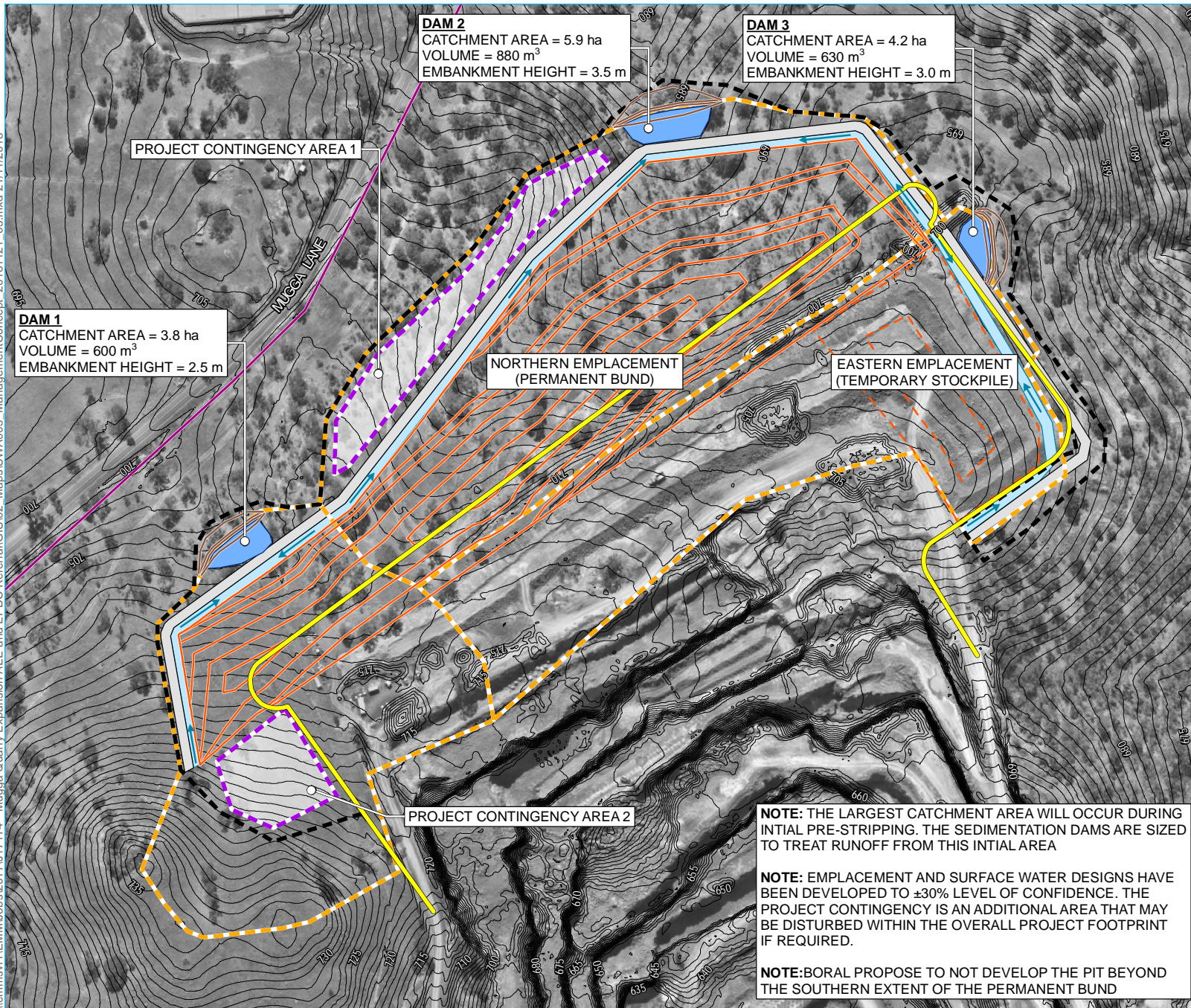
Water quality monitoring will be undertaken from each sedimentation dam and downstream receiving water locations (SW 1 and SW 2 as shown on Figure 4.4). The monitoring will identify water quality impacts associated with sedimentation dam overflows. If water quality impacts are identified, the following contingency measures can be implemented:

- water treatment chemicals (such as gypsum, coagulants or low toxicity flocculants) can be applied to the sedimentation dams to improve treatment of turbidity, suspended sediment, phosphorus and some metals; and/or
- water from the basins can be dewatered to the quarry pit sump (via pumping) to minimise discharge. As discussed in Section 4.2, water in the quarry pit sump is used for haul road dust suppression and is not discharged from the site.

### 5.3 Proposed measures

This section describes the proposed water management measures and should be read in conjunction with Figure 5.1, which shows the location of the proposed major drainage, sedimentation dams and their associated catchment areas.

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**DAM 1**  
CATCHMENT AREA = 3.8 ha  
VOLUME = 600 m<sup>3</sup>  
EMBANKMENT HEIGHT = 2.5 m

**DAM 2**  
CATCHMENT AREA = 5.9 ha  
VOLUME = 880 m<sup>3</sup>  
EMBANKMENT HEIGHT = 3.5 m

**DAM 3**  
CATCHMENT AREA = 4.2 ha  
VOLUME = 630 m<sup>3</sup>  
EMBANKMENT HEIGHT = 3.0 m

PROJECT CONTINGENCY AREA 1

NORTHERN EMPLACEMENT  
(PERMANENT BUND)

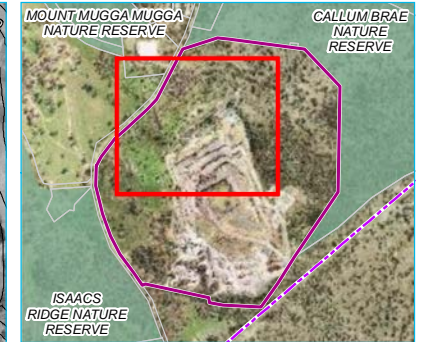
EASTERN EMPLACEMENT  
(TEMPORARY STOCKPILE)

PROJECT CONTINGENCY AREA 2

**NOTE:** THE LARGEST CATCHMENT AREA WILL OCCUR DURING INITIAL PRE-STRIPPING. THE SEDIMENTATION DAMS ARE SIZED TO TREAT RUNOFF FROM THIS INITIAL AREA

**NOTE:** EMPLACEMENT AND SURFACE WATER DESIGNS HAVE BEEN DEVELOPED TO ±30% LEVEL OF CONFIDENCE. THE PROJECT CONTINGENCY IS AN ADDITIONAL AREA THAT MAY BE DISTURBED WITHIN THE OVERALL PROJECT FOOTPRINT IF REQUIRED.

**NOTE:** BORAL PROPOSE TO NOT DEVELOP THE PIT BEYOND THE SOUTHERN EXTENT OF THE PERMANENT BUND



- KEY**
- Site location - 321 Mugga Lane, Symonston
  - Total disturbance area
  - Approved pit extent
  - Emplacement contours (Boral)
  - Proposed eastern emplacement contours (EMM)
  - Dam embankment
  - Sedimentation dam
  - Perimeter road (including batters)
  - Toe drain (including batters)
  - Project contingency area
  - Sedimentation dam catchment area
  - Contour (LiDAR - 1m)

Water management concept

Boral Mugga Quarry overburden expansion  
Surface Water Assessment  
Figure 5.1



Source: EMM (2018); Boral (2018); NearMap (2018); actmap (2016); LPI (2015)

0 50 100  
m  
GDA 1994 MGA Zone 55

### 5.3.1 Drainage

Surface drains will be established to manage runoff from the emplacement areas. The drains will be designed and constructed in accordance with the methods recommended in *Environment Protection Guidelines for Construction and Land Development in ACT* (EPA, 2011) and *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). Rock armouring will be used to manage scour and erosion risks where required.

Figure 5.1 shows the proposed alignment of major drainage.

A preliminary civil design of drainage infrastructure is provided in Appendix A.

### 5.3.2 Sedimentation Dams

Runoff from the emplacement areas will be captured in one of three sedimentation dams that will be designed in accordance with the methods recommended in *Environment Protection Guidelines for Construction and Land Development in ACT* (EPA, 2011), which require a minimum dam volume of 150 m<sup>3</sup> of storage per hectare of contributing catchment area. Figure 5.1 shows the proposed location, contributing catchment area and estimated footprint of each dam. Table 5.1 provides a summary of the catchment area, dam volume and estimated embankment height.

It is noted that the sedimentation dam sizes have accounted for the contingency areas and the initial (pre-disturbance) catchment areas, which will reduce in size as the emplacement areas are established as a portion of each emplacement area will drain back towards the pit. Hence, the dam sizing is conservative.

A preliminary civil design of the sedimentation dams is provided in Appendix A.

**Table 5.1 Sedimentation dam: key metrics**

	<b>Dam 1</b>	<b>Dam 2</b>	<b>Dam 3</b>
Catchment area <sup>1</sup>	3.8 ha	5.9 ha	4.2 ha
Treatment volume	600 m <sup>3</sup>	880 m <sup>3</sup>	630 m <sup>3</sup>
Embankment height	2.5 m	3.5 m	3.0 m

Notes: 1. Includes contingency areas

Following rainfall events all dams will be dewatered to 20% capacity to provide capacity to capture and treat future runoff. The dams will be dewatered via pumping into water cart trucks that will then apply water to haul roads for dust suppression.

The dams will occasionally overflow when full. The dams will be sized to capture 150 m<sup>3</sup> of runoff per ha of catchment area. This is equivalent to 15 mm of runoff from the catchment area. Accounting for soil infiltration losses, approximately 30 to 50 mm of rainfall is expected to be required to produce 15mm of runoff. Hence, overflows may occur when more than 30 mm of rainfall occurs. As noted in Table 4.1, 25mm or more of rain will occur 4.5 days /per year (on average). Hence, overflows are expected to occur between 2 to 4 times per year (on average). The range is dependent on rainfall infiltration losses into the soil.

### 5.3.3 Contingency measures

Boral will implement a surface water monitoring program (described in section 6). If monitoring identifies that the proposed measures are not providing effective treatment, the following additional measures can be implemented:

- water treatment chemicals (such as gypsum, coagulants or low toxicity flocculants) can be applied to the sedimentation dams to improve the treatment of turbidity, suspended sediment, phosphorus and some metals; and/or
- water from the sedimentation basins can be dewatered to the quarry pit sump (via pumping) to minimise discharge frequency and volume. As discussed in Section 4.2, water in the quarry pit sump is used for haul road dust suppression and is not discharged from the site.

## 6 Monitoring, inspection and maintenance plans

### 6.1 Monitoring plan

#### 6.1.1 Overview

This section describes a surface water monitoring program that will be implemented by Boral. The objective of this program is to collect data to:

- enable the effectiveness of water quality controls to be assessed;
- identify and quantify water quality impacts to receiving waters; and
- enable compliance with any consent and/or licence conditions to be assessed.

The following sections describe the monitoring locations, monitoring plan and methods.

#### 6.1.2 Locations

Monitoring will be undertaken from the following locations:

- sedimentation Dams 1, 2 and 3 (as indicated in Figure 5.1); and
- receiving water locations SW 1 and SW 2 (as indicated in Figure 4.4).

#### 6.1.3 Methods

The monitoring program will comprise biannual monitoring of a range of analytes during or shortly after dam overflows occur. Table 6.1 details the proposed comprehensive analytes and monitoring methods. Boral will keep a record of all monitoring results.

**Table 6.1 Monitoring analytes**

Category	Proposed sampling analytes	Analysis method
Physio-chemical Properties	pH, electrical conductivity (EC) and turbidity.	Analysis to be undertaken by a NATA certified laboratory or measured in-situ using a water quality meter
	total suspended solids, total dissolved solids, total hardness and oil and grease	Analysis to be undertaken by a NATA certified laboratory
Nutrients	total nitrogen, ammonia, nitrate, nitrite, total Kjeldahl nitrogen, total phosphorus and reactive phosphorous	Analysis to be undertaken by a NATA certified laboratory
Metals (dissolved fraction)	Al, As, B, Cd, Cr, Cu, Ni, Pb, Se, Ag, V and Zn	Field filter samples using a 0.45 µm filter. Analysis to be undertaken by a NATA certified laboratory

#### 6.1.4 Duration

Monitoring is to be undertaken on a bi-annual basis during the:

- construction / establishment phase of the project; and
- initial two years following rehabilitation.

Monitoring would only be undertaken during or shortly after the sedimentation dams are overflowing. No monitoring is proposed if no overflows occur in a given review period (discussed in Section 6.1.5).

#### 6.1.5 Water quality review process

The water quality data presented in Section 4.4 characterised the water quality at SW 1 and SW 2 as having elevated concentrations / levels of turbidity, nitrogen, phosphorus, aluminium, copper, lead (SW 1 only) and zinc.

The contributing catchment areas to the sampling locations were relatively undisturbed by the quarry operation at the time of sampling (see Figure 4.3). Hence, the recorded water quality characteristics are interpreted to be associated with the local soil geochemistry and are therefore likely to be persistent in any water quality sampling that is undertaken during the construction, rehabilitation and post rehabilitation phases of the project.

As only a single sample from SW 1 and SW 2 is available, there is insufficient data to reliably establish trigger values that can be practically applied to a trigger value response plan.

The following approach is proposed to review results and identify the need to implement contingency measures:

- water quality results will be reviewed annually;
- results from each of the three sedimentation dams will be compared to:
  - receiving water results. It is noted that the receiving water sampling locations will receive runoff from catchment areas downstream of the sedimentation dams as well as any overflows from the dams. Hence, any water quality impacts will be diluted relative to the concentrations in dam overflows, therefore water quality impacts can be inferred by comparing water quality of overflows to receiving water quality;
  - the pre-development sampling results presented in Section 4.4; and
  - default trigger values provided in the ANZECC / ARMCANZ (2000) guidelines.
- an assessment for the results against the above bench-marks will be made. If this process identifies that overflows from the sedimentation dams are degrading receiving water quality, one or both contingency measures provided in 5.3.3 will be implemented.

## 6.2 Inspection and maintenance program

Table 6.2 provides an inspection and maintenance plan that will be implemented by Boral informally on a frequent basis and formally on a quarterly basis.

**Table 6.2 Inspection and maintenance plan**

<b>Location</b>	<b>Inspect for</b>	<b>Risk to stormwater system</b>	<b>Maintenance actions</b>
Dam Embankment	Slumping, erosion, cracking, animal burrows, seepage at embankment toe	Potential embankment failure	Engage a suitably qualified geotechnical engineer to inspect the embankments and advise on appropriate remedial actions
Dam Embankment	Vegetation growth	Can lead to piping failure of embankments overtime	Remove any trees or shrubs that have seeded on the embankment
Dam spillway	Blockage of spillway, scour of spillway	Uncontrolled overflows from the dam and spillway scour could result in embankment failure	Remove any blockage from spillway Remediate any scour damage and provide rock armouring to prevent further scour
Dam storage	Sediment accumulation and excessive macrophyte growth	Reduce storage volume and treatment effectiveness of the dam	Remove excessive sediment and macrophyte growth to maintain design dam capacity
Dam storage	Dead animal carcasses	Degradation of water quality	Remove carcasses
Drainage	Sediment accumulation, scour / erosion damage and blockages	Uncontrolled overflows from the drainage system and increases in sediment loss rates.	Remove excessive sediment accumulation and other blockages Remediate any scour damage and provide rock armouring to prevent further scour
Drainage	Dead animal carcasses	Degradation of water quality	Remove carcasses



## 7 Residual impacts

### 7.1 Changes to surface flow regimes

Changes to surface flow regimes can occur due to the realignment of existing catchment boundaries and the harvesting of runoff that has been captured in the sedimentation dams. These changes are discussed further below.

#### 7.1.1 Changes to catchment boundaries

The proposed emplacement design seeks to minimise the realignment of catchment boundaries. Hence, no material redistribution of surface flows is expected. However, it is noted that the upper portion of the Area 3 catchment will be removed as the quarry pit progresses to its approved extraction limit.

#### 7.1.2 Changes due to sedimentation basins

The sedimentation basins will be designed and operated in accordance with the guideline titled Environment Protection Guidelines for Construction and Land Development in ACT (EPA, 2011), which recommends the following design and management practices:

- the basins will be sized to capture the initial 150 m<sup>3</sup> of runoff per hectare (ha) of disturbance area. This is equivalent to 15 mm of runoff. Accounting for soil infiltration losses, approximately 30 to 50 mm of rainfall is expected to be required to produce 15 mm of runoff; and
- following rainfall, the basins will be dewatered to 20% capacity to provide capacity to capture the next runoff event.

As the sedimentation basins will capture the initial 15 mm of runoff from each rainfall event it is expected that the frequency of stream flows in the immediate receiving waters will reduce. The magnitude of this change will progressively diminish in downstream sections of waterways as the contributing catchment area increases.

### 7.2 Changes to water quality

The proposed sedimentation dams will be designed, constructed and operated in accordance with the guideline titled Environment Protection Guidelines for Construction and Land Development in ACT (EPA, 2011) and are therefore expected to provide effective sedimentation treatment.

Boral will implement a surface water monitoring program that is described in Section 6. If monitoring identifies that the sedimentation dams are not providing effective treatment during overflow conditions, the contingency measures discussed in Section 5.3.3 will be implemented. Overall, this approach is expected to mitigate water quality impacts to downstream receiving waters.

## 7.3 Other impacts

### 7.3.1 Flood impacts

The project is expected to have a neutral to beneficial impact on flooding in downstream waterways due to the following:

- The northern emplacement will be rehabilitated using a rock / soil mix to create a stable landform. A rock /soil mix comprises a 300 to 500 mm mixture of coarse rock and fine soils established on top of the waste rock. The resulting soil matrix is expected to promote rapid vegetation growth and have permeability and water retention characteristics that are greater than or similar to the existing clay based soils. Hence, during and following intense rainfall, runoff volumes and peak flows from the northern emplacement are expected to be similar to or less than runoff from the existing landform.
- The sedimentation basins will capture initial runoff from the emplacement area, reducing runoff volumes and peak flows in downstream waterways.

Hence, no flood impacts are expected.

### 7.3.2 Groundwater impacts

The project is not expected to impact groundwater as:

- no changes to the pit depth or extent are proposed; and
- groundwater is not expected to be encountered during construction and operation of the project (refer to Section 4.5 for further information on hydrogeology).

### 7.3.3 Impacts to the existing quarry water management system

The project is not expected to impact the functionality of the quarry's existing water management system as:

- the project will not materially increase the contributing catchment area to the existing water management system as overflows from the sedimentation basins will drain to the north, away from the quarry's existing water management system.
- if water is pumped from the sedimentation basins into the quarry pit sump to avoid overflows (proposed as contingency measure), no impacts to the functionality of the existing water management system are expected as:
  - the quarry pit sump is a large volume that will not overflow to receiving waters; and
  - there is a significant opportunity to dewater the sump via application to haul roads for dust suppression purposes.

### 7.3.4 Mosquito breeding

No permeant waterbodies are proposed as the sedimentation dams will be dewatered following rainfall. Hence, no material increase in mosquito breeding habitat is expected.

## 8 Conclusions

### 8.1 Project context

Boral proposes to establish a new permanent bund and temporary emplacement area to store up to 620,000 m<sup>3</sup> of quarried overburden and weathered rock material from its Mugga Quarry operations at 321 Mugga Lane, Symonston. The project is required to enable the ongoing operation of the quarry which supplies gravel and construction materials to the construction market within the ACT and surrounding NSW regional areas. No changes to the existing pit or production rates are proposed.

This surface water assessment forms part of the Draft EIS for the project and includes:

- a description of the quarry's existing water management system and the surface water environment;
- a description of proposed water management controls, including contingency measures;
- a description of proposed monitoring and inspection programs; and
- an assessment of residual impacts.

### 8.2 Identified risks

Identified water management risks include:

- discharge of sediment laden water from the disturbance area during construction and early stages of rehabilitation; and
- discharge of seepage from the emplacement areas that may contain elevated concentrations of nitrate cadmium, chromium, copper and zinc (see discussion in Section 4.4.2).

### 8.3 Water management approach

It is proposed to manage water quality risks by capturing runoff and seepage from the emplacement areas in sedimentation dams. The dams will be dewatered following rainfall events but will overflow to receiving waters when full.

Water quality monitoring will be undertaken from each sedimentation dam and downstream receiving water locations. The monitoring will identify water quality impacts associated with sedimentation dam overflows. If water quality impacts are identified, the following contingency measures can be implemented:

- water treatment chemicals (such as gypsum, coagulants or low toxicity flocculants) can be applied to the sedimentation dams to improve treatment of turbidity, suspended sediment, phosphorus and some metals; and/or
- water from the basins can be dewatered to the quarry pit sump (via pumping) to minimise discharge. Water in the quarry pit sump is used for haul road dust suppression and is not discharged from the site.

## 8.4 Residual impacts

The assessment concludes that:

- the project will not result in flood impacts on adjoining properties.
- the project will not impact the functionality of the quarry's existing water management system.
- the frequency of stream flows in the immediate receiving waters will reduce due to the capture of the initial 15 mm of runoff from each rainfall event in the sedimentation basins. The magnitude of this change will progressively diminish in downstream waterways as the contributing catchment area increases.
- the proposed controls, including monitoring and contingency measures are expected to mitigate water quality impacts to downstream receiving waters.

## 9 References

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000)

*Environment Protection Act 1997*

*Water Resources Act 2007*

*Planning and Development Act 2007*

Environment Protection Guidelines for Construction and Land Development in the Act (Environment Protection Guidelines) (EPA 2011)

Water Quality Environment Protection Policy 2008

ACT Water Strategy 2014-44: Striking the Balance (ACT Water Strategy)

Australian Rainfall and Runoff (Commonwealth of Australia, 2016)

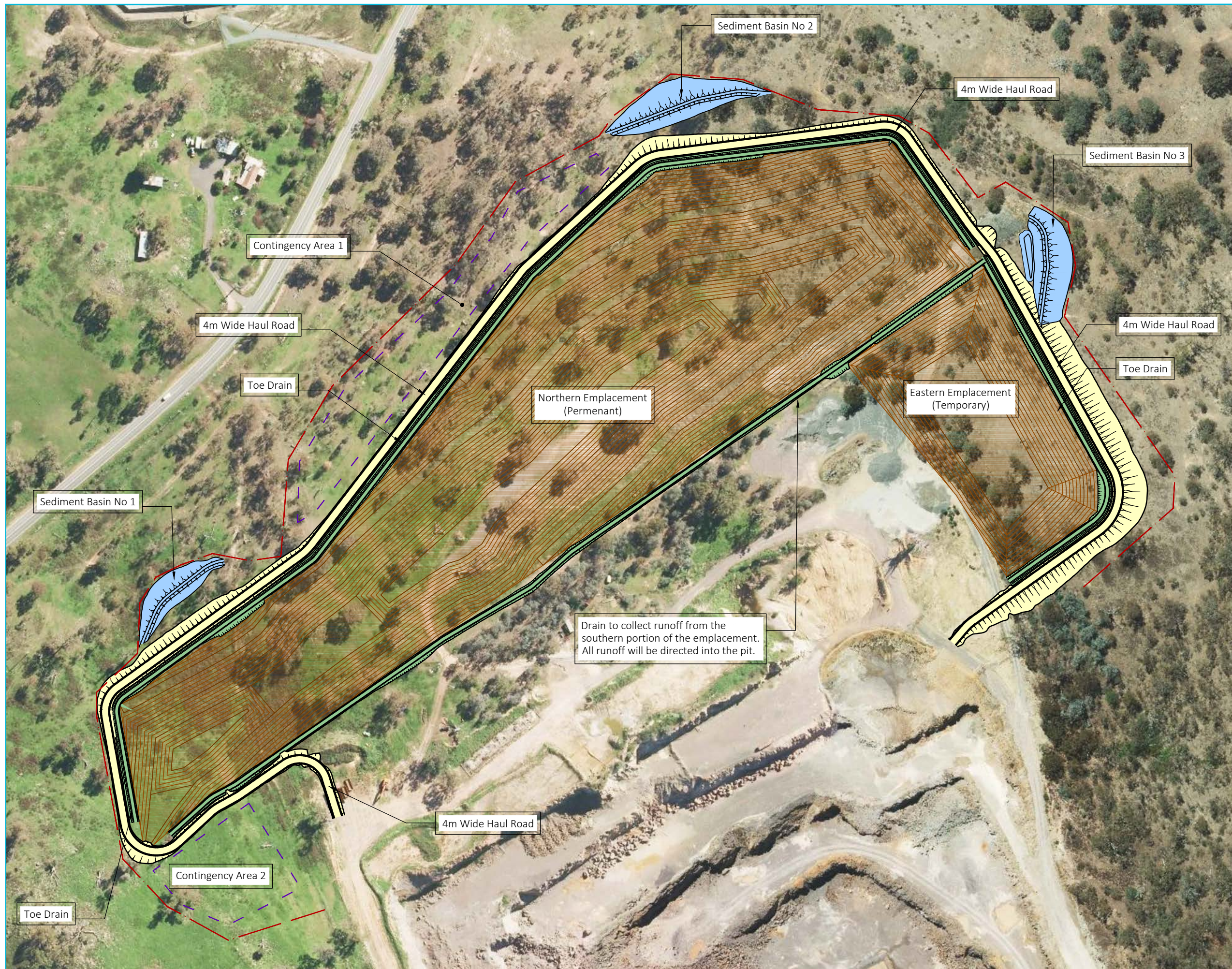


Appendix A

Preliminary design drawings

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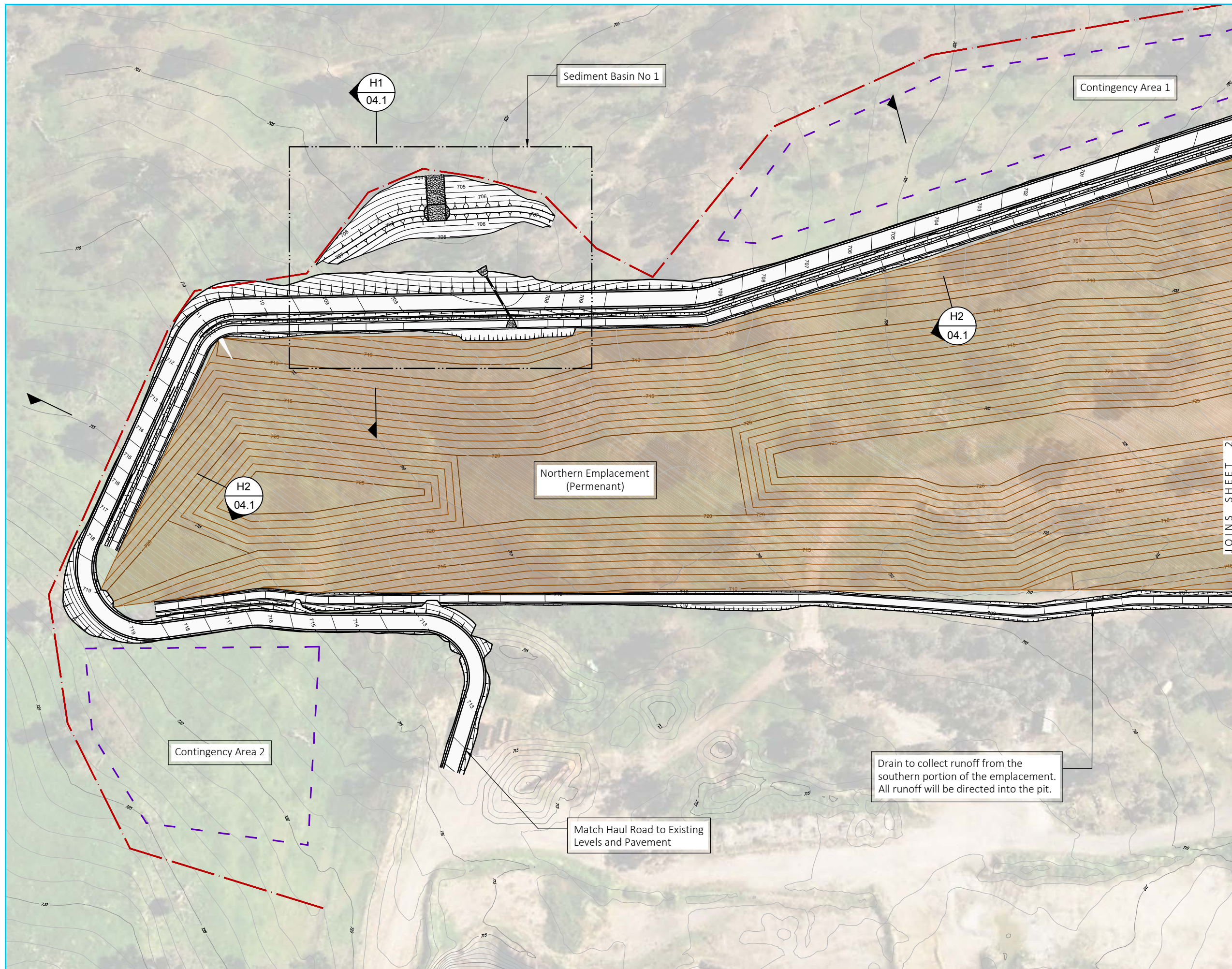
- Legend**
- Project Disturbance Boundary - - -
  - Contingency Area - - -
  - Emplacement Areas
  - Toe Drain
  - Haul Road
  - Sediment Basin

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

Site Plan

Boral Mugga Quarry  
Overburden Expansion  
Figure 01-1





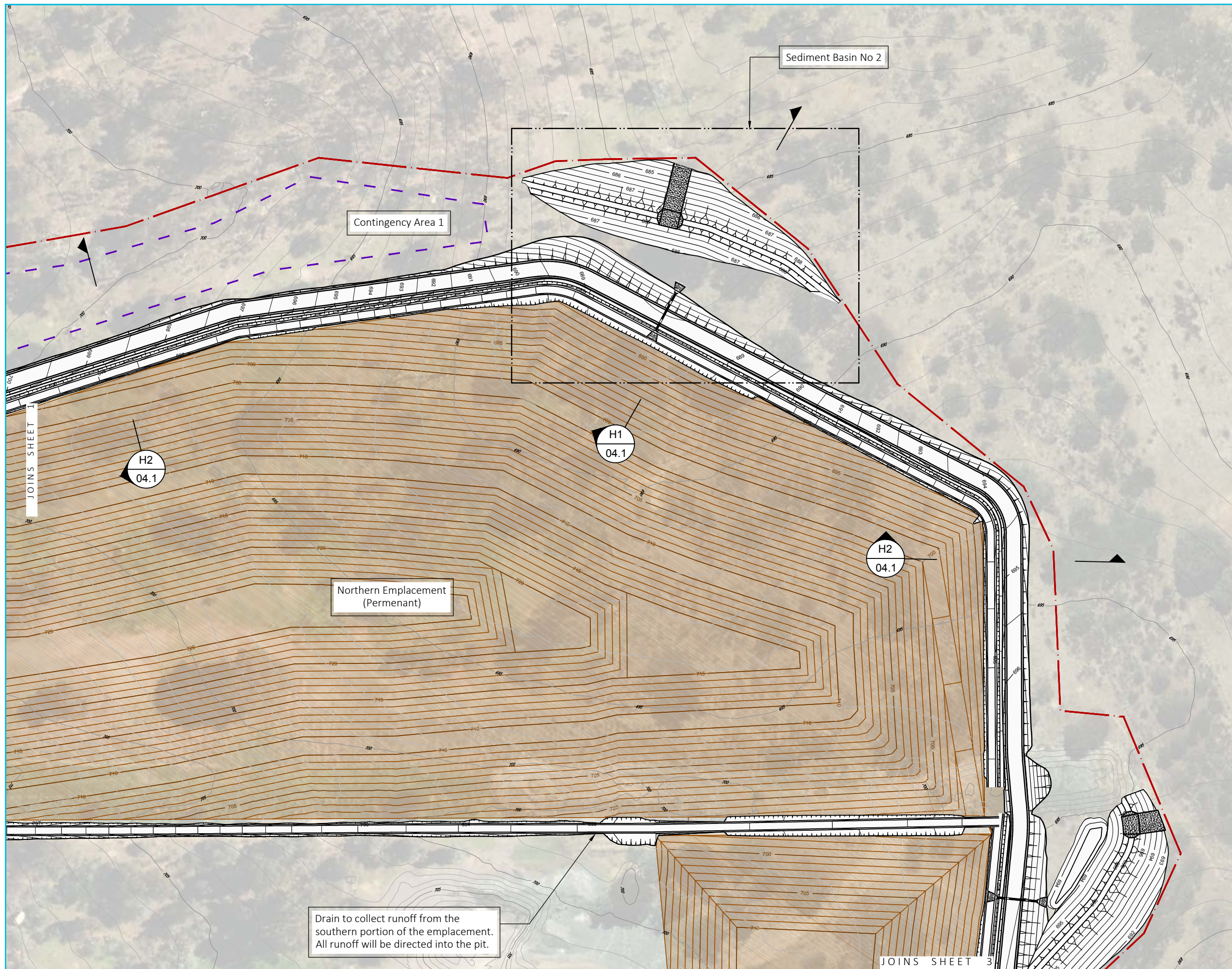
- Legend**
- Project Disturbance Boundary - - -
  - Contingency Area - - -
  - Emplacement Areas

JOINS SHEET 2

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

General Arrangement Plan  
Sheet 1  
Boral Mugga Quarry  
Overburden Expansion  
Figure 02-1



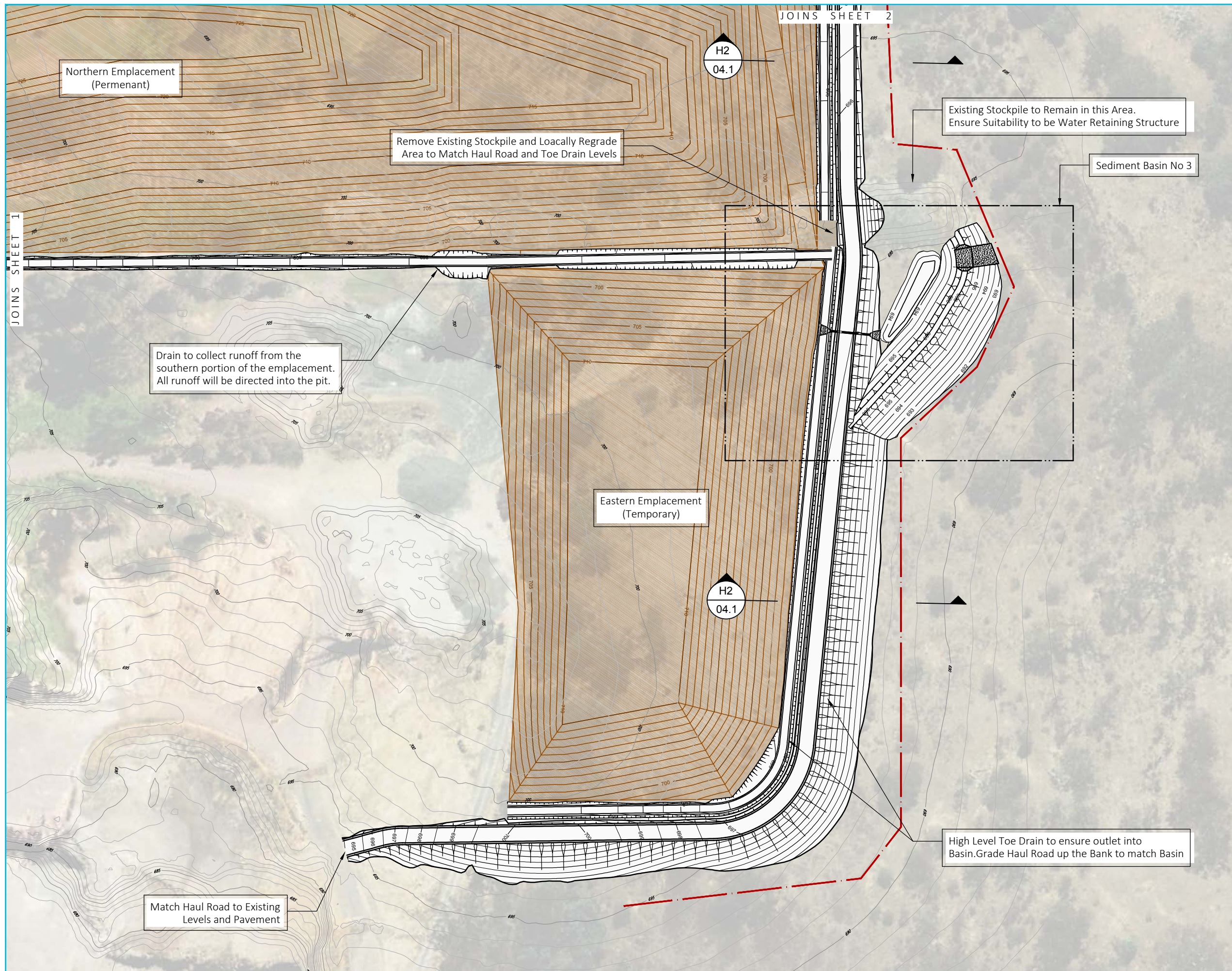


- Legend**
- Project Disturbance Boundary - - -
  - Contingency Area - - -
  - Emplacement Areas

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

General Arrangement Plan  
Sheet 2  
Boral Mugga Quarry  
Overburden Expansion  
Figure 02-2





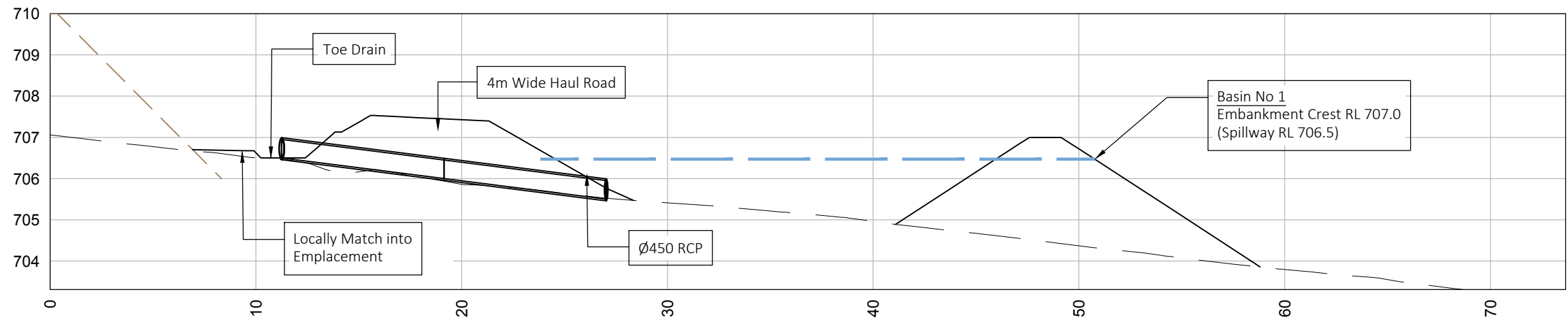
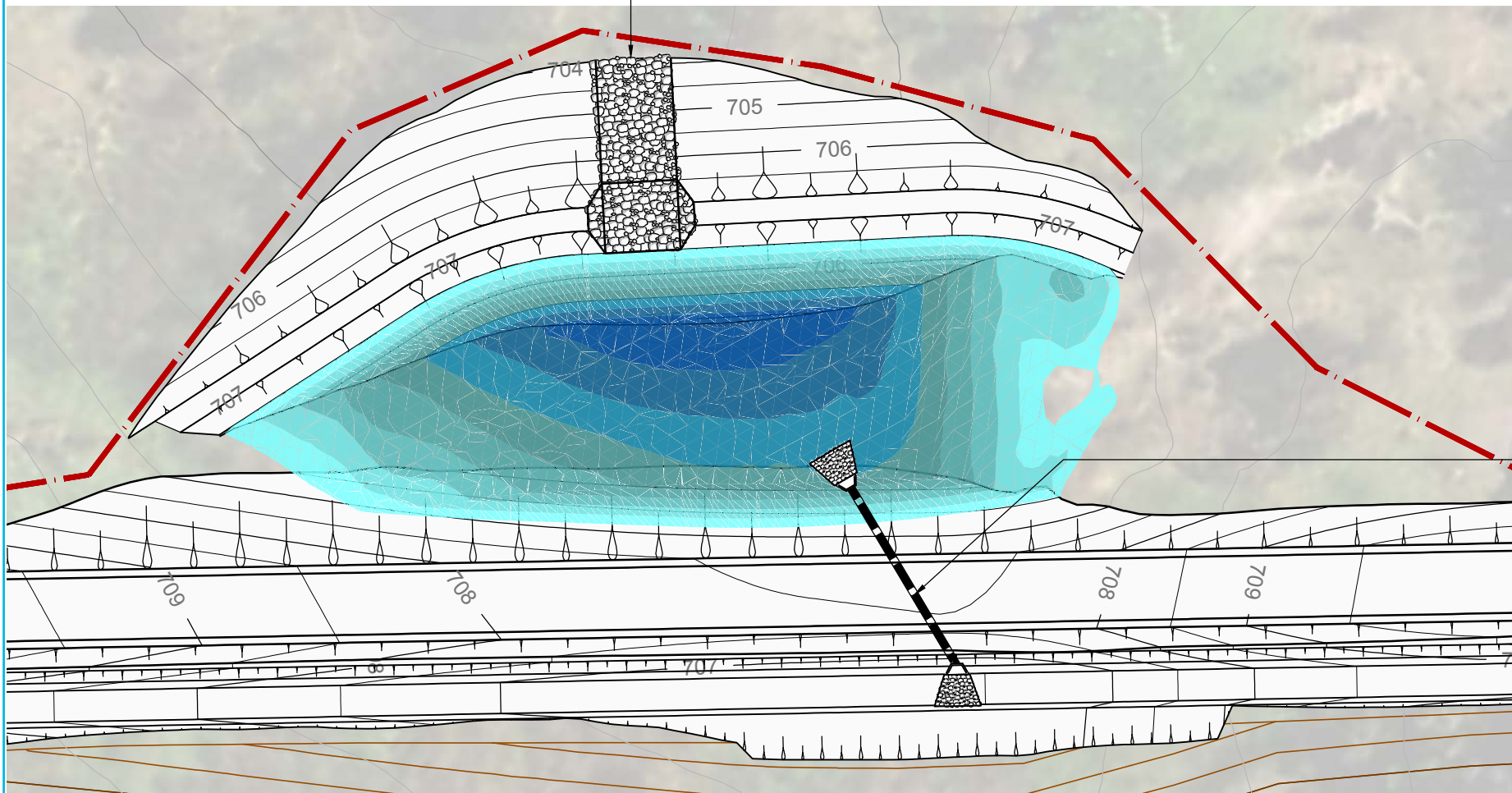
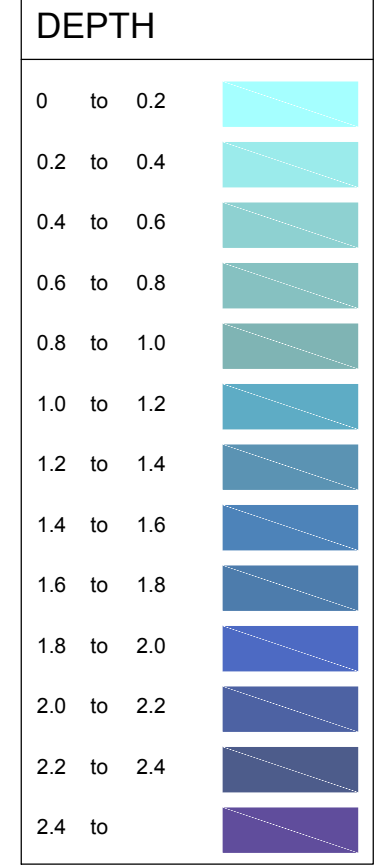
- Legend**
- Project Disturbance Boundary — · —
  - Contingency Area - - -
  - Emplacement Areas

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

General Arrangement Plan  
Sheet 3  
Boral Mugga Quarry  
Overburden Expansion  
Figure 02-3

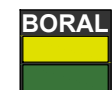


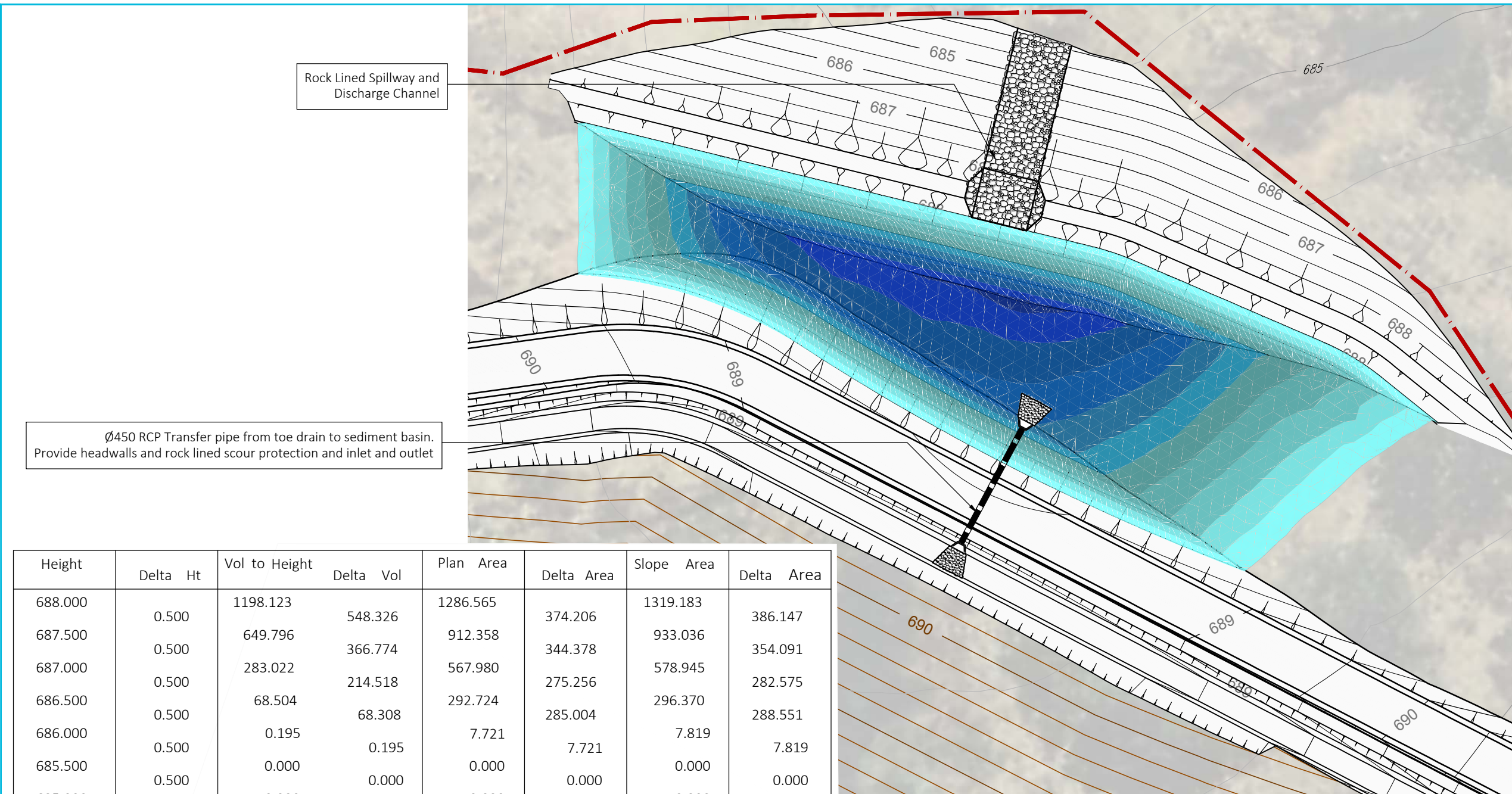
Height	Delta Ht	Vol to Height	Delta Vol	Plan Area	Delta Area	Slope Area	Delta Area
706.500	0.500	624.369	345.619	841.315	295.536	858.551	304.297
706.000	0.500	278.751	210.137	545.778	262.559	554.253	268.182
705.500	0.500	68.614	67.662	283.220	262.778	286.072	265.407
705.000	0.500	0.952	0.952	20.442	20.442	20.664	20.664
704.500	0.000	0.000		0.000		0.000	



PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

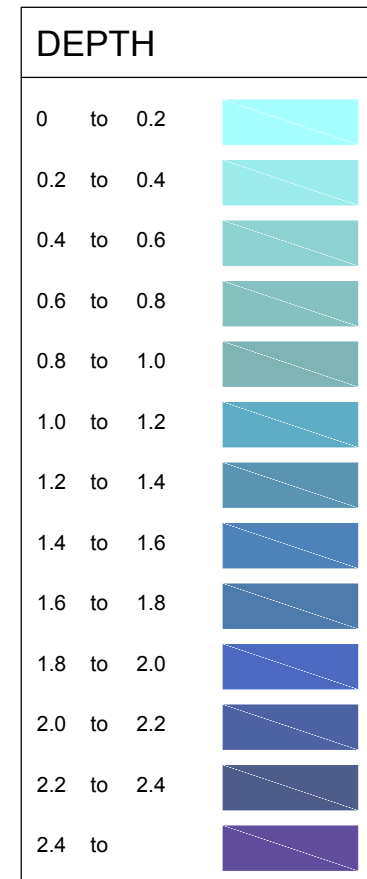
Sediment Basin No 1  
Detail Plan  
Boral Mugga Quarry  
Overburden Expansion  
Figure 03-1



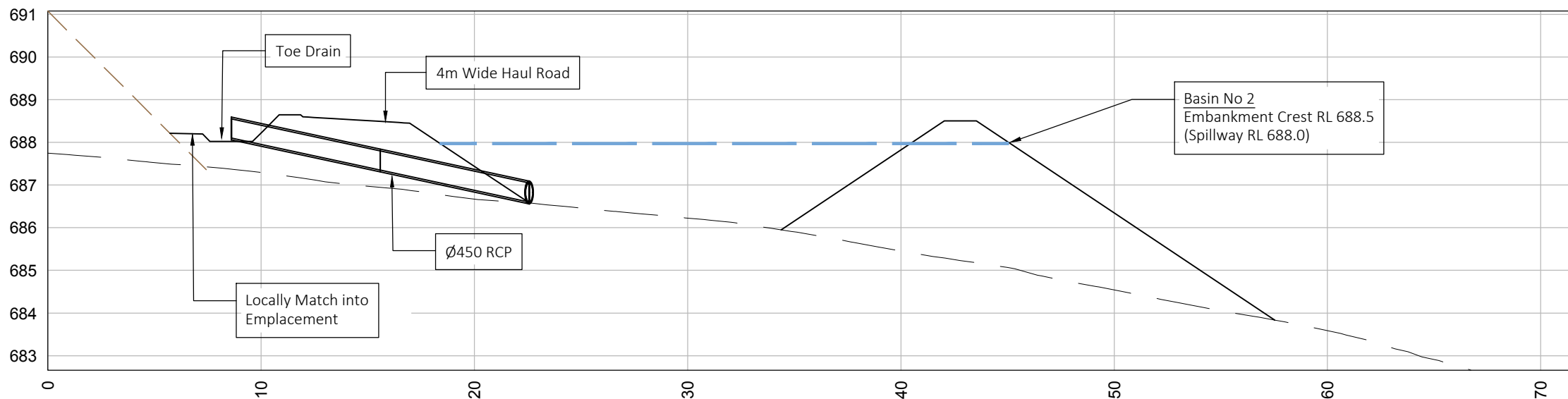


Rock Lined Spillway and Discharge Channel

Ø450 RCP Transfer pipe from toe drain to sediment basin. Provide headwalls and rock lined scour protection and inlet and outlet



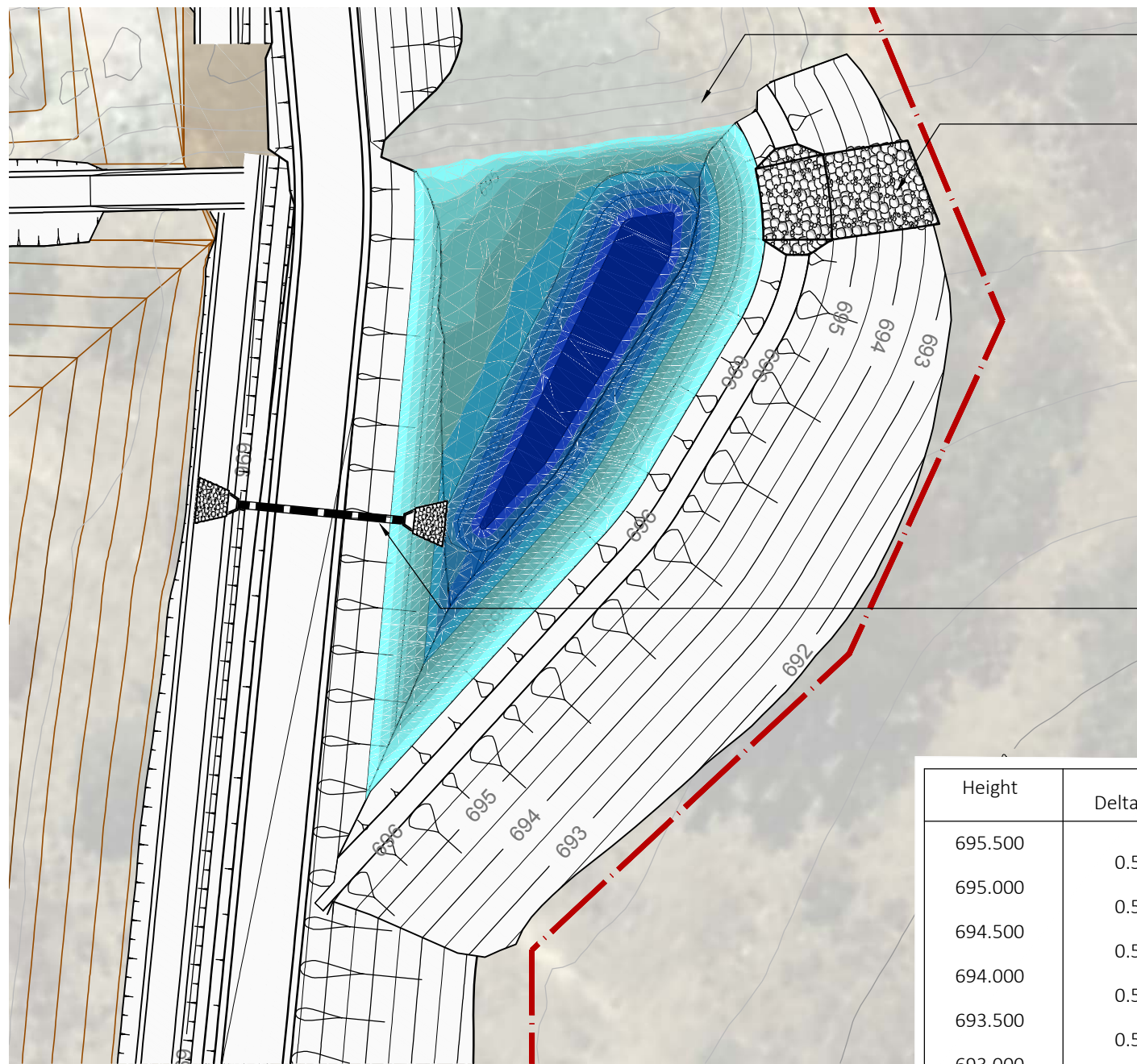
Height	Delta Ht	Vol to Height	Delta Vol	Plan Area	Delta Area	Slope Area	Delta Area
688.000	0.500	1198.123	548.326	1286.565	374.206	1319.183	386.147
687.500	0.500	649.796	366.774	912.358	344.378	933.036	354.091
687.000	0.500	283.022	214.518	567.980	275.256	578.945	282.575
686.500	0.500	68.504	68.308	292.724	285.004	296.370	288.551
686.000	0.500	0.195	0.195	7.721	7.721	7.819	7.819
685.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000
685.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000



PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

Sediment Basin No 2  
Detail Plan  
Boral Mugga Quarry  
Overburden Expansion  
Figure 03-2



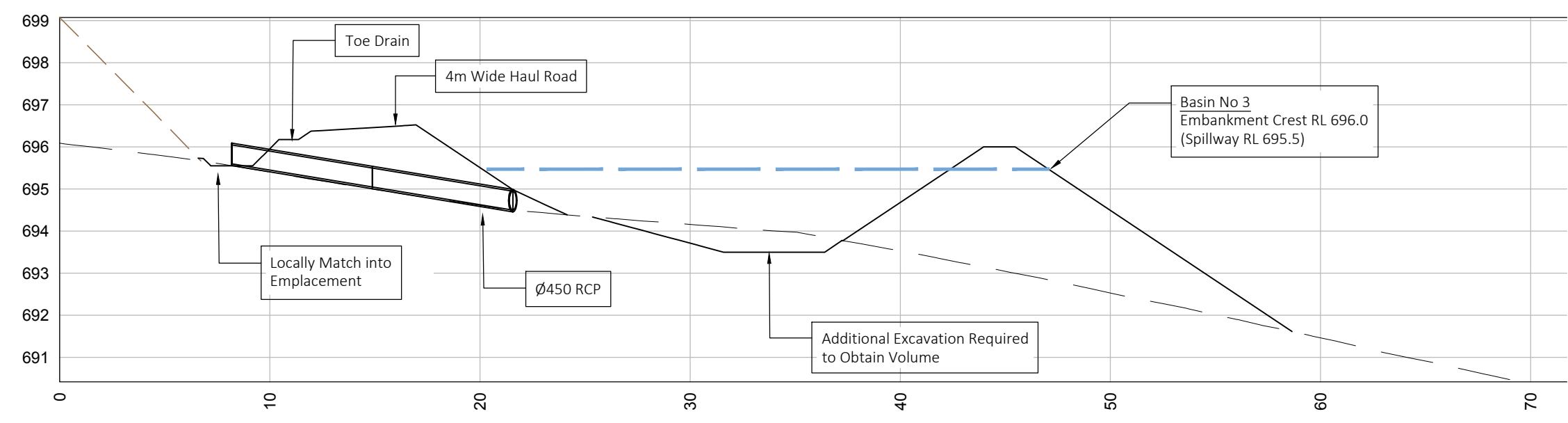
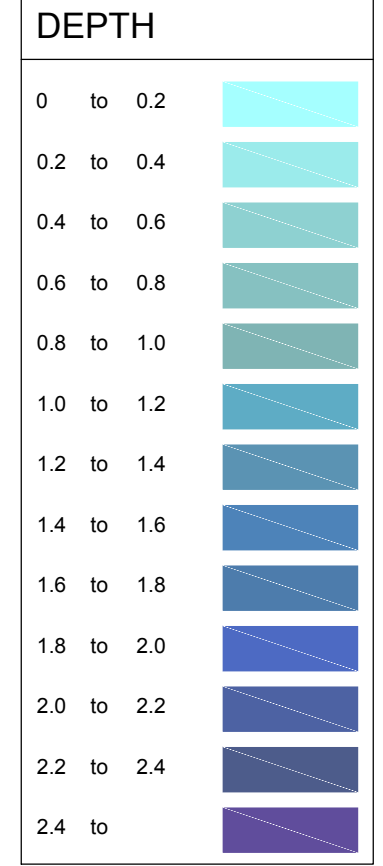


Utilise Existing Embankment to for Edge of Basin

Rock Lined Spillway and Discharge Channel

Ø450 RCP Transfer pipe from toe drain to sediment basin. Provide headwalls and rock lined scour protection and inlet and outlet.

Height	Delta Ht	Vol to Height	Delta Vol	Plan Area	Delta Area	Slope Area	Delta Area
695.500	0.500	625.057	278.033	635.472	157.108	661.965	166.742
695.000	0.500	347.024	193.810	478.363	191.165	495.223	198.013
694.500	0.500	153.214	102.788	287.198	142.601	297.210	148.097
694.000	0.500	50.426	50.426	144.597	144.597	149.113	149.113
693.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000
693.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000



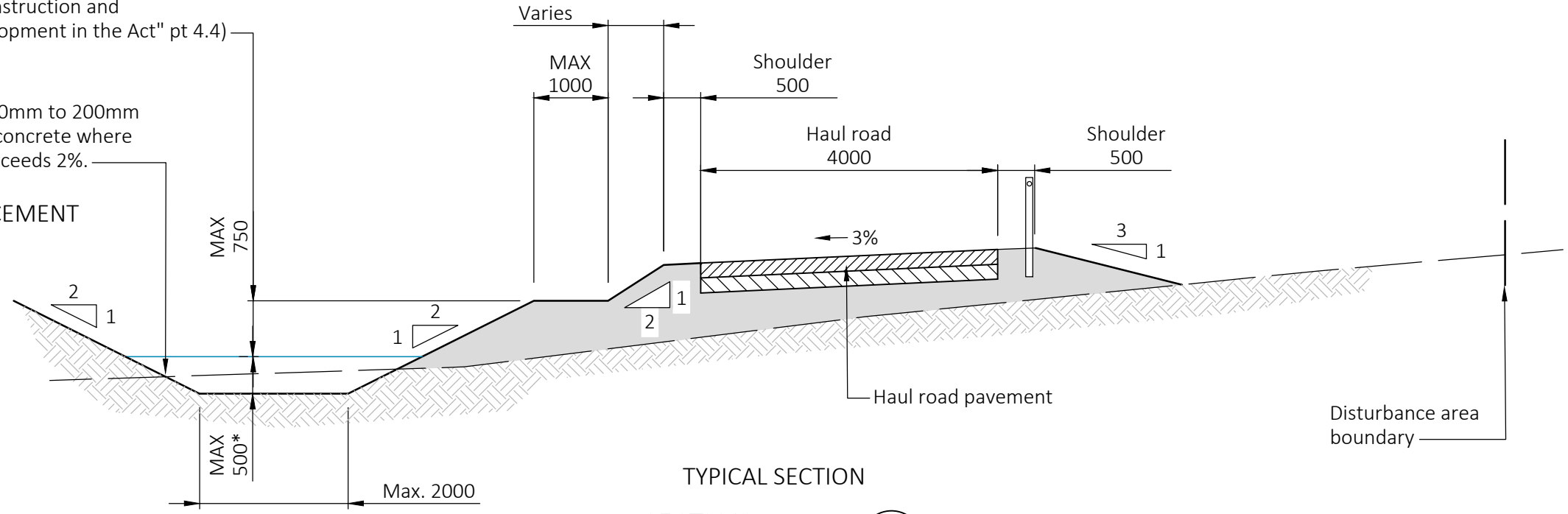
PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

Sediment Basin No 3  
Detail Plan  
Boral Mugga Quarry  
Overburden Expansion  
Figure 03-3

Earth bank high flow treatment  
 \*Min flow depth rqd 350mm.  
 (Design flow depth 500mm)  
 (Refer "Construction and  
 Land Development in the Act" pt 4.4)

Line channel with 100mm to 200mm  
 DN rock or recycled concrete where  
 longitudinal grade exceeds 2%.

EMPLACEMENT



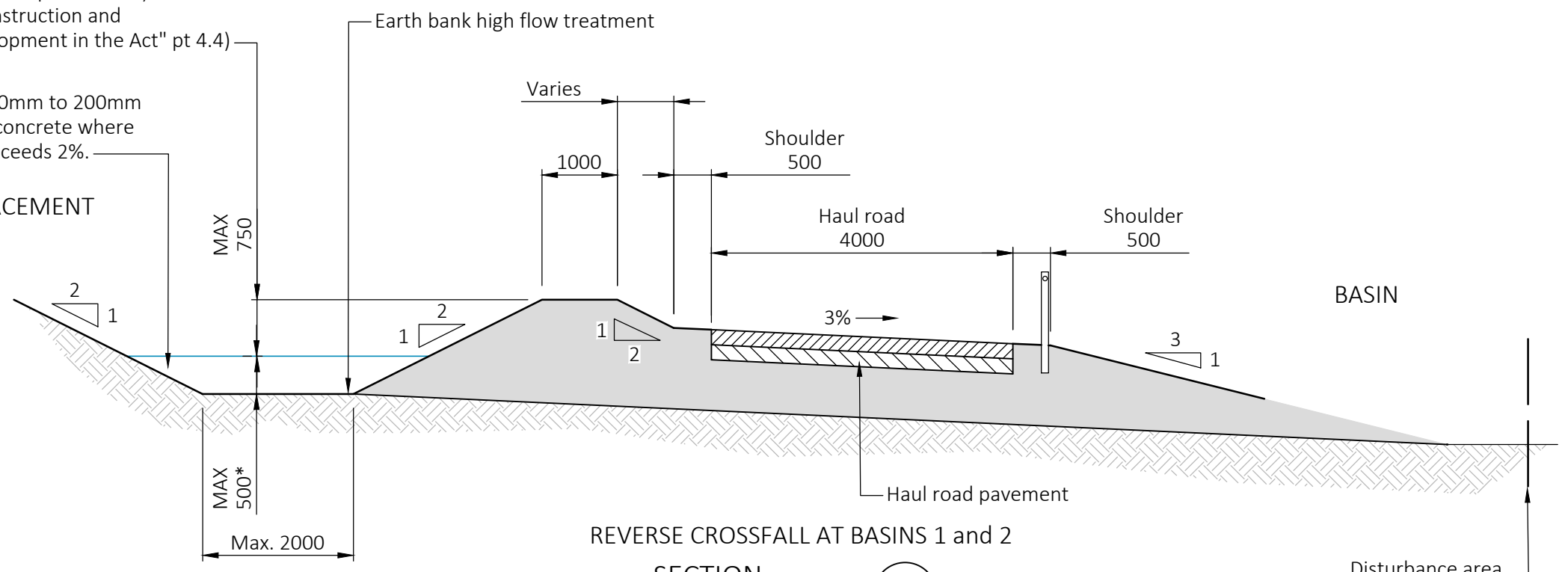
TYPICAL SECTION

SECTION H2  
 SCALE 1: 75

Earth bank high flow treatment  
 \*Min flow depth rqd 350mm.  
 (Design flow depth 500mm)  
 (Refer "Construction and  
 Land Development in the Act" pt 4.4)

Line channel with 100mm to 200mm  
 DN rock or recycled concrete where  
 longitudinal grade exceeds 2%.

EMPLACEMENT



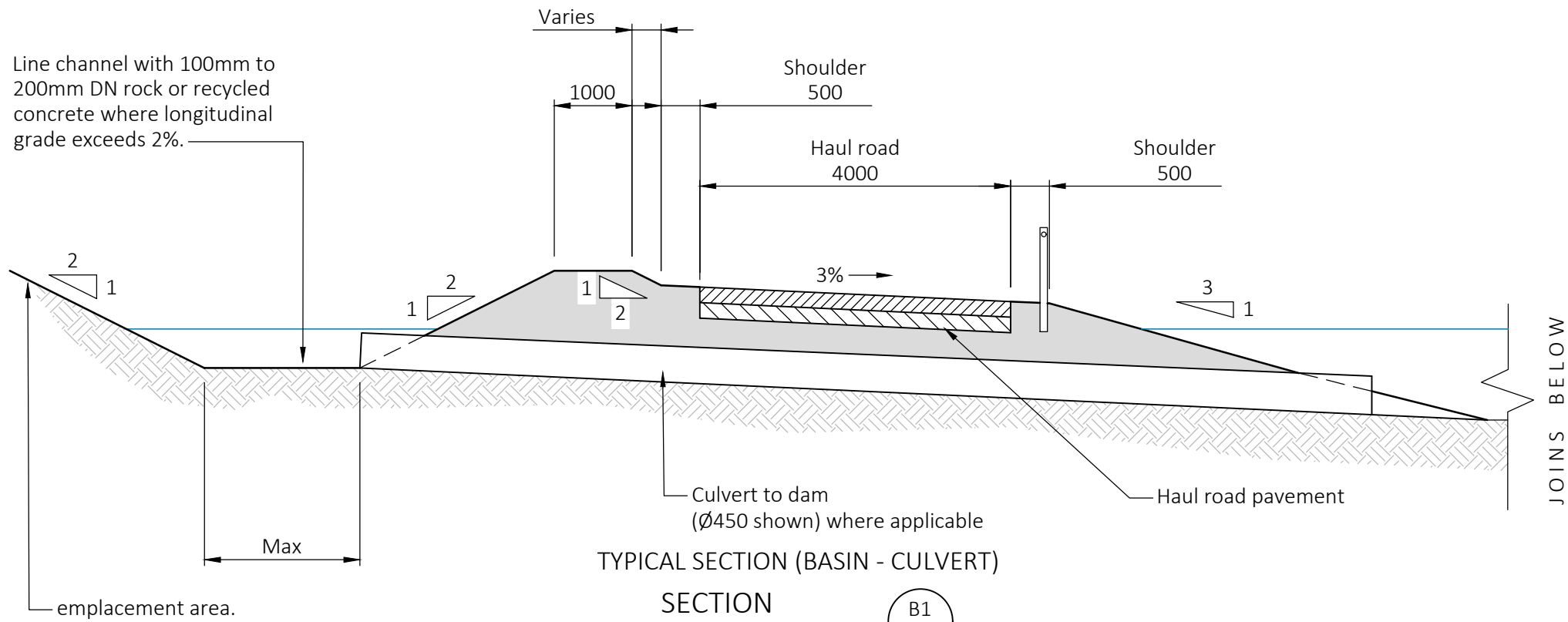
REVERSE CROSSFALL AT BASINS 1 and 2

SECTION H1  
 SCALE 1: 75

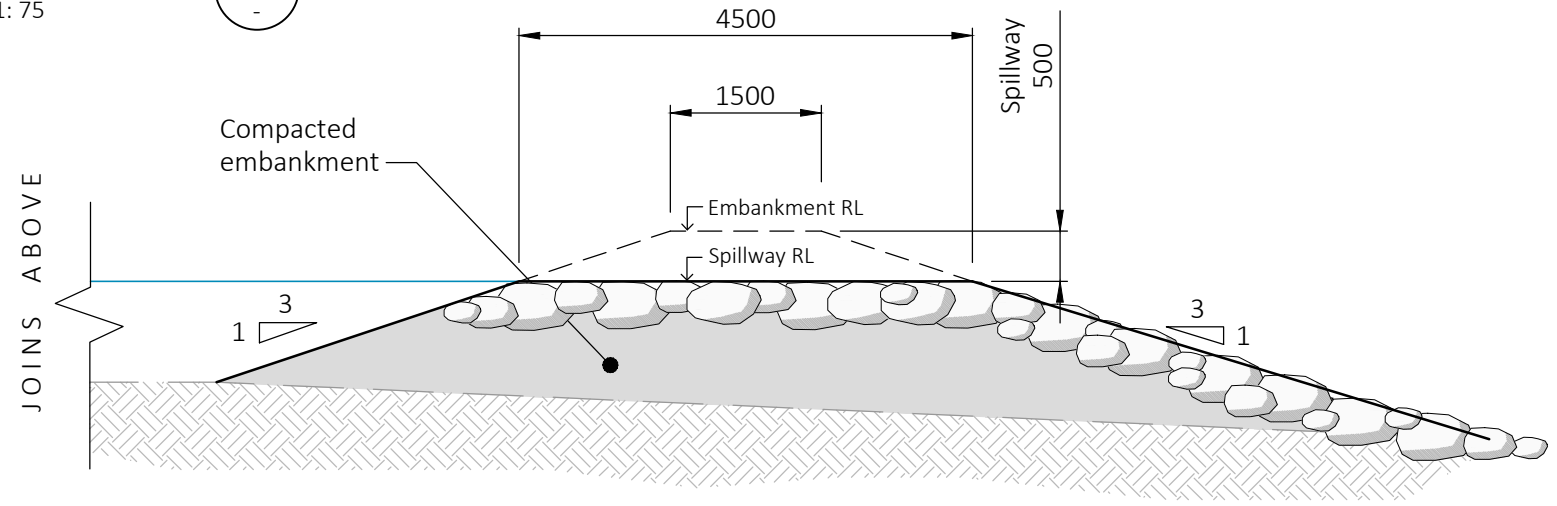
PRELIMINARY DESIGN  
 NOT FOR CONSTRUCTION

Typical Sections  
 Haul Road - Sheet 1  
 Boral Mugga Quarry  
 Overburden Expansion  
 Figure 04-1

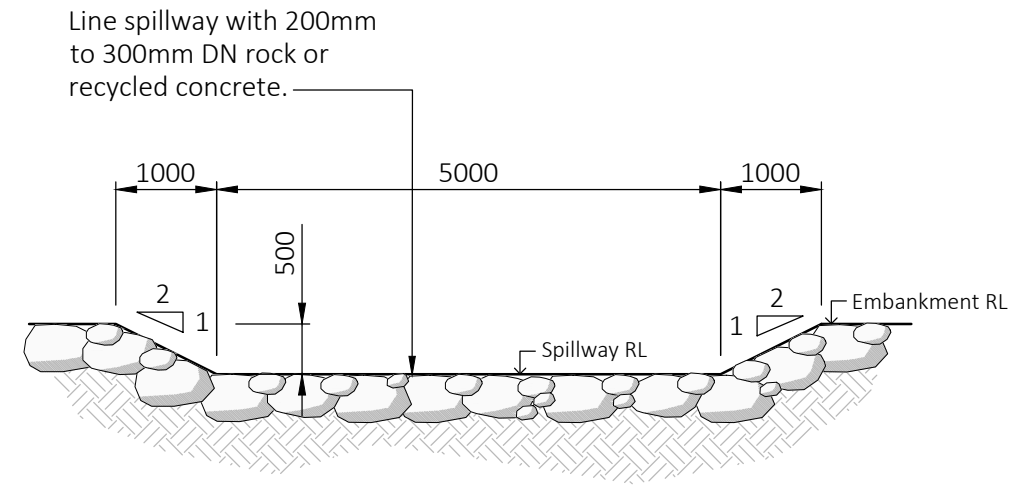




TYPICAL SECTION (BASIN - CULVERT)  
SECTION B1  
SCALE 1: 75



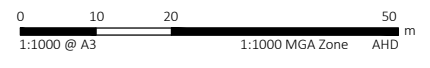
TYPICAL SECTION CONTINUED (BASIN - EMBANKMENT)  
SECTION B1  
SCALE 1: 75



DETAIL  
SCALE 1: 75  
SECTION B2

PRELIMINARY DESIGN  
NOT FOR CONSTRUCTION

Typical Sections  
Sediment Basins - Sheet 2  
Boral Mugga Quarry  
Overburden Expansion  
Figure 04-2









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Appendix M

# Noise impact assessment

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# Mugga Quarry Overburden Expansion Project

## Noise Impact Assessment

Prepared for Boral Resources (Country) Pty Ltd | 16 July 2018



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## Mugga Quarry Overburden Expansion Project

Noise impact assessment

Prepared for Boral Resources (Country) Pty Ltd | 16 July 2018

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## Mugga Quarry Overburden Expansion Project

Final

Report J17174RP1 | Prepared for Boral Resources (Country) Pty Ltd | 16 July 2018

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Prepared by **Lucas Adamson**

Approved by **Katie Teyhan**

Position Acoustic Consultant

Position Associate

Signature



Signature



Date 16 July 2018

Date 16 July 2018

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This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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### Document Control

Version	Date	Prepared by	Reviewed by
V1-0	16 July 2018	Lucas Adamson	Katie Teyhan

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# 1 Introduction

## 1.1 Background

Boral Resources (Country) Pty Ltd (Boral), a wholly owned subsidiary of Boral Limited, proposes to establish a new permanent bund and temporary stockpile area to store quarried overburden and weathered rock material from its Mugga Quarry operations (the project) at 321 Mugga Lane, Symonston (the site).

The project is required to enable the ongoing extraction operations of the quarry and supply of aggregates and quarry products to the construction market within the Australian Capital Territory (ACT) and surrounding New South Wales (NSW) regional areas.

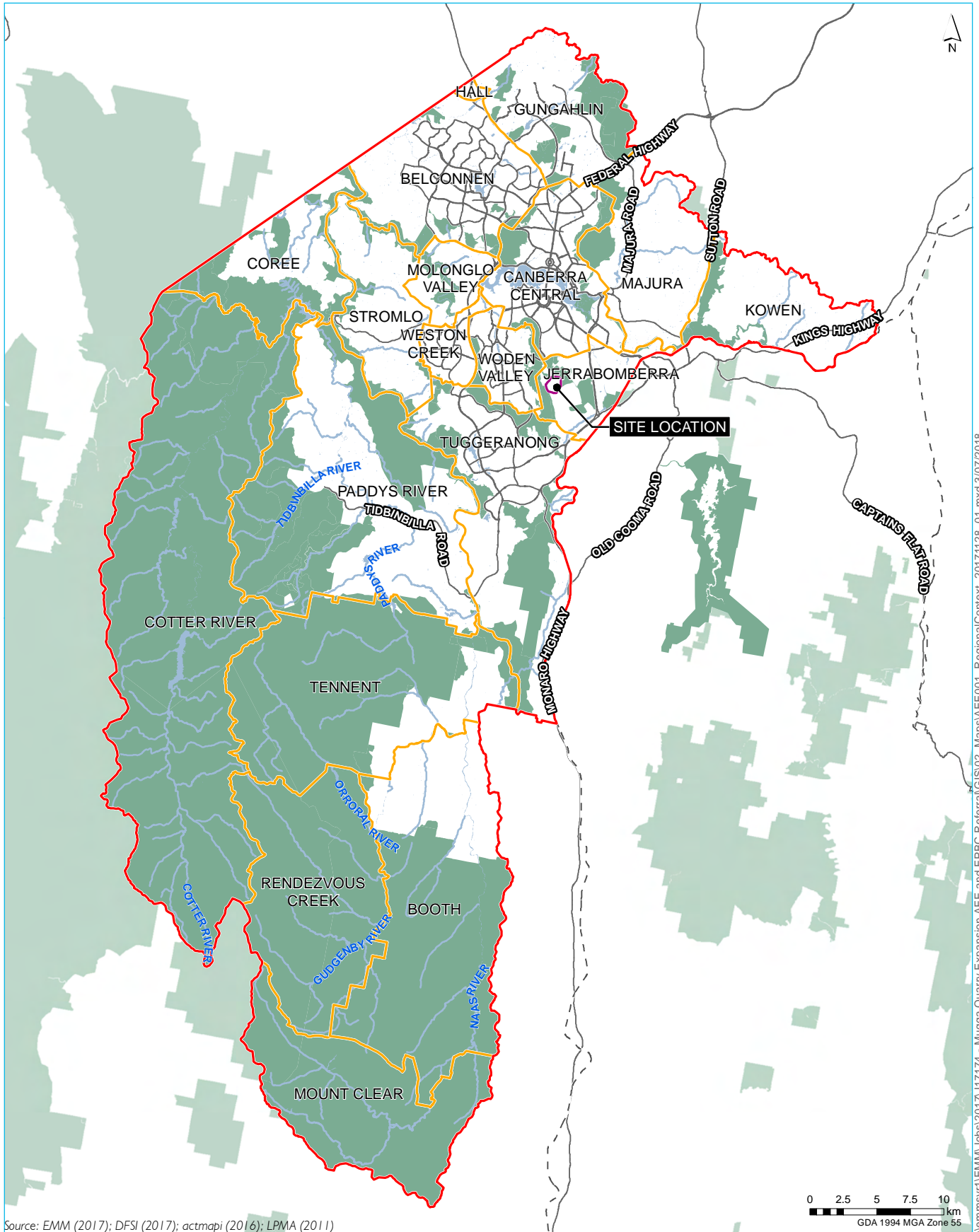
The site in its regional and local context can be seen in Figure 1.1 and Figure 1.2.

EMM Consulting Pty Ltd (EMM) has been engaged by Boral to undertake the noise impact assessment (NIA) component to support a Development Application (DA). This NIA documents the assessment methodology and potential impacts of the project, and identifies mitigation and management measures, where relevant. Vibration emissions from the project would be similar to existing levels from the current operations. Given this, and the relative proximity of sensitive receptors, vibration impacts are considered unlikely and have not been assessed further.

## 1.2 Methodology overview

Assessment of noise has been undertaken in accordance with ACT Regulations. Where guidance is not provided in this document (eg in assessing the likelihood of sleep disturbance), reference has been made to the NSW *Noise Policy for Industry* (NPfI). This assessment has been undertaken with reference to the following relevant policies and guidelines:

- ACT Government 2005, *Environment Protection Regulation* (EPR);
- NSW Environmental Protection Authority (EPA) 2017, *Noise Policy for Industry* (NPfI);
- NSW Department of Environment, Climate Change and Water (DECCW) 2011, *Road Noise Policy* (RNP);
- ACT Government 2009, *Noise Measurement Manual* (NMM);
- ACT Government 2010, *Noise Environment Protection Policy* (NEPP); and
- ACT Government 2015, Environmental Authorisation (EA) 0422.



Source: EMM (2017); DFSI (2017); actmapi (2016); LPMA (2011)

KEY

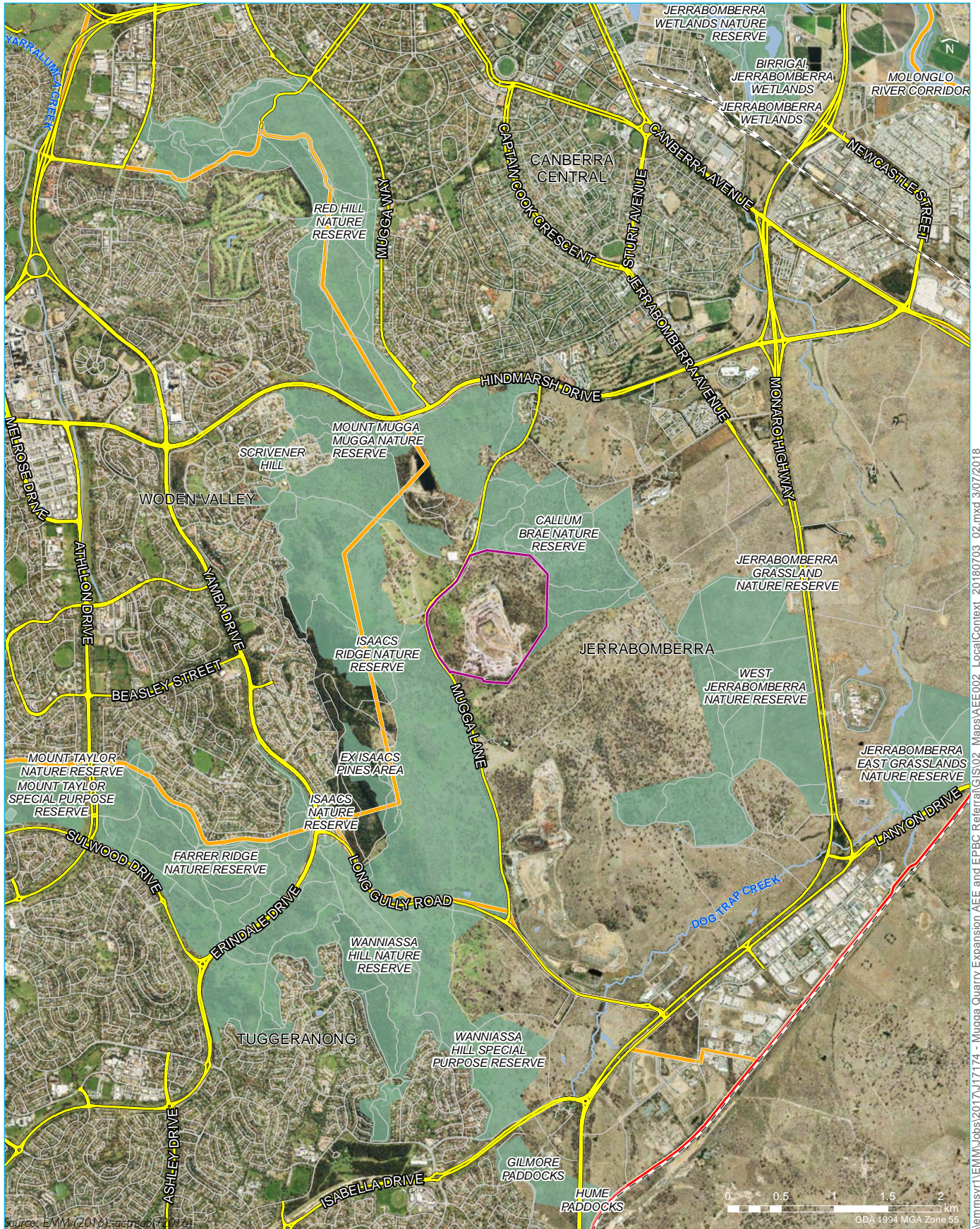
- Site location - 321 Mugga Lane, Symonston
- ACT boundary
- District boundary
- Railway
- Main road
- Watercourse
- Waterbody
- ACT reserve
- NPWS reserve

Regional context

Boral - Mugga Quarry overburden expansion  
Noise Impact Assessment

Figure 1.1

\\emmsvr1\EMM\Jobs\2017\17174 - Mugga Quarry Expansion AEE and EPBC Referral\GIS\02\_Maps\AEE001\_RegionalContext\_20171128\_01.mxd 3/07/2018



KEY

- Site location - 321 Mugga Lane, Symonston
- ACT boundary
- District boundary
- Electricity transmission line
- Main road
- Local road
- Rail line
- Watercourse
- Waterbody
- ACT reserve

Local context

Boral - Mugga Quarry overburden expansion  
 Noise Impact Assessment  
 Figure 1.2

### 1.3 Glossary of acoustic terms

A number of technical terms are required when discussing noise. These are explained in Table 1.1.

**Table 1.1** Glossary of acoustic terms

Term	Description
dB	Noise is measured in units called decibels (dB).
A-weighting	There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
$L_{A1}$	The A-weighted noise level exceeded for 1% of a measurement period.
$L_{A10}$	The A-weighted noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise levels.
$L_{A90}$	Commonly referred to as the background noise, this is the A-weighted level exceeded 90% of the time.
$L_{Aeq}$	The A-weighted energy average noise from a source, and is the equivalent continuous sound pressure level over a given period. The $L_{Aeq,15\text{ minute}}$ descriptor refers to an $L_{Aeq}$ noise level measured over a 15-minute period.
$L_{Amax}$	The maximum root mean squared A-weighted sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period (as defined in the NPfl).
Sound Power Level	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature Inversion	A positive temperature gradient. A meteorological condition where atmospheric temperature increases with altitude.

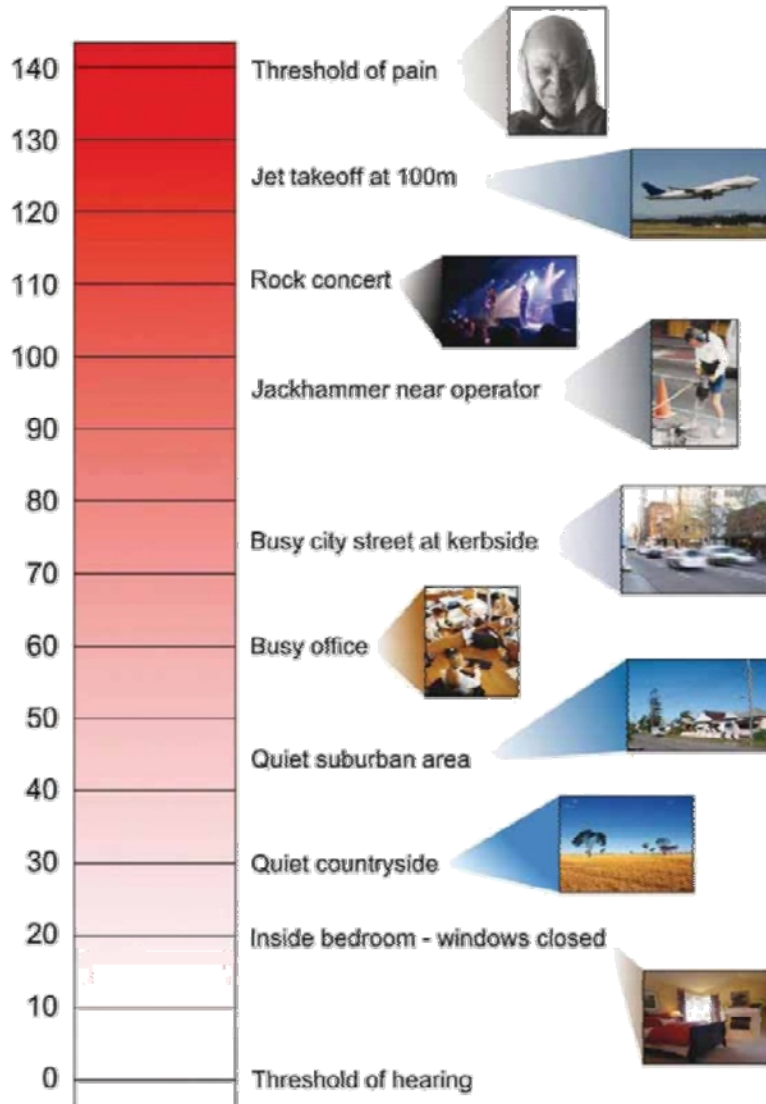
Decibels (dB) are the unit of measurement for noise. Table 1.2 gives an indication of what an average person perceives about changes in noise levels:

**Table 1.2** Perceived change in noise

Change in sound level (dB)	Perceived change in noise
1 to 2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

Examples of common noise levels are provided in Figure 1.3.

Indicative A-weighted decibel (dBA) noise levels in typical situations



Source: Road Noise Policy (Department of Environment, Climate Change and Water (DECCW) 2011)

Figure 1.3 Common noise levels

## 2 Project overview

The project involves the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 cubic metres (m<sup>3</sup>) of quarried overburden and weathered rock material from Mugga Quarry.

The additional bund and emplacement areas will be located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road) and resides within an extractive industry lease area of 106.4 hectares (ha).

The topography of the site is undulating with a slope across the proposed extension area from the south-west to the north-east. Elevation within the proposed extension area varies from approximately 730 m Australian Height Datum (AHD) in the south-west to approximately 690 m AHD in the north-east.

The site has a long history of supporting construction materials manufacturing and contains four Boral operations, namely an asphalt plant, a concrete batching plant, a recycling facility and the hard rock quarry that is associated with the proposed emplacement area (refer Figure 2.1).

The quarry is located in the central portion of the site and currently produces crush rock products with a production rate at times up to 1,000,000 tonnes per annum (tpa). The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities. The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00 am to 6:00 pm Monday to Saturday.

As total production of the quarry will not be increasing, there will be no change to current operating hours, external traffic movements, groundwater management or employment. No changes are proposed to the other operations at the site.

A plan of the project can be seen in Figure 2.2.

### 2.1 Site and surrounds

#### 2.1.1 Site description

The site is leased Territory Land, identified as Block 2031 Jerrabomberra District. The site is located approximately 10 kilometres (km) to the south-east of Canberra Central. The site is generally known as 321 Mugga Lane, Symonston.

Located within a broadacre rural setting and surrounded by low density land uses and established remnant native vegetation, the site has a long history of supporting the operation of a hard rock quarry and associated asphalt plant, concrete batching facility and recycling facility. Vehicular access to the site is via an existing entry off Mugga Lane, adjacent to the site's south-western boundary.

An overview of the existing site operations is provided in Table 2.1.

**Table 2.1 Overview of site operations**

Operational element	Production rate	Details
Hard rock quarry	Up to 1,000,000 tpa. Average production rate approximately 500,000 tpa	Located in the central portion of the site and currently produces crush rock products with a production rate at times up to 1,000,000 tpa. The average production rate is in the vicinity of 500,000 tpa. Elements of the existing quarry include an extraction area, crushing and screening plant, product stockpiling area, offices and amenities. The quarry can operate 24 hours a day, seven days a week however is usually operating from 6:00 am to 6:00 pm Monday to Saturday.
Fixed asphalt plant	Up to 75,000 tpa Average 145 tons per day (tpd) production rate, with maximum 1,000 tpd	The project would produce up to 75,000 tpa of asphalt, with an average of 140 tpd to a peak of 1,000 tpd. The fixed asphalt plant is approved to operate 24 hours a day, 7 days a week.
Concrete Batching Plant (CBP)	36,000 m <sup>3</sup> per annum Maximum capacity to produce up to 60,000 m <sup>3</sup>	Located to the north of the asphalt plant. It currently produces 36,000 m <sup>3</sup> per annum and has a maximum capacity to produce up to 60,000 m <sup>3</sup> . Elements of the existing CBP include cement and flyash silos, aggregate storage bins, concrete production and loading facilities, offices and amenities. The CBP operates 24 hours a day, seven days a week.
Recycling facility	Up to 100,000 tpa	Recycling is located on the central western edge of the quarry and currently processes up to 100,000 tpa of recycled construction and demolition waste. Elements of the recycling facility include raw and finished material stockpiles, a mobile crushing plant, offices and amenities. The recycling facility can operate 24 hours a day, 7 days a week however deliveries generally occur between 7:00 am and 4:30 pm with production occurring overnight when needed to meet market demand.

The topography is undulating with a significant slope across the site from the north-east to south-east with a fall of approximately 40 metre (m). The site is leased by Boral Resources (Country) Pty Ltd, a wholly owned subsidiary of Boral Limited.

The site is zoned Non-Urban NUZ1 Broadacre under the Territory Plan.

### 2.1.2 Project area

This project includes the establishment of a new permanent bund and temporary emplacement area to store up to 620,000 m<sup>3</sup> of quarried overburden and weathered rock material located north and east of the quarry's existing operations between the pit face and Mugga Lane (public road).

A plan of the project can be seen in Figure 2.1.

### 2.1.3 Surrounds

The site is situated within a broadacre rural setting surrounded by low density land uses and established remnant native vegetation.

The land use zoning for the site has made provisions requiring a 1 km clearance buffer around the site to afford protection from conflicting development. The nearest rural residence is therefore located approximately 2 km to the south and approximately 2 km to the west of the site.

Land uses surrounding the site include:

- **north** – Mugga Lane (public road), vacant broadacre land, reservoir, bus depot, one rural residence and Boral’s Mugga 2 quarry;
- **east** - vacant broadacre land;
- **south** – vacant broadacre land and one rural residence; and
- **east** – Mugga Lane, vacant broadacre land and one rural residence;

Surrounding land uses can be seen in Figure 2.1.

## 2.2 Project alternatives

Boral considered the following alternatives for the emplacement of overburden and weathered rock:

- Emplacement within the Mugga 1 pit – Boral is already planning to emplace approximately 270,000m<sup>3</sup> of overburden and weathered rock within the pit, for possible processing or relocation. Total overburden material in-pit emplacement is not considered viable as it would begin to sterilise approved resource and shorten the lifespan of the quarry;
- Emplacement within the disused Mugga 2 quarry pit – inquiries are being made with the ACT Government to determine whether this is a possibility and whether it would be commercially viable. However, based on haulage costs, even without a tipping fee, it is not an attractive option from a commercial perspective. Emplacement within the Mugga 2 pit would also negate later re-use and blending of the weathered rock material;
- Emplacement at another Boral quarry – the closest Boral Quarry is at Hall Quarry at Jeir NSW, approximately 55 km to the north. Hall Quarry does not have development approval to receive overburden from external sites, and the cost involved in trucking material over such a long distance is not commercially viable. It would also negate later re-use and blending of the weathered rock material; and
- Emplacement out of pit on adjoining quarry land – this has been considered the most viable solution from a commercial perspective, given it’s the shortest haulage distance. It also means the weathered rock material can be later blended and re-used, instead of simply being applied to land.



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Source: EMM (2018); Boral (2018); actmapi (2016); GA (2016)

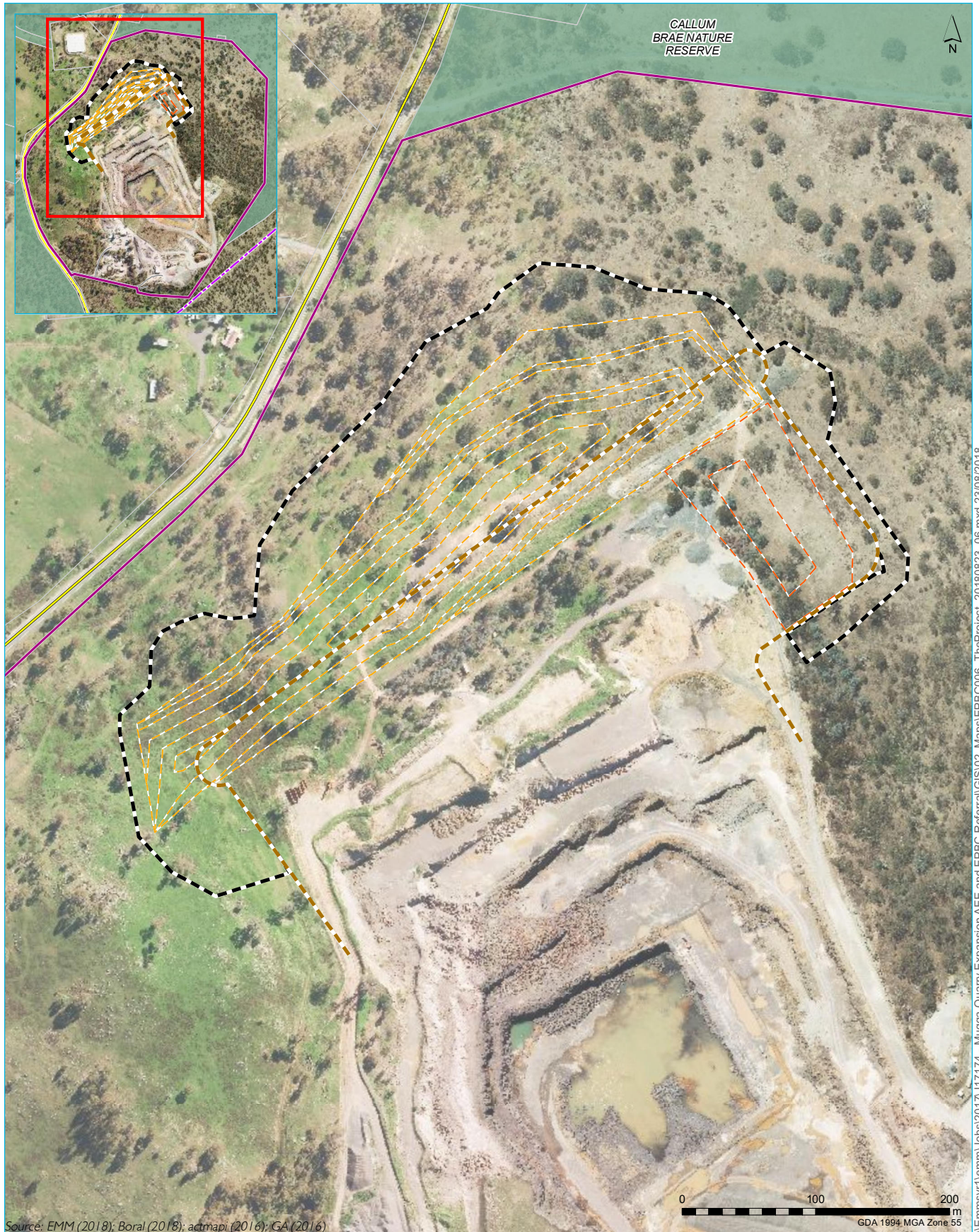
**KEY**

- |   |                               |                |
|---|-------------------------------|----------------|
| Site location - 321 Mugga Lane, Symonston   | Asphalt plant                 | Local Road     |
| Total disturbance area                      | Concrete batching plant       | Block boundary |
| Approved pit extent                         | Quarry                        | ACT reserve    |
| Emplacement contours (Boral)                | Recycling facility            |                |
| Proposed eastern emplacement contours (EMM) | Electricity transmission line |                |
|   | Main road                     |                |

Current site  
 Boral - Mugga Quarry overburden expansion  
 Noise Impact Assessment

Figure 2.1





Source: EMM (2018); Boral (2018); actmap (2016); GA (2016)

**KEY**

- Site location - 321 Mugga Lane, Symonston
- Main road
- Total disturbance area
- Block boundary
- Approved pit extent
- Emplacement contours (Boral)
- Proposed eastern emplacement contours (EMM)
- Electricity transmission line
- ACT reserve

**Project Layout**

Boral - Mugga Quarry overburden expansion  
Noise Impact Assessment

Figure 2.2



## 3 Existing environment

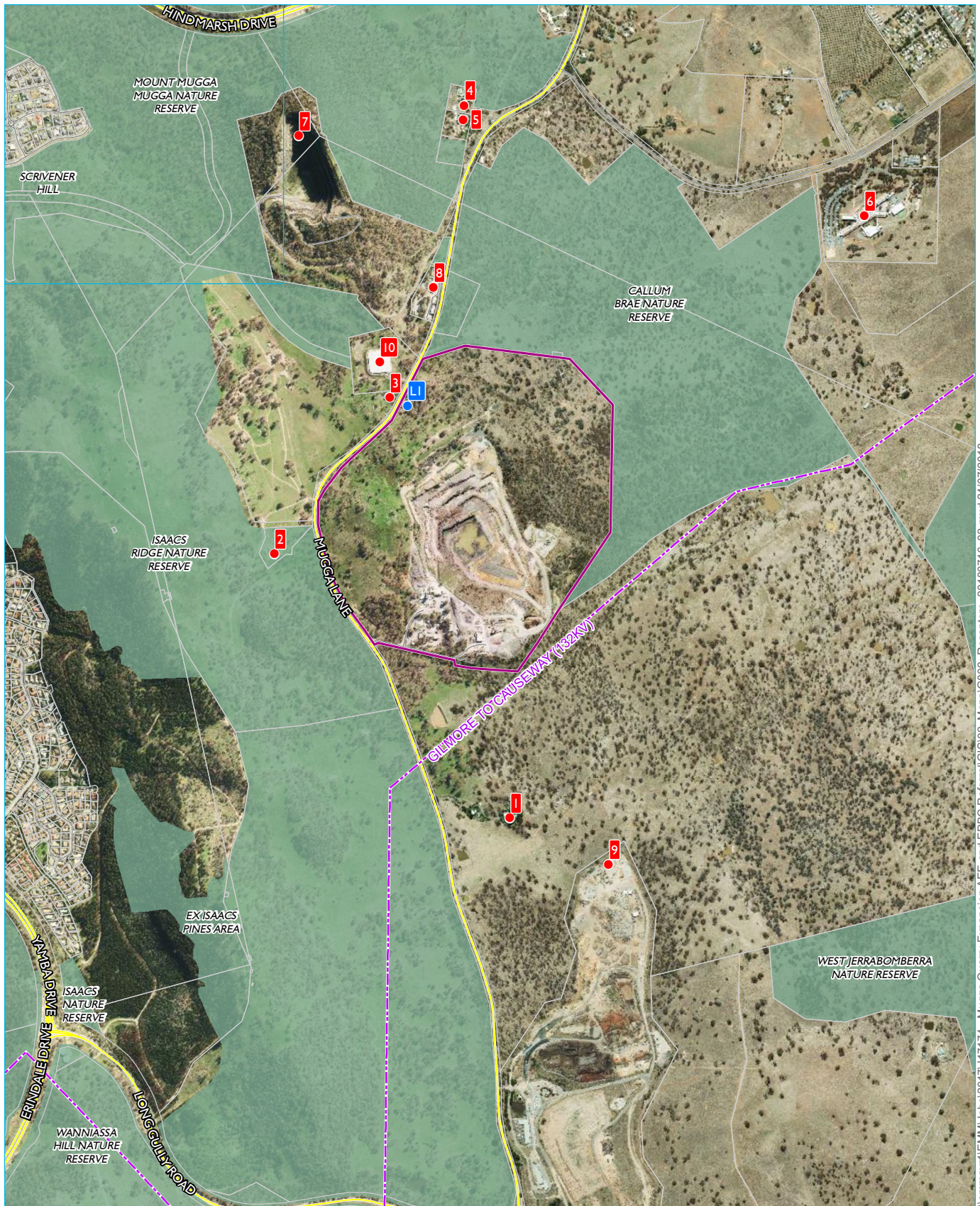
### 3.1 Assessment locations

The nearest representative noise sensitive receivers to the project are defined in Table 3.1 and shown in Figure 3.1. They are further referred to in this report as assessment locations. If noise criteria (defined in Section 4) can be satisfied at these closest assessment locations, then noise criteria will be satisfied at assessment locations further from the project.

**Table 3.1** Assessment locations

ID	Receptor type <sup>1/2</sup>	Approx. distance from site (m)	Easting <sup>3</sup>	Northing <sup>3</sup>
1	Broadacre/Residential	650	694011	6083258
2	Broadacre/Residential	600	693146	6084258
3	Broadacre/Residential	850	693577	6084854
4	Broadacre/Commercial	1900	693853	6085896
5	Broadacre/Commercial	2000	693848	6086021
6	Broadacre/Commercial	2100	695293	6085471
7	Broadacre/Industrial	1600	693278	6085542
8	Broadacre/Industrial	1100	693747	6085174
9	Broadacre/Industrial	1000	694371	6083062
10	Broadacre/Industrial	950	693531	6084956

Notes: 1. As defined by the EPR 2005  
2. As defined in the NPfI.  
3. Coordinates refer to MGA 55H



Source: EMM (2018); DFSI (2017); GA (2015)

**KEY**

Receptor

- Broadacre
- Noise monitoring location
- Site location - 321 Mugga Lane, Symonston

- Electricity transmission line
- Main road
- Local Road
- Watercourse
- Block boundary
- ACT reserve

Assessment locations

Boral – Mugga Quarry overburden expansion  
Noise Impact Assessment

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## 3.2 Background and ambient noise levels

### 3.2.1 Unattended noise monitoring

In order to establish the existing ambient noise environment of the area, noise monitoring was conducted. One noise logger was placed on Boral land to the north of the current quarry pit (see Figure 3.1). The location of noise monitoring was selected after inspection of the quarry and its surrounds, giving due consideration to other noise sources which may influence the readings, the proximity of assessment locations to the site, security issues for the noise monitoring devices and gaining permission for access from the residents or landowners.

To establish the ambient noise levels in the area, both unattended and short-term operator-attended noise surveys were conducted at the monitoring locations in general accordance with the procedures described in Australian Standard AS 1055-1997 - Acoustics - Description and Measurement of Environmental Noise.

The unattended measurements were carried out using an Acoustic Research Laboratories (ARL) EL316 environmental noise logger (serial number 0022135). The logger was in place from 20 March to 5 April 2018 (17 days).

The noise logger was programmed to record statistical noise level indices continuously in 15 minute intervals, including the  $L_{Amax}$ ,  $L_{A1}$ ,  $L_{A10}$ ,  $L_{A50}$ ,  $L_{A90}$ ,  $L_{A99}$ ,  $L_{Amin}$  and the  $L_{Aeq}$ . Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed  $\pm 0.5$  dB. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Weather data for the survey period was obtained from the Bureau of Meteorology (BoM) Automatic Weather Station (AWS) at Canberra Airport (Station ID 070351), approximately nine km north-east of the quarry. The wind speed and the rainfall data was used to exclude noise data during periods of any rainfall and/or wind speed in excess of 5 m/s in accordance with NMM methods. A summary of existing background and ambient noise levels is given in Table 3.2. Results are provided for each day and graphically in Appendix A.

**Table 3.2 Summary of existing background and ambient noise**

Monitoring location	Period	Rating Background Level <sup>1</sup> (RBL), dB	Measured $L_{Aeq, period}$ Noise Level <sup>2</sup> , dB
L1 – Mugga Quarry	Day	38	55
	Evening	31	46
	Night	28	44

Notes: 1. The RBL is an NPfl term and is used to represent the background noise level.  
2. The energy averaged noise level over the measurement period and representative of general ambient noise.  
3. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: 10 pm to 7 am, Morning Shoulder: 5 am to 7 am

### 3.2.2 Attended noise monitoring

EMM completed 15 minute attended noise measurements on 20 March and 5 April 2018 at the noise logger location, to identify noise sources contributing to the ambient noise environment.

Operator attended measurements were conducted using Svan 957 and Brüel and Kjær Type 2250 Type 1 sound level meters (serial numbers 14572 and 3008201, respectively) to both quantify and qualify the

existing noise sources. Field calibration of the instrument was completed using a Brüel and Kjær type 4230 calibrator. Attended measurements were undertaken in accordance with AS 1055-1997 Description and Measurement of Environmental Noise, Parts 1, 2 and 3.

Meteorological conditions throughout the survey period were relatively calm and clear with no winds above 5 m/s and no rain.

A summary of results of the attended noise monitoring is provided in Table 3.3.

**Table 3.3 Summary of 15-minute attended noise measurements**

Location	Date	Start time	Measured noise level dB			Comments
			L <sub>Aeq</sub>	L <sub>A90</sub>	L <sub>Amax</sub>	
L1 – Mugga Quarry	20/03/18	14:30	53	46	65	Frequent site noise including the drill and dozer. Frequent bird noise and road traffic on Mugga Lane. Occasional wind in trees and aircraft noise
	5/4/18	11:00	54	39	71	Occasional site noise including distant trucks and rumble. Frequent road traffic on Mugga Lane. Occasional insects and bird noise.

### 3.3 Meteorology

Noise propagation over distance can be significantly affected by the prevailing weather conditions. Of most interest are source to receiver winds, the presence of temperature inversions and drainage flow effects, as these conditions can enhance received noise levels. To account for these phenomena, the NPfl specifies the following two options in regard to meteorological analysis procedures to determine the prevalent weather conditions:

1. Adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – ie a conservative approach that considers source-to-receiver wind vectors for all receivers and F class temperature inversions with wind speeds up to 2 m/s at night; or
2. Determine the significance of noise-enhancing conditions. This involves assessing the significance of temperature inversions (F and G class stability categories) for the night-time period and the significance of light winds up to and including 3 m/s for all assessment periods during stability categories other than E, F or G. Significance is based on a threshold of occurrence of 30% determined in accordance with the provisions in this policy. Where noise-enhancing meteorological conditions occur for less than 30% of the time, standard meteorological conditions may be adopted for the assessment.

#### 3.3.1 Prevailing winds

The NPfl recommends consideration of wind effects if they are “significant”. The NPfl defines “significant” as the presence of source-to-receiver wind speed (measured at 10 m above ground level) of 3 m/s or less, occurring for 30% of the time in any assessment period and season.

This is further clarified by defining source-to-receiver wind direction as being the directional component of wind. The NPfl states that where wind is identified to be a significant feature of the area then assessment of noise impacts should consider the highest wind speed below 3 m/s, which is considered to prevail for at least 30% of the time.

A thorough review of the vector components of hourly wind data was undertaken for data obtained during 2014 to 2016 (two calendar years) from the BoM Canberra Airport AWS (ID 070351), approximately nine km north east from the site. The analysis identified that winds during the night-time period are a feature from the east (90°) through to the south south east (157.5°). No prevailing winds were identified during the daytime or evening periods as part of this review.

### 3.3.2 Temperature inversions

The NPfl states that the assessment of the impact of temperature inversions be confined to the night-time noise assessment period where temperature inversions occur.

The frequency of temperature inversions was determined based on sigma-theta data obtained from the BoM Canberra Airport AWS. Analysis of the data found that F or G stability class (temperature inversions) occurs for greater than 30% of the night-time period and, as such, temperature inversions have been considered in the prediction and assessment of noise from the project for the night-time period.

### 3.3.3 Assessed meteorological conditions

Noise emission levels from operation of the quarry at all assessment locations have been calculated based on the meteorological parameters shown in Table 3.4.

**Table 3.4 Weather conditions considered in noise modelling**

Assessment Period	Meteorological condition	Air temperature	Relative humidity	Wind speed	Direction	Stability category
Day	Calm	20°C	70%	0.5 m/s	All	D class
Evening	Calm	10°C	90%	0.5 m/s	All	D class
Night	Calm	10°C	90%	0.5 m/s	All	D class
	Winds	10°C	90%	2.5 m/s	90° to 157.5°	D class
	Inversion	10°C	90%	2.0 m/s	All	F class

## 4 Noise criteria

### 4.1 Operational noise

#### 4.1.1 Environmental Authorisation 422

Table 3.3: Noise Pollution and Table 3.4: Noise Emission in Schedule 3 of Boral's Mugga Quarry existing Environmental Authorisation (EA) 0422 contains the conditions relevant to noise pollution for the operating site. These are reproduced below.

**Table 3.3: Noise Pollution**

	<b>Requirement</b>
1	Only permit blasting on the site between the hours of 8 am and 5 pm Monday to Friday, excluding Public Holidays
2	The airblast overpressure level from blasting operations in or on the site must not exceed 120 dB (Lin Peak) at any time, at any point on the boundary of the site adjacent to the closest residential boundary.
3	The ground vibration peak particle velocity from blasting operations carried out in or on the site must not exceed 10 mm/s at any time, at any point on the boundary of the site adjacent to the closest residential boundary.

**Table 3.4: Noise Emission**

	<b>Requirement</b>
1	Shall manage the operations at the site so that noise levels do not exceed the following levels at any point on the boundary of the site.  Monday –Saturday: 7 am to 6 pm – 45 dB(A)  Sunday and Public Holidays: 9 am to 6 pm – 45 dB(A)  At any other time – 35 dB(A)

#### 4.1.2 ACT Noise standards

In the ACT, noise is considered to cause 'environmental harm' if it exceeds certain limits set out in the EPR.

The ACT is divided into seven zones for the purposes of establishing acceptable noise levels. The acceptable noise levels for each zone (referred to as the noise standards) are set out in Table 4.1 (Part 2.2 of Schedule 2) of the EPR. The acceptable noise levels are highest for industrial areas and lowest for residential areas.

**Table 4.1 ACT noise zones and standards**

Zone	ACT land	Noise Standard, $L_{A10,period}$ dB	
		Day <sup>1</sup>	Night <sup>2</sup>
A	Industrial zones	65	55
B	City or town centres, Central National Area (City Hill precinct)	60	50
C	Group, corridor and office sites, Central National Area (Parliamentary zone and other areas)	55	45
D	Commercial zones (other than in zone C)	50	35
E	Restricted access or broadacre zones (other than in zone C)	50	40
F	Community facility or leisure accommodation zone (other than in zone C)	same as the noise standard for the adjoining noise zone with the loudest noise standard for the time period	
G	All other land (other than land in the Central National Area (Fairbairn))	45	35

Notes: 1. Day is 7 am-10 pm Monday to Saturday and 8 am-10 pm on Sundays and public holidays.  
2. Night is 10 pm-7 am Monday to Saturday and 10 pm-8 am on Sundays and public holidays.

The project site and all assessment locations (1 to 10) fall within Zone E (Broadacre).

## 4.2 Project specific noise goals

For the purpose of this assessment, the noise standards outlined in the EPR have been adopted with the view of applying appropriate noise goals for the project. These are summarised in Table 4.2.

**Table 4.2 Noise goals**

Assessment location	Description	Noise limits, $L_{A10,period}$ dB	
		Day	Night
1	Broadacre (Zone E)	50	40
2	Broadacre (Zone E)	50	40
3	Broadacre (Zone E)	50	40
4	Broadacre (Zone E)	50	40
5	Broadacre (Zone E)	50	40
6	Broadacre (Zone E)	50	40
7	Broadacre (Zone E)	50	40
8	Broadacre (Zone E)	50	40
9	Broadacre (Zone E)	50	40
10	Broadacre (Zone E)	50	40

The noise zones outlined in the EPR have been established with a view to maintaining acceptable noise amenity levels at assessment locations and with consideration of potential cumulative noise impacts from existing and/or successive developments.

## 4.3 Sleep disturbance

The project currently operates during the night period (ie 10.00 pm to 7.00 am). In the absence of an ACT policy on sleep disturbance, this assessment has been guided by the NSW NPfI. The NPfI suggests that a

detailed maximum noise level event assessment should be undertaken where the development/premises night-time noise levels at a residential location exceed:

- $L_{Aeq,15\text{ minute}}$  40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or
- $L_{Amax}$  52 dB or the prevailing RBL plus 15 dB (whichever is the greater).

Guidance regarding potential for sleep disturbance is also provided in the RNP. The RNP calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. However, the RNP provides the following conclusions from the research on sleep disturbance:

- maximum internal noise levels ( $L_{Amax}$ ) below 50 to 55 dB are unlikely to awaken people from sleep; and
- one or two noise events per night, with maximum internal noise levels ( $L_{Amax}$ ) of 65 to 70 dB, are not likely to affect health and wellbeing significantly.

It is commonly accepted by acoustic practitioners and regulatory bodies that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60 to 65 dB calculated at the facade of a residence is unlikely to cause awakening affects.

If noise levels over the screening criteria are identified, then additional analysis would consider factors such as:

- how often the events would occur;
- the time the events would occur;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current scientific literature available regarding the impact of maximum noise level events at night.

Table 4.3 provides the maximum noise level event screening criteria for the residential assessment locations.

**Table 4.3 Maximum noise level event screening criteria**

Assessment location	Adopted RBL, dB <sup>1</sup>	Maximum noise level event screening criteria, dB	
		$L_{Aeq,15\text{ minute}}$	$L_{Amax}$
1-3	30 <sup>2</sup>	40	52

Notes: 1. RBLs calculated in accordance with the NPfI procedures.  
2. Minimum assumed RBL for night-time period as per NPfI procedures

## 5 Noise assessment method

### 5.1 Noise modelling overview

Quantitative modelling of operational noise was undertaken using the Brüel & Kjær Predictor Version 11.00 noise prediction software (Predictor). This software calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. The model incorporates factors such as:

- the lateral and vertical location of plant and equipment;
- the distances between each noise source and assessment location;
- ground effects;
- atmospheric absorption;
- topography; and
- meteorological conditions.

Three-dimensional digitised ground contours of the site and surrounding land were incorporated to model topographic effects. Equipment was modelled at locations and heights representative of potential operating scenarios for the project.

The model was used to predict noise levels at the assessment locations identified in Table 3.1 and shown in Figure 3.1 assuming meteorological parameters as per Table 3.4. The modelling results were then compared against the relevant criteria described in Section 4 to determine potential impacts.

### 5.2 Operational noise modelling

#### 5.2.1 Acoustically significant plant and equipment

Table 5.1 summarises the noise sources and associated sound power levels used in the operational noise model. The sound power levels for select plant and equipment have been obtained during on-site measurements by EMM. All other sound power levels have been obtained from the EMM sound power database and are based on measurements undertaken at similar facilities.

**Table 5.1 Operational plant and equipment sound power levels**

Plant/equipment	Quantity		Sound power level, $L_{Aeq,15\text{ minute}}$ dB
	Day	Night	
Road trucks <sup>1</sup>	2	2	101
Front end loader (FEL) – Face	1	1	114
Front end loader (FEL) – Quarry/Rec.	2	2	115
Front end loader (FEL) – CBP/Asp.	2	2	105
Haul trucks <sup>1</sup>	6	6	108
Compressor	1	1	101
Drill	1	1	116

**Table 5.1 Operational plant and equipment sound power levels**

Plant/equipment	Quantity		Sound power level, $L_{Aeq,15\text{ minute}}$ , dB
	Day	Night	
Excavator (35 tonne)	2	2	109
Excavator (65 tonne)	1	1	114
Dozer	1	1	117
Processing plant	1	1	116
Water cart	1	1	96
Bobcat	1	1	100

Notes: 1. Travelling under 20 km/h.

2. For the purposes of providing a conservative assessment  $L_{Aeq}$  and  $L_{A10}$  noise levels are assumed to be the same.

### 5.2.2 Operating assumptions

In addition to the sound power levels and quantities provided, main operating assumptions adopted are as follows:

- All on-site equipment is assumed to operate for 12 hours (80%) of the 15 hour day period , and for 1 hour (11%) of the 9 hour night period (consistent with current operating hours);
- all onsite vehicle movements are 20 km/hr or less.

The quantities and sound power levels of plant and equipment levels provided in Table 5.1 are representative of the project working at full capacity. This scenario has been modelled for the day and night periods and is considered to represent an acoustically worst-case operating scenario.

### 5.3 Sleep disturbance

The noise sources most likely to cause intermittent transient noise impacts (and subsequently potential sleep disturbance) are FEL loading and unloading aggregate and stockpiled materials. Measured at a site with similar operations and equipment to those used at the project, the maximum noise level from the aforementioned activities was  $L_{Amax}$  125 dB. This  $L_{Amax}$  noise level was used to represent maximum noise level events occurring in the noise model. These events were modelled at various locations across the site to represent various worst case noise scenarios. The predicted noise levels from each location were then ranked to provide a range. Noise levels were predicted under standard and noise enhancing meteorological conditions as provided in Table 3.4.

## 6 Noise assessment

### 6.1 Operational noise

Noise emissions have been predicted for the peak operating scenario during calm and prevailing meteorological conditions as relevant (refer Table 3.4). The noise level predictions are therefore considered conservative for assessment purposes.

Table 6.1 presents the predicted operational noise levels. Results are provided for the day and night periods during worst-case meteorological conditions.

Site noise emission levels are predicted to satisfy the relevant noise limits at most assessment locations. Noise contour maps for the predicted worst-case  $L_{A10}$  noise levels for day and night periods are provided in Appendix B and C, respectively.

**Table 6.1 Predicted operational noise levels**

Assessment location	Description	Noise limits, $L_{A10}$ , dB		Predicted worst-case noise level, $L_{A10}$ , dB		Exceedance (Day/Night), dB
		Day	Night	Day	Night	
1	Broadacre	50	40	50	42	Nil/2
2	Broadacre	50	40	49	40	Nil
3	Broadacre	50	40	48	40	Nil
4	Broadacre	50	40	42	34	Nil
5	Broadacre	50	40	42	34	Nil
6	Broadacre	50	40	47	39	Nil
7	Broadacre	50	40	41	33	Nil
8	Broadacre	50	40	47	38	Nil
9	Broadacre	50	40	45	37	Nil
10	Broadacre	50	40	48	39	Nil

Notes: 1. Day is 7am-10pm Monday to Saturday and 8am-10pm on Sundays and public holidays.

2. Night is 10pm-7am Monday to Saturday and 10pm-8am on Sundays and public holidays.

Operational noise emission levels are predicted to meet the noise limits at all assessment locations for calm conditions during the daytime period under worst-case meteorological conditions. During the night-time period, a minor exceedance of up to 2 dB is predicted to occur at one assessment location (1) under worst-case meteorological conditions.

It is of note that this assessment assumes that  $L_{Aeq}$  and  $L_{A10}$  noise emission levels are the same and as such, provides a conservative assessment.

Analysis of the unattended noise monitoring data (presented graphically in Appendix A) showed that ambient noise levels are generally increasing from 5 am Monday to Saturday. On these days during the noise monitoring period, the  $L_{A90}$  descriptor was often above 35 dB before 6 am (ie the time the project would commence operations).

In addition to this, as noted in Table 2.2, a 1–2 dB change in sound levels is deemed ‘typically indiscernible’ to the human ear. Therefore, changes of 1–2 dB are unlikely to be perceivable at nearby residences.

Further, the site has no reported history of causing an ‘environmental nuisance’ in terms of noise and has not received any noise complaints in recent times.

With these factors taken into account, it is unlikely that project noise emissions would cause adverse impacts at any assessment locations.

## 6.2 Maximum noise level event assessment

In the absence of an ACT policy on sleep disturbance, this assessment has been guided by the NSW NPfI. The predicted  $L_{Amax}$  noise levels from the quarry at the nearest residential assessment locations are presented in Table 6.2 for noise enhancing meteorological conditions.

Typical maximum noise level events, including truck air brakes, FEL/dozer activities and other various operations have been assessed. A worst case maximum noise level event of  $L_{Amax}$  125 dB was adopted to cover any of these possible events. This is based on our experience with events at similar facilities.

**Table 6.2 Predicted maximum noise levels - external**

Assessment location <sup>1</sup>	Predicted noise levels, $L_{Amax}$ dB	Screening criteria, $L_{Amax}$ dB
1	52	52
2	48	52
3	42	52

Notes: 1. In accordance with the NPfI, sleep disturbance impacts were only assessed at residential assessment locations.

Under prevailing meteorological conditions, noise modelling predicts that the  $L_{Amax}$  sleep disturbance screening criteria will be satisfied.

The NSW RNP provides the following conclusion from the research on sleep disturbance:

*maximum internal noise levels below 50 to 55 dB(A) are unlikely to awaken people from sleep*

It is commonly accepted by acoustic practitioners and regulatory bodies that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels below 60 dB at the facade of a residence are unlikely to cause awakening reactions and are not likely to significantly affect health and wellbeing.

Hence, it is unlikely that night-time operations from the project will cause sleep-disturbance at any of the assessment locations.

Nonetheless, work practices during the night period will be appropriately managed to minimise the impact and number of potential maximum noise events. Recommendations in this regard are provided in Chapter 7.

## 7 Management and mitigation

It is unlikely that the level or nature of noise emissions from the project will cause any community response or noticeable change in the surrounding acoustic environment. Accordingly, there is no requirement for additional operational noise management and mitigation.

Notwithstanding, Boral will manage noise emissions from the project, particularly during the night-time period, by adopting universal work practices such as:

- reinforcement of noise mitigating activities through the Operational Environmental Management Plan (OEMP) and toolbox talks including:
  - the avoidance of the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby receptors;
  - where possible, avoiding the use of equipment that generates impulsive noise;
  - minimising the need for vehicle reversing for example, by arranging for one-way site traffic routes;
  - minimising the movement of materials and plant and unnecessary metal-on-metal contact;
- use of broadband audible reverse alarms on vehicles used on site; and
- scheduling respite periods for intensive works.

## 8 Conclusion

EMM has completed a NIA for the project. This assessment considered the potential for noise impacts during operation of the project and was prepared in accordance with the methodology outlined in the EPR, as well as other relevant guidelines and standards.

Findings of the assessment are summarised as follows:

- Operational noise levels are predicted to satisfy relevant criteria in the daytime and night-time periods at most assessment locations. During the night-time period, a minor exceedance of up to 2 dB is predicted to occur at one assessment location (1) under worst-case meteorological conditions.

Analysis of noise monitoring data showed that ambient noise levels are generally increasing from 5 am and the  $L_{A90}$  descriptor was often above 35 dB before 6 am (ie the time the project would commence operations). In addition, a 1–2 dB change in sound levels is deemed ‘typically indiscernible’ to the human ear and is unlikely to be perceivable at nearby residences. Further, the site has no reported history of causing an ‘environmental nuisance’ in terms of noise and has not received any noise complaints in recent times.

Due to these, it is unlikely that project noise emissions would cause adverse impacts at this assessment location.

- Sleep disturbance from operation of the Project during the night period has been assessed. Internal maximum noise level events are predicted to be below those likely to awaken residents.

## References

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ACT Government 2005, *Environment Protection Regulation* (EPR);

ACT Government 2010, *Noise Environment Protection Policy* (NEPP);

Australian Standard (AS) 1055-1997, Acoustics - Description and Measurement of Environmental Noise.

NSW Department of Environment and Climate Change (DECC) 2009 *Interim Construction Noise Guideline*

NSW Department of Environment, Climate Change and Water (DECCW) 2011, *Road Noise Policy* (RNP);

NSW Environment Protection Authority (2000) *NSW Noise Policy for Industry* (NPfI).

World Health Organization 1999, *Guidelines for Community Noise*

## Appendix A

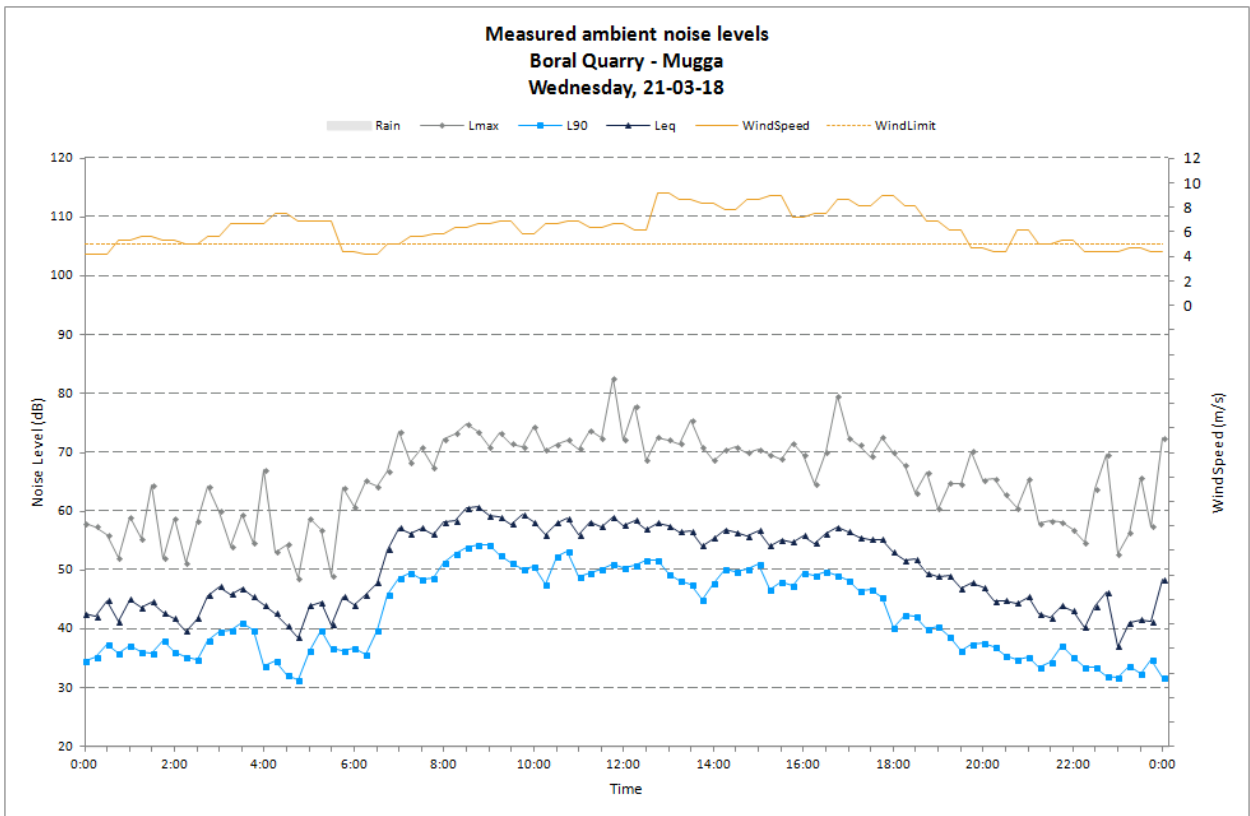
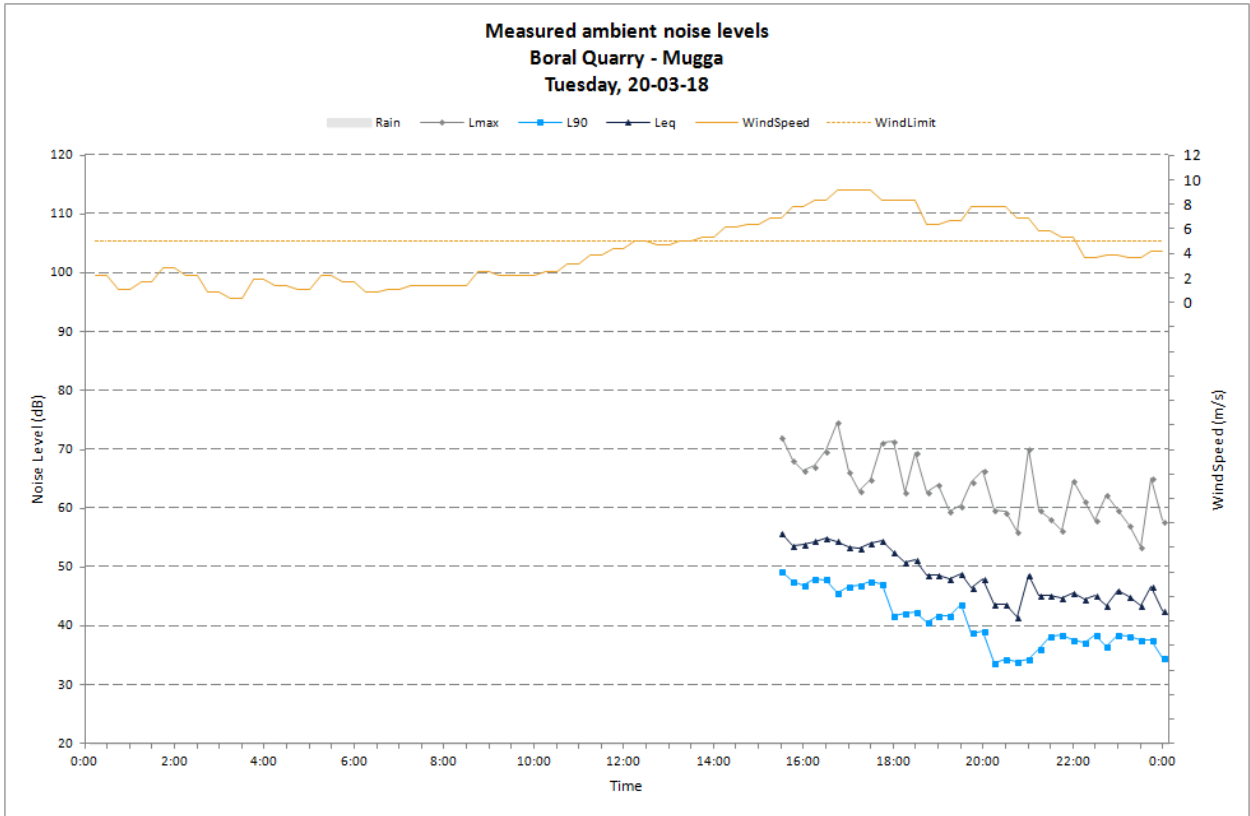
### Unattended noise monitoring data and charts

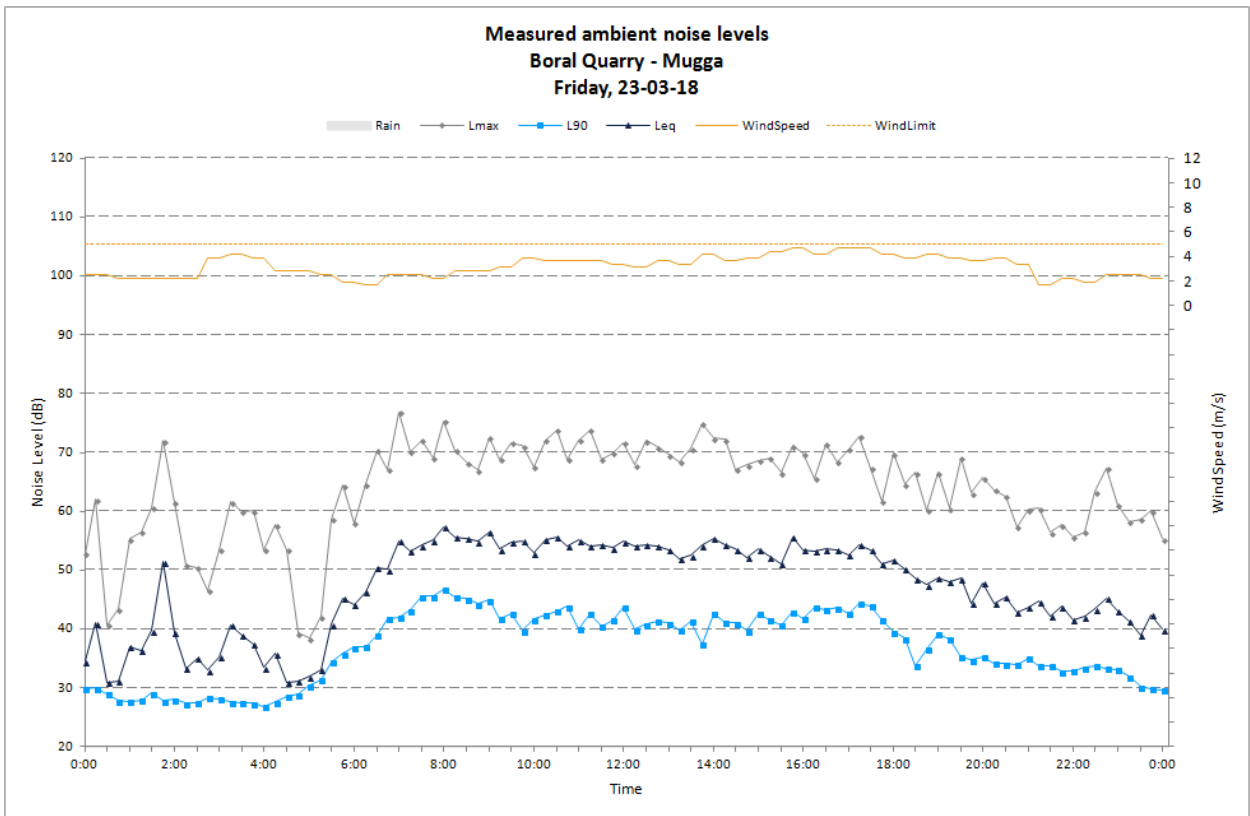
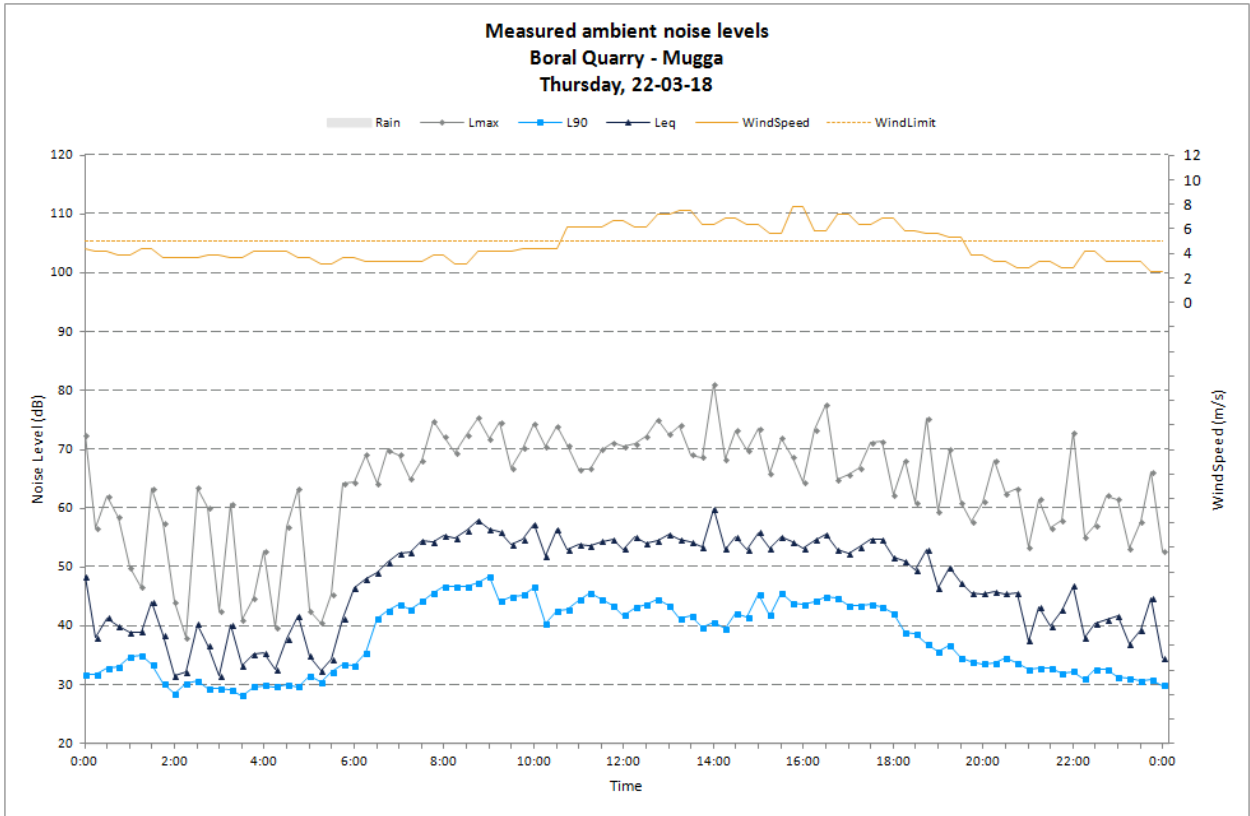
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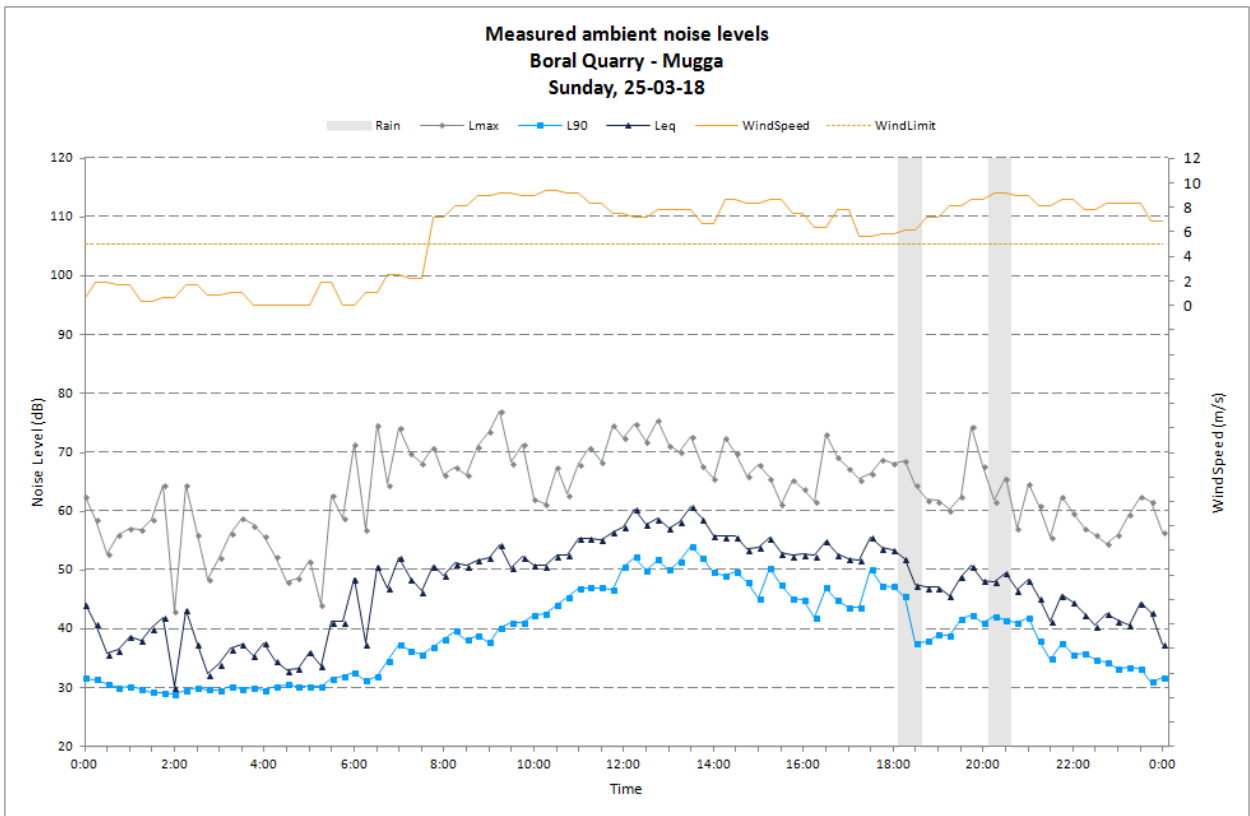
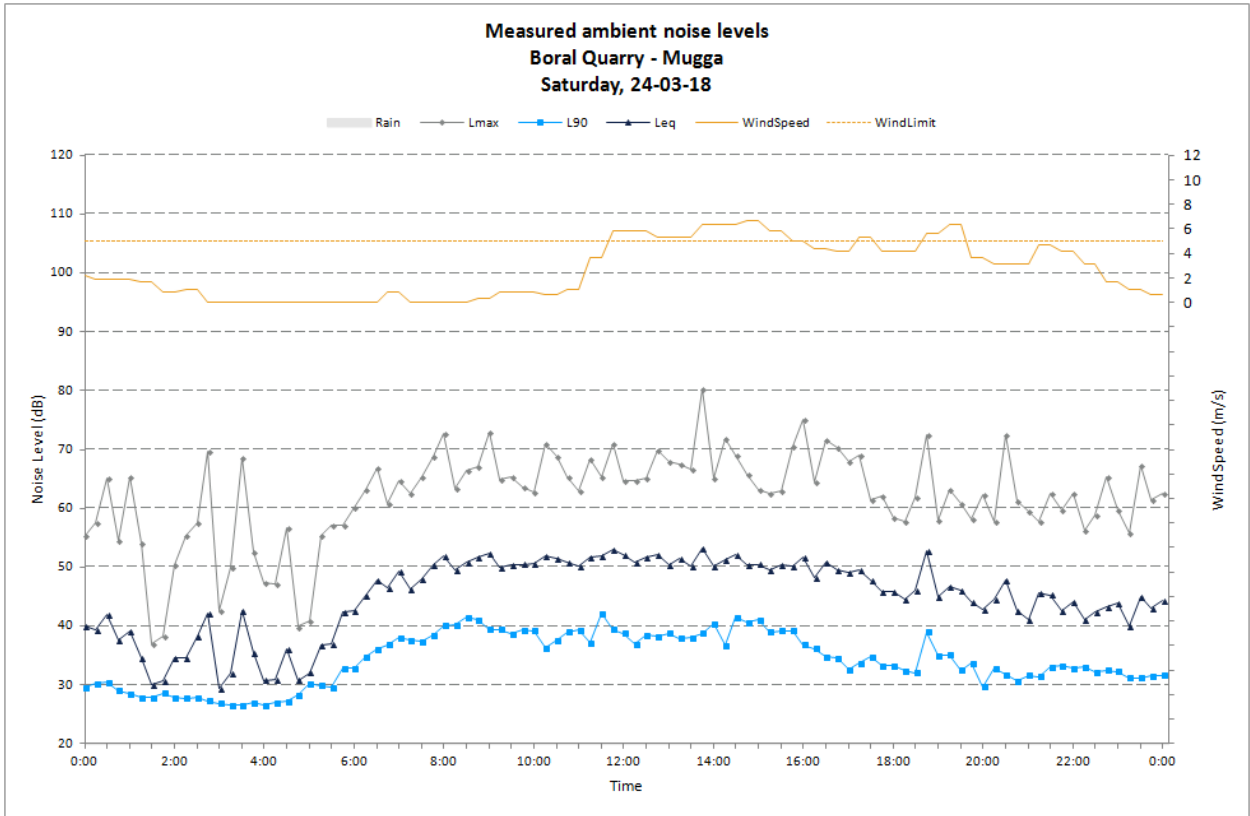
**Table A.1 Summary of daily noise logging results**

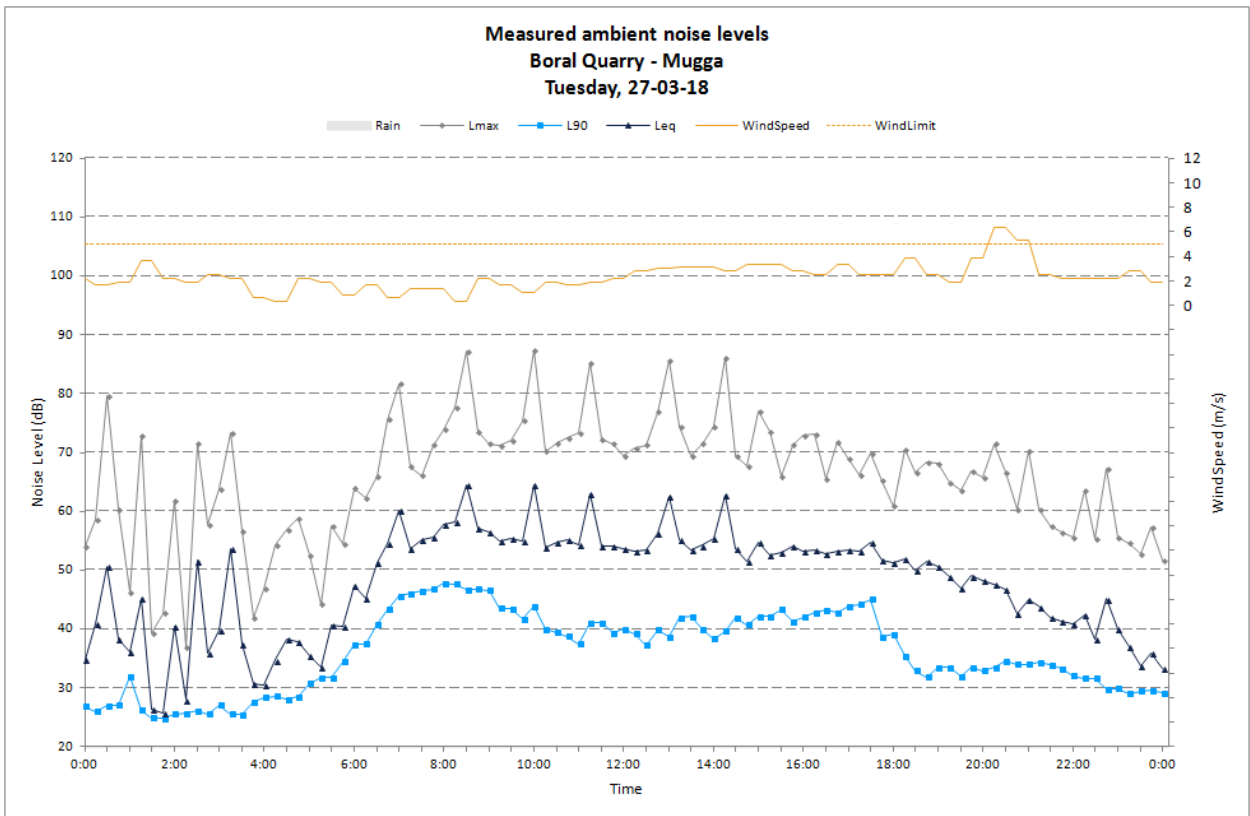
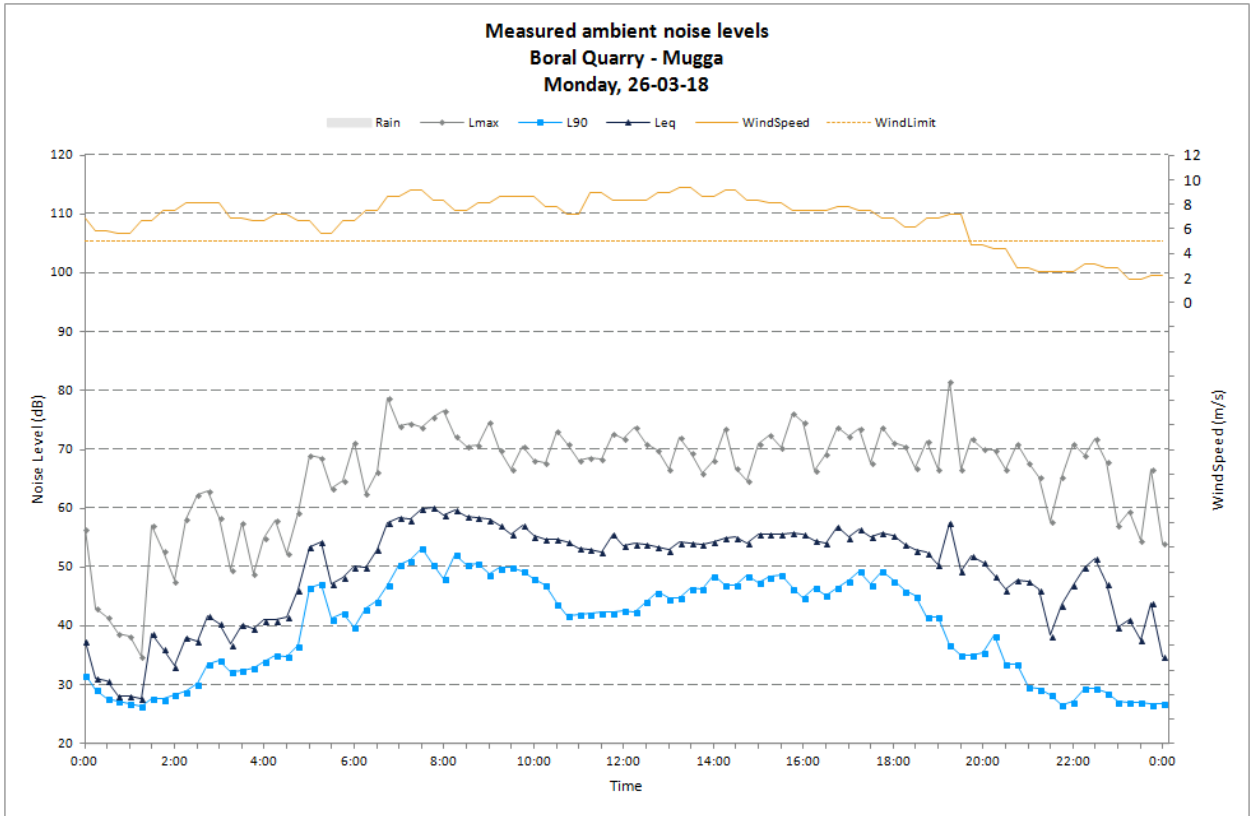
<b>Date</b>	<b>ABL Day</b>	<b>ABL Evening</b>	<b>ABL Night</b>	<b>L<sub>Aeq,11 hour</sub> Day</b>	<b>L<sub>Aeq,4 hour</sub> Evening</b>	<b>L<sub>Aeq,9 hour</sub> Night</b>
Tuesday, 20-03-18	0	0	0	0	0	0
Wednesday, 21-03-18	0	0	29	0	0	44
Thursday, 22-03-18	0	0	28	0	0	44
Friday, 23-03-18	40	33	27	54	47	42
Saturday, 24-03-18	0	0	30	0	0	43
Sunday, 25-03-18	0	0	0	0	0	0
Monday, 26-03-18	0	0	26	0	0	49
Tuesday, 27-03-18	39	0	28	57	0	49
Wednesday, 28-03-18	40	31	28	58	47	46
Thursday, 29-03-18	0	28	29	0	45	41
Friday, 30-03-18	0	29	28	0	44	40
Saturday, 31-03-18	33	31	28	51	46	38
Sunday, 01-04-18	0	30	29	0	44	39
Monday, 02-04-18	34	0	28	49	0	38
Tuesday, 03-04-18	0	0	0	0	0	0
<b>Overall (RBL)/L<sub>Aeq</sub> (period)</b>	<b>38</b>	<b>31</b>	<b>28</b>	<b>55</b>	<b>46</b>	<b>44</b>

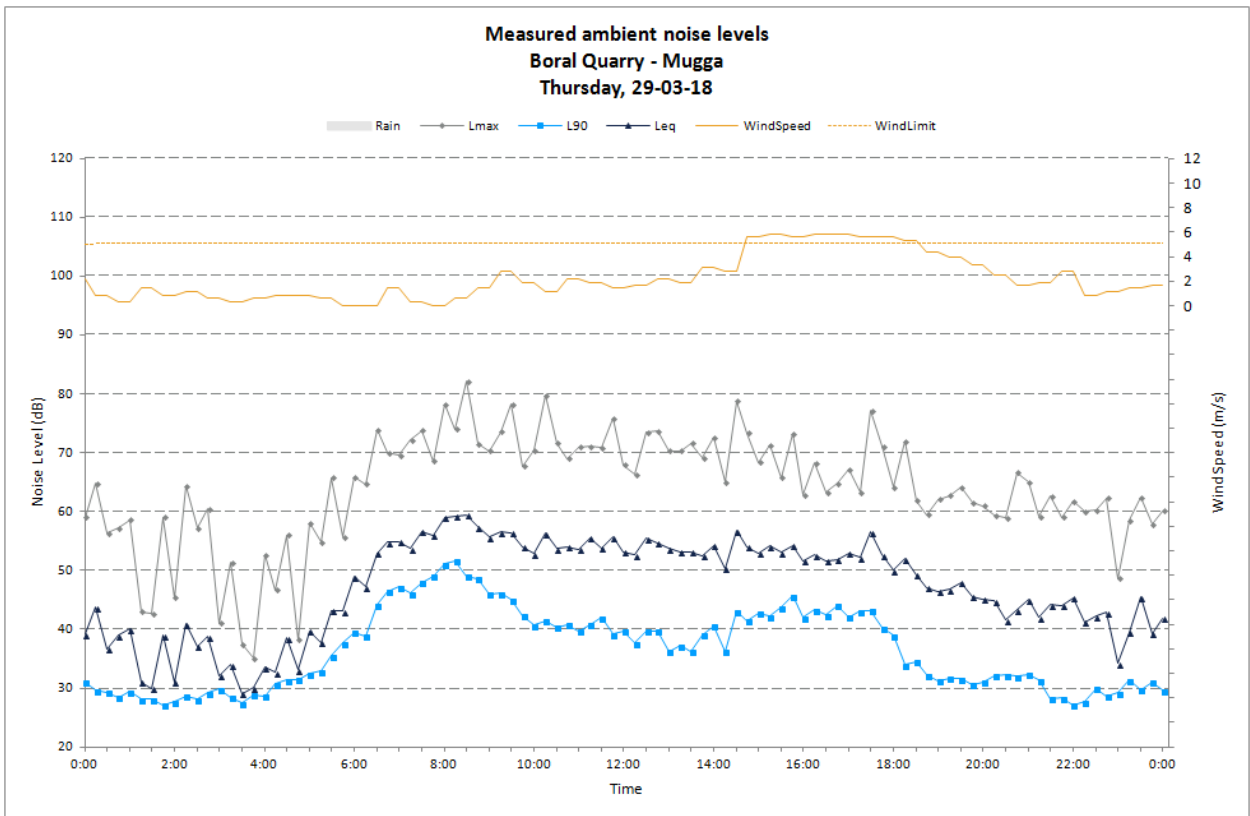
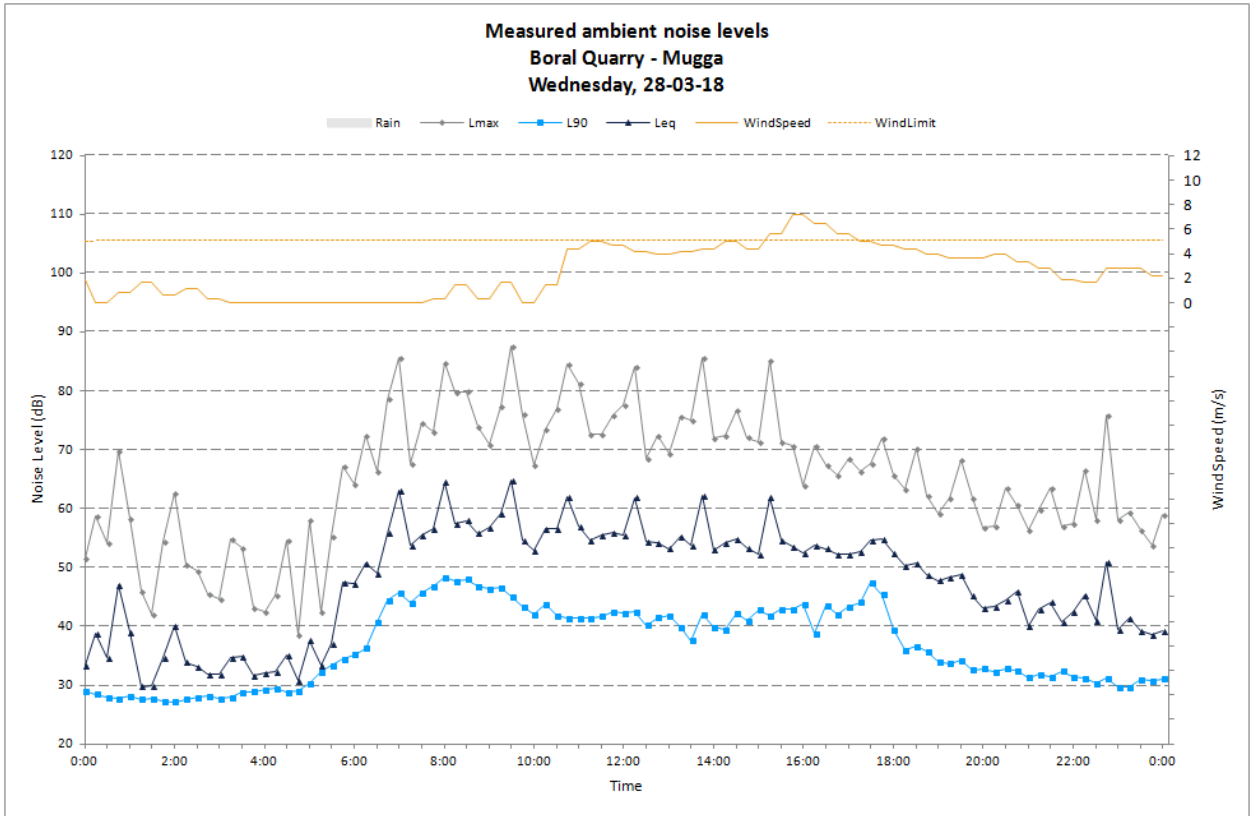
Notes: 1. '0' indicates that there was insufficient data due to weather conditions.

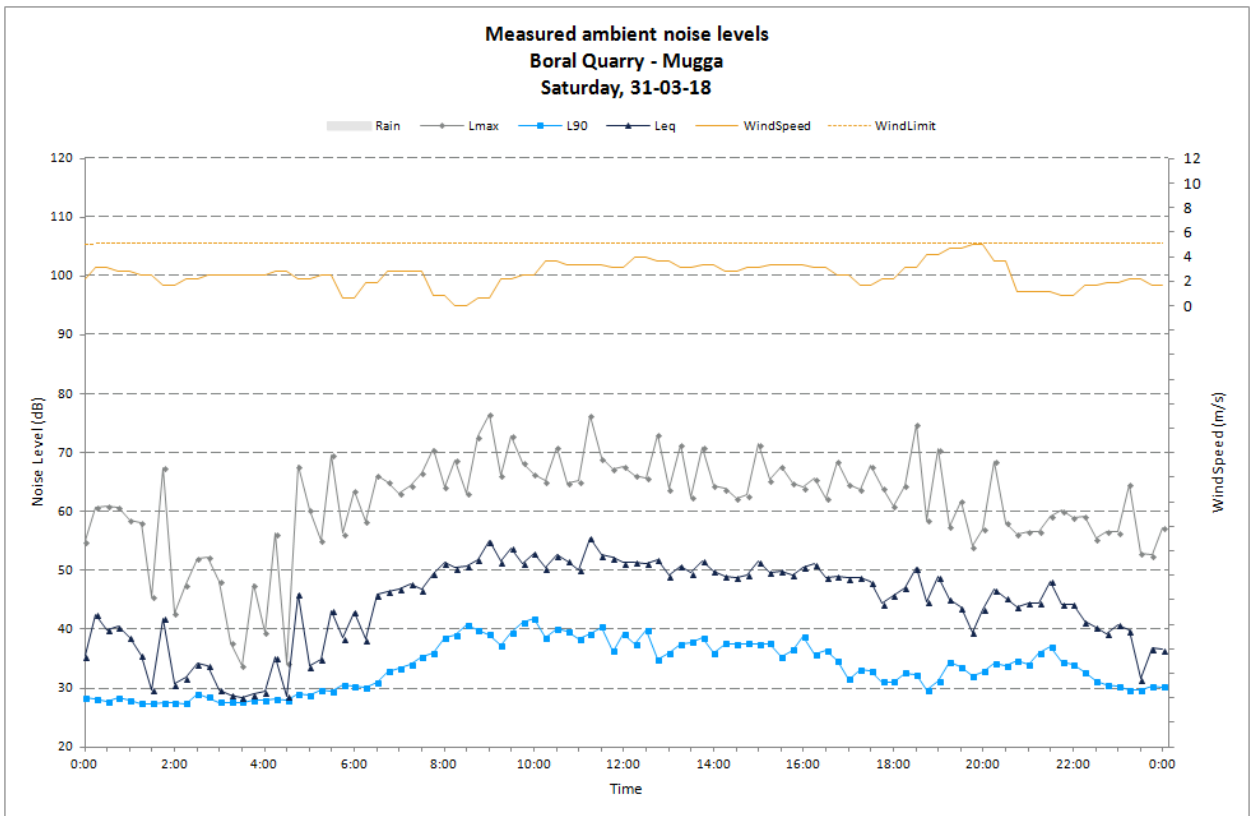
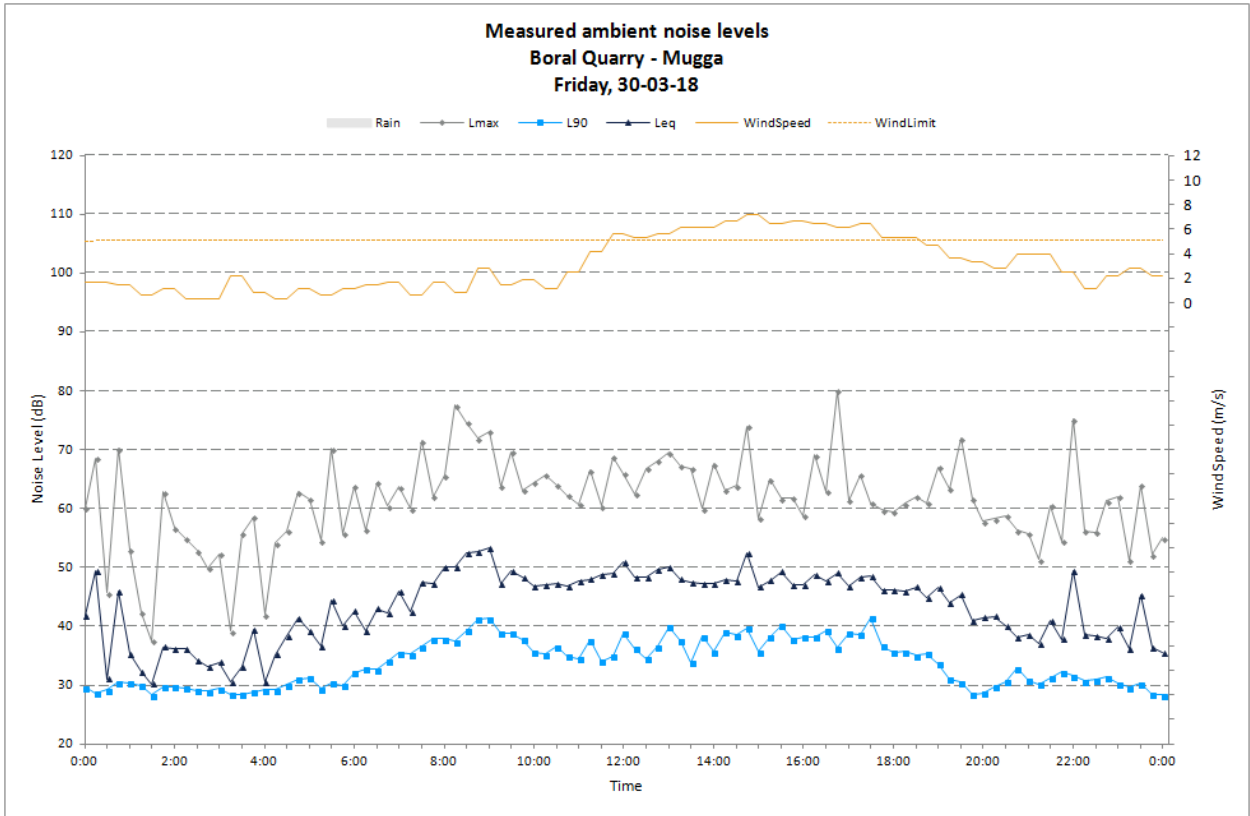


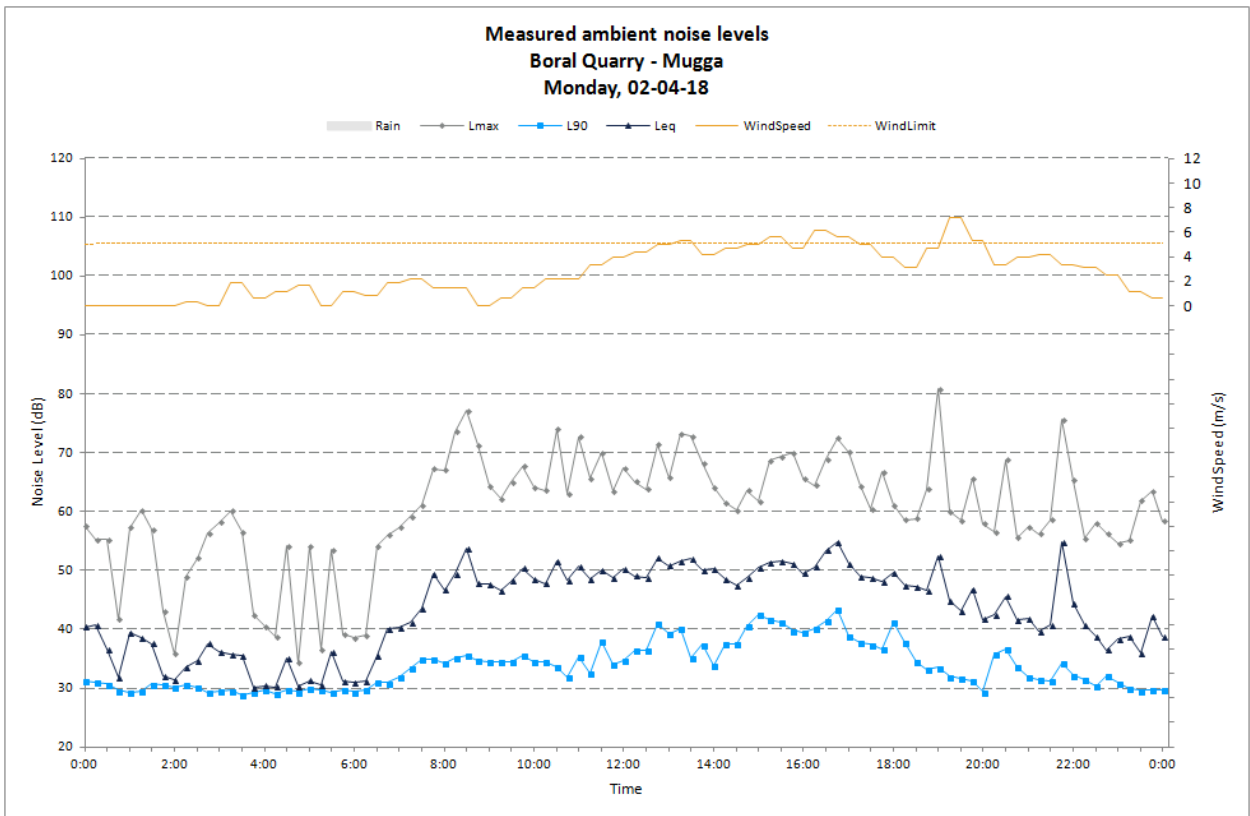
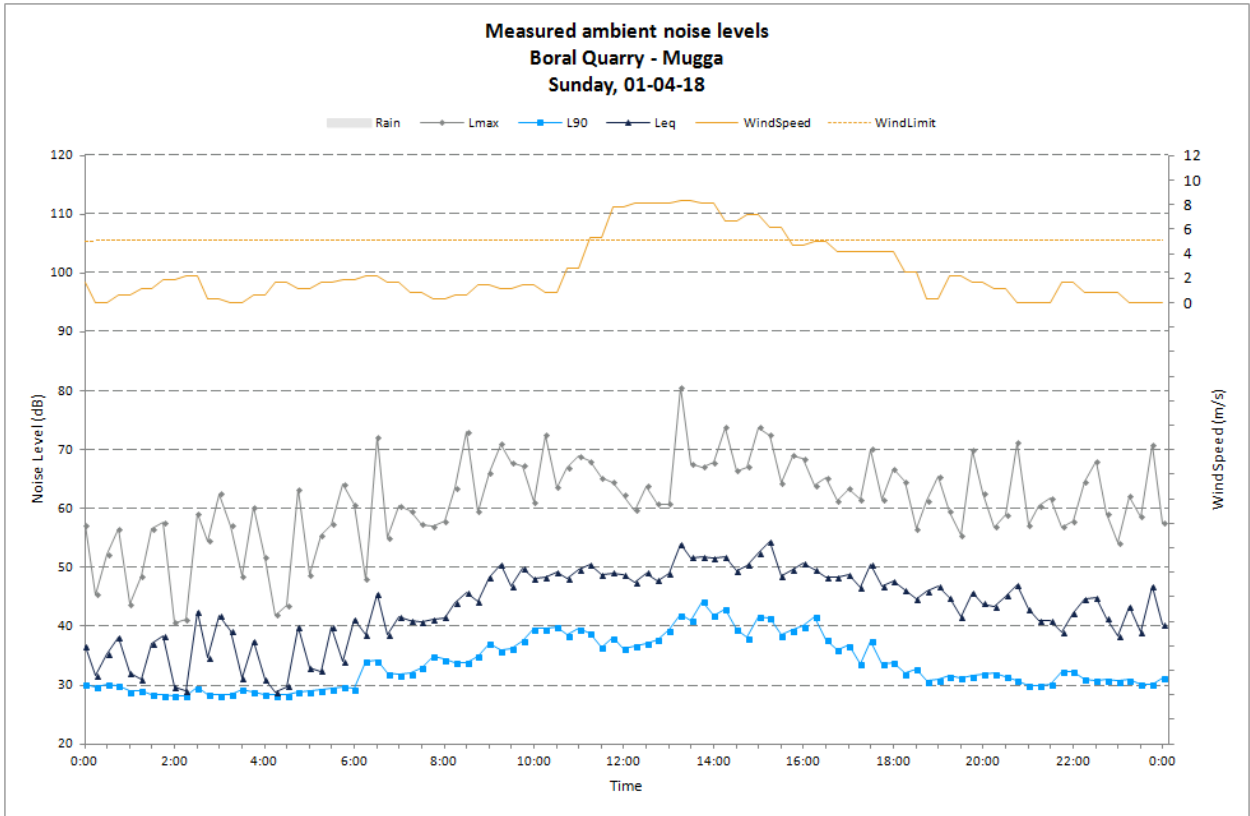




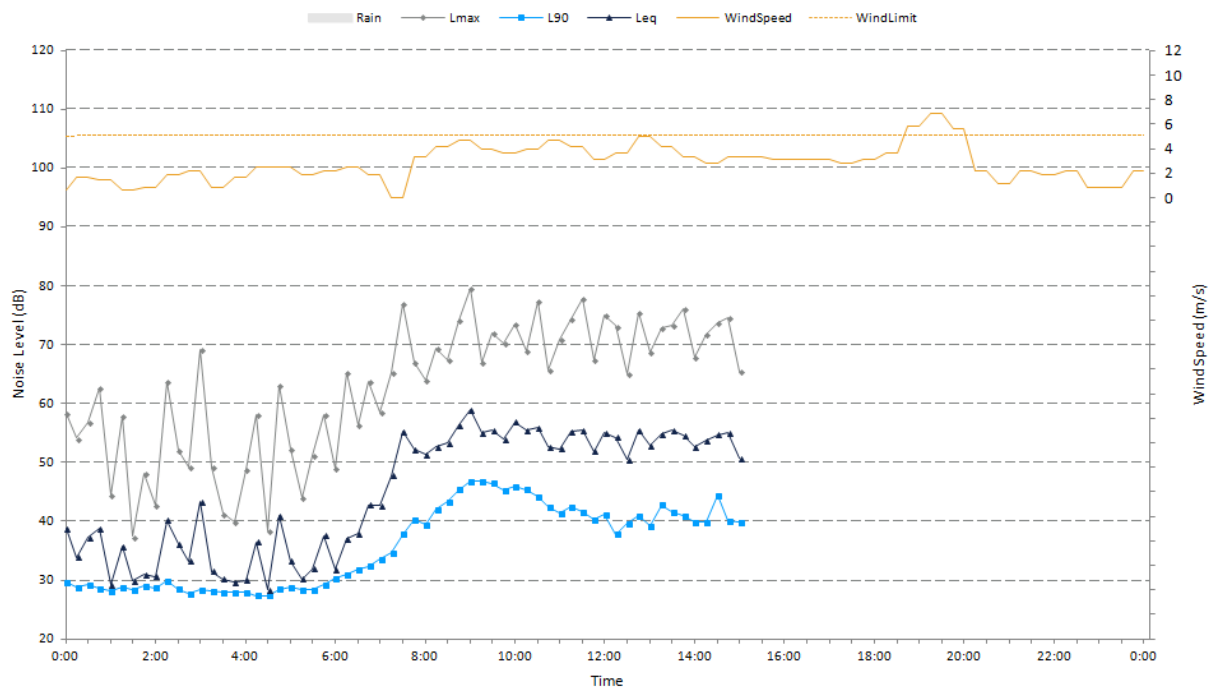








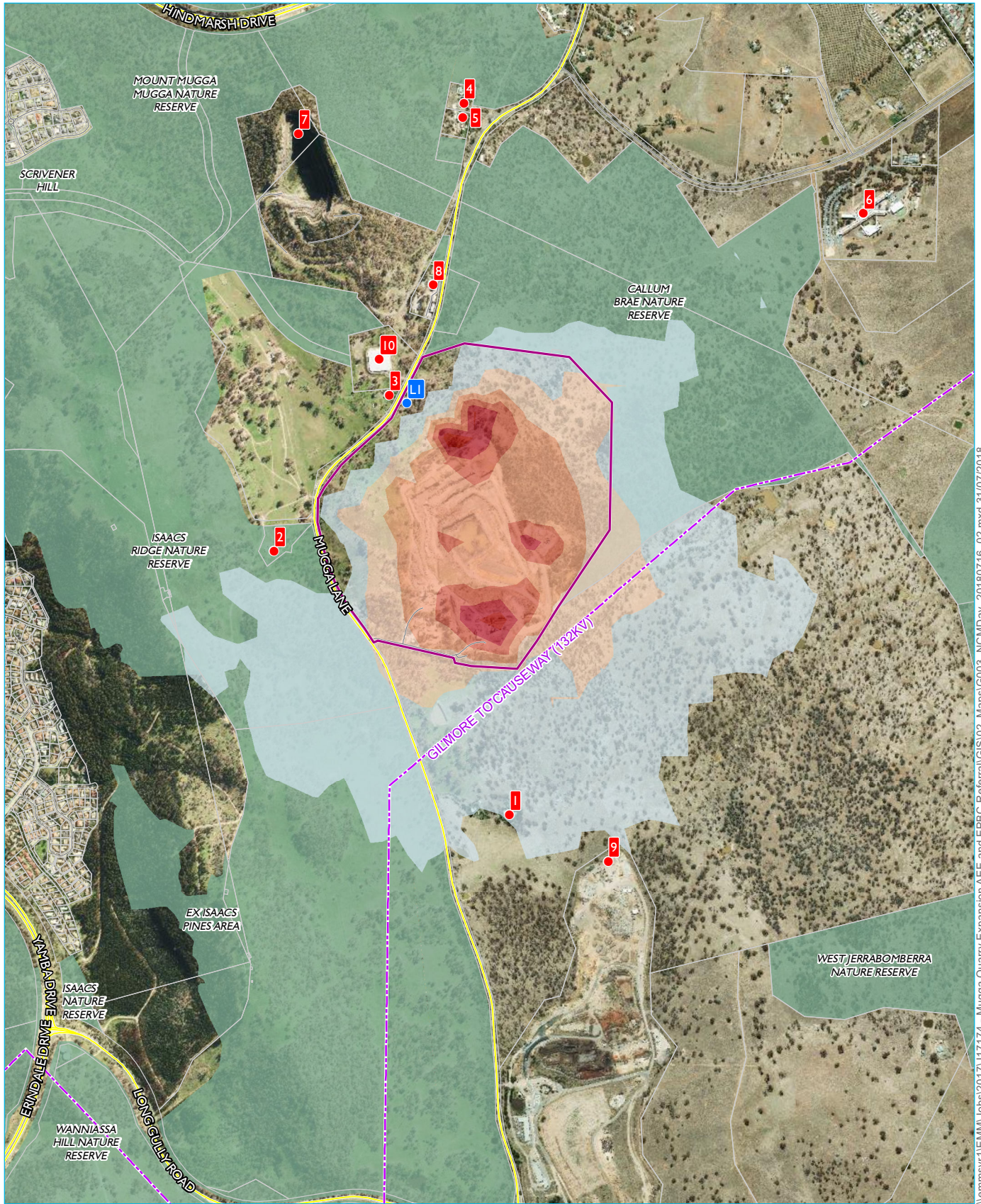
Measured ambient noise levels  
Boral Quarry - Mugga  
Tuesday, 03-04-18



## Appendix B

### Noise contour map - Day

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I:\emmsr\1\EMM\Jobs\2017\117174 - Mugga Quarry Expansion\AEE and EPBC Referral\GIS\02\_Maps\G003\_Maps\20180716\_02.mxd 31/07/2018

Source: EMM (2018); DFSI (2017); GA (2015)

**KEY**

● Broadacre	--- Electricity transmission line	Noise receptor LA10, Period dB
● Noise monitoring location	— Main road	50
□ Site location - 321 Mugga Lane, Symonston	— Local road	55
	— Watercourse	60
	□ Cadastre	65
	■ Reserve	70
		75

**Noise contour map - day**

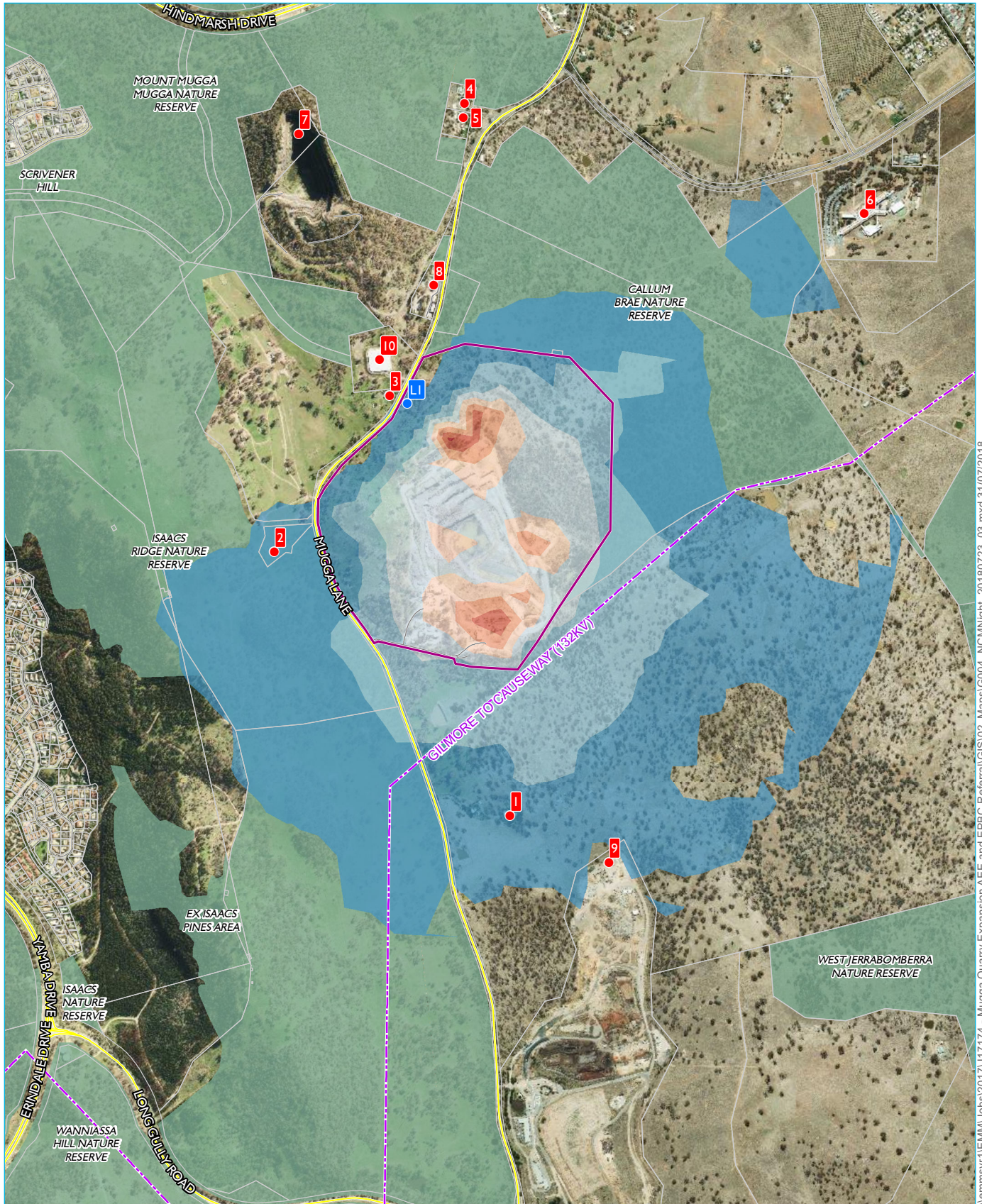
Boral - Mugga Quarry overburden expansion  
Noise Impact Assessment  
Figure B.1



## Appendix C

### Noise contour map - Night

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Source: EMM (2018); DFSI (2017); GA (2015)

**KEY**

Receptor	--- Electricity transmission line	Noise receptor LA10,Period dB
● Broadacre	— Main road	■ 40
● Noise monitoring location	— Local road	■ 45
□ Site location - 321 Mugga Lane, Symonston	— Watercourse	■ 50
	□ Cadastre	■ 55
	■ Reserve	■ 60
		■ 65
		■ 70

**Noise contour map - night**

Boral – Mugga Quarry overburden expansion  
Noise Impact Assessment  
Figure C.1



I:\emmsr\1\EMM\Jobs\2017\117174 - Mugga Quarry Expansion\AEE and EPBC Referral\GIS\102\_Maps\G004\_Maps\light\_20180723\_03.mxd 31/07/2018



#### SYDNEY

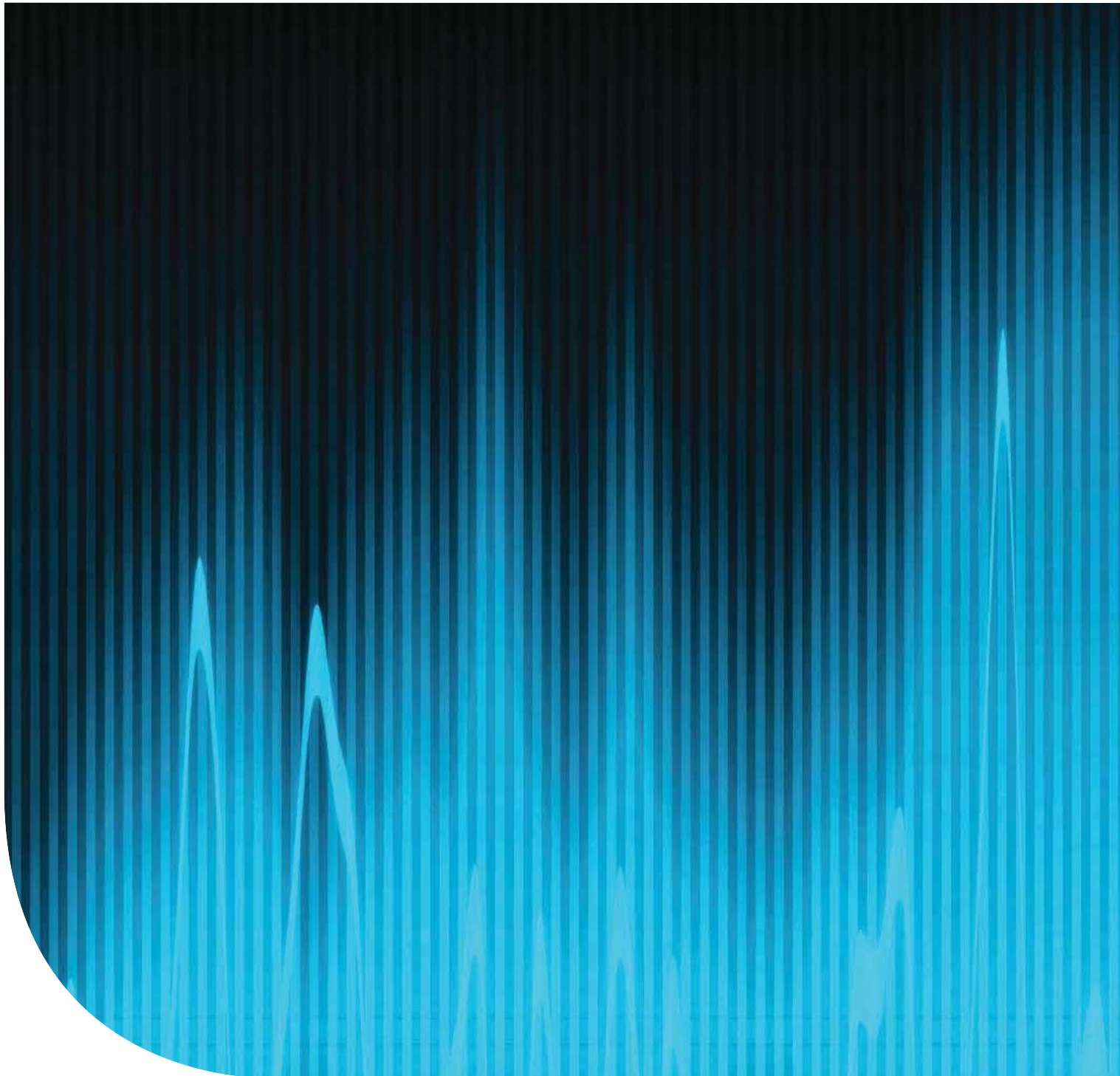
Ground floor, Suite 01, 20 Chandos Street  
St Leonards, New South Wales, 2065  
T 02 9493 9500 F 02 9493 9599

#### NEWCASTLE

Level 1, Suite 6, 146 Hunter Street  
Newcastle, New South Wales, 2300  
T 02 4907 4800 F 02 4907 4899

#### BRISBANE

Level 4, Suite 01, 87 Wickham Terrace  
Spring Hill, Queensland, 4000  
T 07 3839 1800 F 07 3839 1866



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Appendix N

## Boral environment policy

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**ZEROHARM  
TODAY**

## Environment Policy

At Boral we own and operate a diverse range of businesses in a number of countries and within many different ecosystems. We acknowledge that the very nature of our operations means there will be impacts on the environment.

We are committed to our goal of zero harm and work to eliminate adverse environmental impacts. Where elimination is not possible, we seek to minimise any harmful effects from our operations which may mean we target better performance than environmental laws require. Wherever practicable, we will secure improved environmental outcomes.

Specifically, Boral will:

- Reduce waste in all its forms, by application of LEAN manufacturing principles, leading to:
  - efficient use of energy, including reuse of waste energy
  - conservation of water
  - minimisation and recycling of waste production materials and energy
  - prevention of pollution; and
  - effective use of virgin and recovered resources and supplemental materials.
- Reduce greenhouse gas emissions from our processes, operations and facilities, including appropriate use of alternative fuels
- Protect and where practicable enhance biodiversity values at and around our facilities.
- Openly and constructively engage with communities surrounding our operations.
- Through communication and training, encourage and assist our employees to enhance Boral's environmental performance.
- Comply with environmental legislation, regulations, standards and codes of practice relevant to the particular business, as a minimum, and
- Allocate sufficient resources to meet the commitments of this Policy:

This policy is delivered through the implementation of Boral's integrated Health Safety Environment and Quality (HSEQ) Management System and related strategies, improvement plans and programs.

A handwritten signature in black ink, appearing to read "Mike Kane".

**Mike Kane**  
**Chief Executive Officer & Managing Director**



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Appendix O

# Boral stakeholder engagement statement

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## BORAL MUGGA OPERATIONS: STAKEHOLDER CONSULTATION – QUARRY OVERBURDEN PROPOSAL

The following statement sets out how Boral's consultation methods and approaches have been applied to the Mugga Quarry Overburden proposal, provides a record of the outcome of consultation, and how the outcomes have been used to inform the preparation of the draft Environmental Impact Statement (EIS), where relevant.

### 1.1 Purpose

The purpose of stakeholder consultation is to

- identify community members and groups that may be affected by the proposed development;
- actively engage with and inform stakeholders about the project;
- identify and address any potential issues (where required) prior to submitting the draft EIS; and
- gain valuable feedback to improve the project's operations and performance.

### 1.2 Consultation extent and stakeholder identification

The following stakeholders were identified for consultation, including:

- Murray Coaches, Mugga Lane;
- Mugga Lane Horse Farm; and
- Occupants of properties to the south along, Mugga Lane (located between Boral's operations and landfill operation).

The extent of consultation and identification of stakeholders for the project took into the consideration:

- that there have been **no** complaints registered with Boral in relation to the operation of the Mugga Quarry for six years;
- previous applications lodged by Boral for this site have received limited or no response from local land occupiers/lease holders, nor the broader community in response to the associated notification/exhibition periods;
- that there are no known active community groups based at or operating from within the locality likely to be affected or influenced by the proposal;
- the predominantly rural nature of the area means there is a limited number of adjoining land occupiers/leaseholders; and
- the distance, separation and topography between Boral operations and adjoining property owners

### 1.3 Methodology

The method of consultation is tailored to the project and the number, type and locational characteristics of identified stakeholders. Given the limited number of stakeholders identified as being potentially affected by the proposal, Boral adopted direct engagement methods. These are set out in in the table below.

Method	Activity
'Door knock' and face to face discussion	'Door knocking' properties of identified stakeholders (i.e. surrounding landowners) to discuss the proposal and seek feedback.
Phone calls	Follow up phone calls to identified stakeholders who did not respond during the 'door knock'.
Calling Cards or letter drop	Stakeholders, who could not be reached during the 'door-knock', follow up phone calls or for whom Boral did not have phone numbers. Calling cards or correspondence were left with details of the Quarry Manager or the Planning and Development Manager (NSW/ACT), refer to <b>Appendix A</b> .



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#### 1.4 Consultation Summary and Timeline

Consultation with the identified stakeholders has been undertaken at various points in the development process, initially in February 2018 and again in October 2018.

As part of the finalisation of the draft EIS identified stakeholders contacted on Tuesday, 18 December 2018 to discuss the proposal and advised of the lodgement of draft EIS. A summary of the stakeholders consulted and methods applied are set out in the table below.

Stakeholder	Method
Brema Group (southern property, formerly occupied by Andrew Cordal)	Discussion with onsite receptionist (door knock) regarding the intent of the visit. Letter and business card left for review and contact should they wish to discuss the proposal or review documentation.
Mugga Horse park lot 264	Attendance to site (door knock). Front gate was locked, letter and business card left for occupant to contact Boral.
Old house (top of hill) no lot reference.	Attendance to site (door knock). Front gate was locked, letter and business card left for occupant to contact Boral.
Murrays Coaches, Lot 146	Spoke to receptionist on site (door knock). Letter and business card left for review and contact should they wish to discuss the proposal or review documentation.

#### 1.5 Stakeholder Response and Consideration

Boral maintains contact with adjoining landowners on an informal basis. As part of earlier discussions held with stakeholders, during February or October 2018, no issues or concerns were raised regarding the current operation or the proposed development.

As no comments or matters were raised in relation to the proposal, no changes have been made to the proposal.

In the event that submissions are received in relation to the letter drop to adjacent landowners or as part of the public exhibition process undertaken in accordance with the *Planning and Development Act 2007*, matters raised will be considered in Boral's Response to Submissions and, where necessary and relevant, used to inform any refinement of the project.



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## **Appendix A: Stakeholder Correspondence**

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18 December 2018

**Boral Construction Materials**  
Boral Resources (Country) Pty  
Ltd  
ABN 451 000 187 002

**Boral Mugga Quarry**  
Mugga Lane  
Symonston ACT 2609  
T: +61 (02) 6239 6841

Neighbours of the Boral Mugga Quarry  
Mugga Lane  
SYMONSTON ACT 2609

[www.boral.com.au](http://www.boral.com.au)

Dear Neighbour

**MUGGA QUARRY – 321 MUGGA LANE, SYMONSTON – PROPOSED DEVELOPMENT,  
NOTICE OF LODGEMENT**

Boral Resources (Country) Pty Ltd (Boral) may have contacted you in early 2018 to discuss a proposal to construct a new permanent bund and temporary emplacement associated with the continued operation of the Mugga Quarry.

A draft Environmental Planning Statement (EIS) has now been prepared by EMM Consulting and lodged with the Environment, Planning and Sustainable Development Directorate – Planning (ACT Planning).

This letter is to inform you that the proposal will shortly go on exhibition. However, should you wish to know more about the proposal, view the plans or draft EIS please feel free to contact the undersigned at [Robert.Young@boral.com.au](mailto:Robert.Young@boral.com.au) or phone 0401 894 245. Alternatively, you may contact Rachael Snape, on 0401 894 110 or email [Rachael.Snape@boral.com.au](mailto:Rachael.Snape@boral.com.au)

Yours faithfully

A handwritten signature in blue ink, appearing to read "Robert Young", is written over a circular stamp. The stamp contains the text "Robert Young Quarry Manager Boral Mugga Quarry".

**Robert Young**  
**Quarry Manager**  
**Boral Mugga Quarry**

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Appendix P

## Boral response to informal submission

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**Subject:** Mugga Quarry proposed overburden bund response to queries

**From:** "Snape, Rachael" <rachael.snape@boral.com.au>

**Date Sent:** Friday, March 8, 2019 4:51:44 PM GMT+11:00

**Date Received:**

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Good afternoon

Further to your query earlier this week in relation to the draft EIS for Mugga Quarry, I hope the following provides some more guidance on the matters raised.

**1) Where "permanent overburden bund/emplacement" is referred to, does this mean it's a one-time situation where the overburden material will be placed there on a singular occasion to remain permanently, or will it be an ongoing process where material will be carted in and out?**

The overburden bund will be built using 620,000 cubic metres of excavated material. The emplacement of material would occur progressively. Once completed the overburden will be naturally revegetated and remain permanently.

The works will not involve the removal of the overburden material from the site, with the permanent bund to be located to the north of the approved existing quarry pit.

Emplacement within the site means no vehicle movements need to occur beyond the site boundaries.

**2) For our own understanding, could you please provide the definition of the following: TSP, PM<sub>10</sub>, PM<sub>2.5</sub> and what kind of dust is being included in the air quality assessment in Appendix H?**

There are acronyms where:

- TSP refers to **T**otal **S**uspended **P**articulates
- PM stands for **P**articulate **M**atter. The numbers after the acronym refer to the size of the PM. So,
  - PM<sub>10</sub> refers to particulate matter less than 10 microns in diameter; and
  - PM<sub>2.5</sub> refers to particulate matter less than 2.5 microns in diameter (these may also be referred to as fine particles).

Further explanation can be found in section 2.1 (p.9) of the Air Quality Assessment (AQA).

The dust referred to in the AQA is related to quarry activities, such as excavation and construction works (refer to section 2, p. 9 – Appendix H). You may see the report frequently uses the term "fugitive dust" which is an industry term referring to small particles, the source of which is primarily soil (refer to section 5.1, p. 25 – Appendix H).

The AQA also assesses particulate matter generated by the combustion of diesel fuel used in our plant or vehicles.

An emissions inventory by source and particle size, as well as TSP, is provided in Table 5-2 (p. 27 – Appendix H).

**3) Could you please provide some clarification around what the gradient numbers as delineated by the black lines (0.5, 5, 10, 25 etc.) mean in the below two snapshots? Our primary concern is that the residential dwelling on our property is included within these two projections so we'd like to understand what the impact would be.**

To summarise the images provided in your email are:

- § Figure 7-1: Maximum predicted 24-hour average PM<sub>10</sub> (µg/m<sup>3</sup>) – site only; and
- § Figure 7-2- Predicted annual average PM<sub>10</sub> (µg/m<sup>3</sup>) – site only.

*Note: µg/m<sup>3</sup> refers to a concentration measurement of micrograms per cubic metre. A microgram is one-millionth*

of a gram modelled to predict the maximum predicted concentrations at the selected assessment locations (i.e. worst-case scenario).

Figure 7-1 shows that for a 24-hour period, the maximum average concentration of PM measuring less than 10 microns (PM<sub>10</sub>) is at:

- **receptor 1 (south of the site):** greater than 5µg/m<sup>3</sup> but below 10 µg/m<sup>3</sup>
- **receptor 2 (west of the site):** below 5 µg/m<sup>3</sup>
- **receptor 3 (to the north of the site):** below 25µg/m<sup>3</sup>

Figure 7-2 shows the predicted annual average concentration of particulate matter less than 10 microns (PM<sub>10</sub>) is at:

- **receptors 1 and 2 (south and west, respectively):** greater than 0.5µg/m<sup>3</sup> but below than 1µg/m<sup>3</sup>; and
- **receptor 3 (to the north of the site):** below 5µg/m<sup>3</sup>.

To determine what this means for a receptor the modelled concentrations can be compared against Government adopted and applied industry standards. For air quality in the ACT (much like the rest of the country) these standards are known as the National Environment Protection Measure (NEPM) Ambient Air Quality (AAQ) standards (this is set out in section 2.2, p. 9 – Appendix H).

The NEPM adopts criteria for the concentrations of PM<sub>10</sub> and PM<sub>2.5</sub>, but is yet to adopt and implement a standard for measuring and managing TSP. Accordingly, for the latter the NSW Environment Protection Agency (EPA) criteria has been used.

A comparison of the NEPM and EPA (NSW) criteria against the dispersion modelling outcomes supplied by our consultants (Ramboll) is summarised in the table below. In all instances the modelled concentrations are below the Government criteria.

Pollutant	Averaging Period	Max Concentration (NEPM)	NSW EPA Criteria	Site only at Receptor 1 (R1)	Site + background at Receptor 1 (R1)
PM <sub>10</sub>	24-hour	50µg/m <sup>3</sup>	50µg/m <sup>3</sup>	~6µg/m <sup>3</sup>	-
	Annual	25 µg/m <sup>3</sup>	25µg/m <sup>3</sup>	<1µg/m <sup>3</sup>	10.8µg/m <sup>3</sup>
PM <sub>2.5</sub>	24-hour	25 µg/m <sup>3</sup>	25µg/m <sup>3</sup>	<2µg/m <sup>3</sup>	-
	Annual	8 µg/m <sup>3</sup>	8µg/m <sup>3</sup>	<0.5µg/m <sup>3</sup>	7.4µg/m <sup>3</sup>
TSP	Annual	-	90µg/m <sup>3</sup>	<2.5 µg/m <sup>3</sup>	26.5µg/m <sup>3</sup>

It is important to note the site-only assessment represents **all** of Boral's on-site operations taking place at the same time.

The site and background includes all of Boral's operations taking place at the same time combined with the existing background (or ambient) air quality (i.e. cumulative).

The current application only concerns the excavation and transport of overburden material, emplacement and bund construction, these operations are considered in the assessment of *incremental concentration and deposition rates*. This incremental assessment seeks to identify the contribution (the additional concentration of PM and TSP) of only the proposed development. These are shown, by receptor in Table 7-1 (p.30).

All other on site operations are approved and are not subject to the application.

Please feel free to get in contact if you require any further assistance.

Kind regards

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Telephone: (02) 9033 4401  
Mobile: + 61 401 894 110  
Fax: (02) 9033 5305  
Email: [Rachae.Snape@bora.com.au](mailto:Rachae.Snape@bora.com.au)

Bora Land & Property Group  
Trinity 2 Level 5  
39 Deh Road, North Ryde NSW 2113  
[www.bora.com.au](http://www.bora.com.au)



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Appendix Q

## Study team

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<b>Personnel</b>	<b>Project Role</b>	<b>Qualifications</b>	<b>Experience</b>
Brett McLennan	EMM – Project Director / Technical Reviewer	Bachelor of Town Planning (Hons)	25 years
Paul Gibbons	EMM – Project Manager / Lead EIS Author / Visual Impact Assessment	Bachelor of Resource Studies Graduate Diploma Resource Studies Master of Urban and Regional Planning	18 years
Tania Amanovic	EMM – Environmental Scientist / EIS Author	Bachelor of Arts in the Faculty of Science (dbl major) – <ul style="list-style-type: none"> <li>• Environmental Management and Development Studies</li> <li>• Culture Change</li> </ul>	8 years
Ryan Desic	EMM – Aboriginal Cultural Heritage	Bachelor of Arts (Hons) in Prehistoric and Historical Archaeology	10 years
Kerryn Armstrong	EMM – Aboriginal Cultural Heritage	Bachelor of Arts Archaeology and Anthropology	2 years
Nathan Garvey	EMM – Biodiversity Assessment	Bachelor of Science Graduate Diploma (Biological Science) Certified Environmental Practitioner (CEDnvp) Biodiversity Assessment Method (BAM) Accredited Assessor	18 years
Katie Diver	EMM – Biodiversity Assessment	Bachelor of Science in Ecology Master of Wildlife Management (Habitat) Accredited BBAM, FBA and BAM assessor	15 years
Antony Edenhofner	EMM – GIS Analyst	Bachelor of Science (Hons) in Applied Economic Geography	19 years
Jackie Clifford	EMM – GIS Analyst	Bachelor of Arts (Geography and Environmental Science) Master of Marine Science and Management	10 years
Scott Fishwick	Ramboll Environ – Air Quality	Bachelor of Science – Atmospheric Science	14 years
Chris Kuczera	Royal Haskoning DHV – Surface Water Assessment	Bachelor of Engineering (Hons)	12 years
Jarrah Muller	EMM – Surface Water Assessment	Bachelor of Engineering (Civil and Environmental) (Hons) Bachelor of Science (Environmental Biology)	12 Years
Katie Teyhan	EMM – Noise Assessment	Bachelor of Engineering (Mechanical)(Hons) Bachelor of Mathematics Advanced Diploma of Management	16 years
Lucas Adamson	EMM – Noise Assessment	Bachelor of Engineering (Hons) (Environmental) Certificate III in Laboratory Skills	8 years





