a. the factors identified in s.5A of the EP&A Act[1]; and
b. the guidance provided by *The Threatened Species Assessment Guideline – The Assessment of Significance (DECCW, 2007)*. This guideline is available on the OEH website: http://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf

5. Where an offsets package is proposed by a proponent for impacts to biodiversity (and a BioBanking Statement has not been sought) this package should:
   a. Meet the OEH's *Principles for the use of biodiversity offsets in NSW*[2], which are available at: http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm
   b. Identify the conservation mechanisms to be used to ensure the long term protection and management of the offset sites; and
   c. Include an appropriate Management Plan (such as vegetation or habitat) that has been developed as a key amelioration measure to ensure any proposed compensatory offsets, retained habitat enhancement features within the development footprint and/or impact mitigation measures (including proposed rehabilitation and/or monitoring programs) are appropriately managed and funded.
6. **Where appropriate**, likely impacts (both **direct** and **indirect**) on any adjoining and/or nearby OEH estate reserved under the *National Parks and Wildlife Act 1974* or any marine and estuarine protected areas under the *Fisheries Management Act 1994* or the *Marine Parks Act 1997* should be considered. Refer to the *Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water* (DECC, 2010).
7. With regard to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the assessment should identify any relevant Matters of National Environmental Significance and whether the proposal has been referred to the Commonwealth or already determined to be a controlled action.

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[1] Following threatened species assessment via the Assessment of Significance, it may be necessary to prepare a **Species Impact Statement** (SIS). The proponent will need to prepare a SIS in the following circumstances:

- If (after having addressed Section 5A) the flora/fauna assessment concludes that there is likely to be a significant impact to threatened species, or
- The proposed development is likely to affect critical habitat declared under the TSC Act.

If a SIS is required, the proponent (not the consultant) must write to OEH for any formal requirements for the SIS that may be deemed appropriate. The SIS must then be prepared in accordance with these requirements and provided to the OEH. In some instances the Minister for the Environment will also need to be consulted for approval.

Methods to reduce the impact on the protected and threatened species should be considered fully, and are considered an integral requirement within any SIS document.

Conducting an Assessment of Significance or an SIS according to the provisions of the *EP&A Act* and the *TSC Act* is a complex task and should be undertaken by suitably qualified person(s).

[2] **Please note** that the OEH's *Principles for the use of biodiversity offsets in NSW* ('the Principles') require offsets to be based on a **quantitative assessment** of the loss in biodiversity from the proposal and the gain in biodiversity from the offset. The methodology must be based on the best available science, be reliable, and used for calculating both the impact and offset sites. Even where a proponent does not intend to use the BioBanking Assessment Methodology and Credit Calculator (Scenario 1), use of a **suitable alternative metric**, justified in the EA, is necessary to demonstrate that the proposal is consistent with the Principles. Ultimately the proponent is expected to demonstrate quantitatively that the biodiversity losses associated with the project will be adequately compensated for by the improvement in vegetation condition and security expected from the offset site. This cannot be properly determined by a hectare comparison alone.

ATTACHMENT B

Guidance Material

Title	Web Address
Commonwealth Environment Protection & Biodiversity Conservation Act 1999	http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Fisheries Management Act 1994	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Threatened Species Conservation Act 1995	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+101+1995+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Aboriginal Cultural Heritage	
Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (2005)	Available from DoPI.
Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	http://www.environment.nsw.gov.au/licences/consultation.htm
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	http://www.environment.nsw.gov.au/licences/archinvestigations.htm
Due Diligence Code for the Protection of Aboriginal Objects in NSW (DECCW 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/ddcop/10798ddcop.pdf
Aboriginal Site Impact Recording Form	http://www.environment.nsw.gov.au/licences/DECCAHIMSSiteRecordingForm.htm
Aboriginal Heritage Information Management System (AHIMS) Registrar	http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm
Biodiversity	
BioBanking Assessment Methodology (OEH, 2014)	http://www.environment.nsw.gov.au/resources/biobanking/140661BBAM.pdf
BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECCW, 2008)	http://www.environment.nsw.gov.au/biobanking/calculator.htm
Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna –Amphibians (DECCW, 2009)	http://www.environment.nsw.gov.au/resources/threatenedspecies/09213amphibians.pdf
Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC, 2004)	http://www.environment.nsw.gov.au/resources/nature/TBSAGuidelinesDraft.pdf
Survey requirements (birds, bats, reptiles, frogs, fish and mammals) for species listed under the EPBC Act	http://www.environment.gov.au/topics/environment-protection/environment-assessments.

OEH Threatened Species website	http://www.environment.nsw.gov.au/threatenedspecies/
Atlas of NSW Wildlife	http://www.environment.nsw.gov.au/wildlifeatlas/about.htm
Vegetation Types databases	http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm
PlantNET	http://plantnet.rbgsyd.nsw.gov.au/
Online Zoological Collections of Australian Museums	http://www.ozcam.org.au/
Threatened Species Assessment Guideline - The Assessment of Significance (DECCW, 2007)	http://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf
Principles for the use of biodiversity offsets in NSW	http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm

NSW RURAL FIRE SERVICE

PCU065835

Department of Planning & Environment
Resource Assessments
[redacted]

Your reference: EAR ID No. 1052
Our reference: D16/1815

20 June 2016

Attention: Lauren Evans

Dear Sir/Madam,

Proposed Quarry – 1105 Bogan Road, Goonumbla

Reference is made to your correspondence dated 6 June 2016 seeking our advice in regards to the preparation of an Environmental Impact Statement (EIS) for a proposed quarry at the subject property under Schedule 2 of the *Environmental Planning and Assessment Regulations 2000*.

The New South Wales Rural Fire Service (NSW RFS) recommends that the preparation of the EIS is to include a bush fire assessment report prepared by a suitably qualified bush fire consultant that addresses the aim and objectives of *Planning for Bush Fire Protection 2006*.

If you have any queries regarding this advice, please contact Simon Derevnin, Development Assessment and Planning Officer, on 1300 NSW RFS.

Yours sincerely

[redacted]

Jason Maslen
Team Leader, Development Assessment and Planning
Planning and Environment Services (East)

Postal address
NSW Rural Fire Service
Records Management
Locked Bag 17
GRANVILLE NSW 2141

Street address
NSW Rural Fire Service
Planning and Environment Services (East)
42 Lamb Street
GLENDENNING NSW 2761

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E csc@rfs.nsw.gov.au
www.rfs.nsw.gov.au

Transport Roads & Maritime Services

16 June 2016

SF2013/003179; WST13/00004/03

The Manager
Resource Assessments
Department of Planning & Environment
[redacted]

Attention: Ms Lauren Evans

Dear Ms Evans

SEAR ID 1052: Lot 32 DP 816454; 'Limestone' 1105 Bogan Road, Goonumbla;
Bogan Road Gravel Quarry
Request for input into Secretary's Environmental Assessment Requirements (SEARs)

Thank you for your email on 6 June 2016 requesting input into SEARs from Roads and Maritime Services for an extension to the Bogan Road Quarry.

Roads and Maritime notes the proposal involves increasing production at the existing quarry site. The proposal would involve extraction and transportation by road of 250,000 tonnes per annum of gravel material. Vehicular access to the site is from Wyatts Lane.

Roads and Maritime has reviewed the submitted documentation and has identified the following key issues to be addressed in the Environmental Impact Statement being prepared in support of the project:

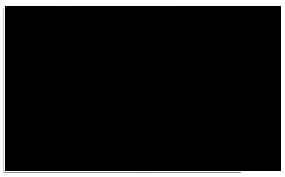
- A traffic impact study prepared in accordance with the methodology set out in Section 2 of the *RTA's Guide to Traffic Generating Developments 2002* and including:
    - For the construction and operation of the quarry, road transport volumes and vehicle types broken down into:
        - origin and destination.
        - travel routes.
        - peak hours.

- The study is to provide details of projected transport operations including:
    - traffic volumes, both proposed and cumulative.
    - materials to be transported and vehicle types used for transport.
    - physical constraints, risks and hazards on the haulage route(s).
    - measures to be employed to ensure a high level of safety for all road users interacting with construction and operational traffic.
- Any over size and over mass vehicles and loads expected for the construction and operation of the project.
- Temporary and permanent staff numbers (including employees and contractors) and staff parking arrangements during construction and operation of the project.
- Measures to be employed to ensure traffic efficiency and safety on the public road network during construction and operation of the project. This includes an assessment of the cumulative impacts of existing and proposed quarry related traffic and existing background traffic on Wyatts Lane, Bogan Road and the intersection fo Bogan Road and the Newell Highway (HW17).
- Local climate conditions that may affect road safety during construction and operation of the project (e.g. dust, fog, wet weather, etc) and appropriate measures to mitigate the impacts of such conditions.

- Access locations and treatments need to be identified and in accordance with *Austroads Guide to Road Design* and Roads and Maritime supplements, including safe intersection sight distance.
- Details of required infrastructure work to support any increased demand on the road network as a result of the project.

Roads and Maritime appreciates the opportunity to contribute to the SEARs and requests that a copy of the SEARs be forwarded to Roads and Maritime at the same time they are sent to the applicant. If you require further information please contact Andrew McIntyre, Manager Land Use Assessment, on 02 6861 1453.

Yours faithfully



Susie Mackay
Network & Safety Manager
Western

Appendix B

SEARs Checklist

Table B1 – SEARs Checklist

Requirement		Section
General Requirements	The EIS must include:	
	An executive summary	Provided on page iii
	a comprehensive description of the development, including:	
	• a detailed site description and history of any previous quarrying on the site, including a current survey plan;	Section 2 - 3 Drawing Schedule
	• identification of the resource, including the amount, type and composition, as well as details regarding the timing and intensity of extractive operations, having regard to DRE's requirements (Attachment 2);	Section 14
	• the layout of the proposed works and components (including any existing infrastructure that would be used for the development);	Section 3 Drawing Schedule
	• an assessment of the potential impacts of the development, as well as any cumulative impacts, including the measures that would be used to minimise, manage or offset these impacts;	Sections 7 - 21
	• a summary of all proposed environmental management and monitoring measures for the development;	Section 22
	• a detailed rehabilitation plan for the site;	Section 3.2
	• any likely interactions between the development and any existing/approved developments and land uses in the area;	Section 15
	• a list of any other approvals that must be obtained before the development may commence;	Section 5.4
	• the permissibility of the development, including identification of the land use zoning of the site;	Section 5
	• identification of sensitive receivers likely to be affected by the development using clear maps/plans, including key landform areas, such as conservation areas and waterways; and	Section 4.1 and 12
	the reasons why the development should be approved, having regard to the economic, social and environmental aspects of the development and taking into consideration the objects of the *Environmental Planning & Assessment Act 1979*; and	Section 23
	a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading.	Provided on page ii
Key Issues	The EIS must assess the potential impacts of the proposal at all stages of the development, including the establishment, operation and decommissioning of the development. The EIS must address the following specific issues:	Sections 7 - 21
	Water – including:	
	• an annual site water balance for representative years over the life of the development and demonstration that sufficient water supplies would be available to meet operational requirements;	Section 13
	• identification of any licensing requirements or other approvals required under the *Water Act 1912* and/or *Water Management Act 2000*;	Section 5.7.5
	• a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant Water Sharing Plan or water source embargo;	Section 13

Table B1 – SEARs Checklist

Requirement		Section
	• an assessment of activities that could cause erosion or sedimentation issues, and the proposed measures to prevent or control these impacts;	Section 13 and 15
	• an assessment of the likely impacts of the development on the quality and quantity of surface and groundwater resources, having regard to EPA and DPI Water requirements (Attachment 2);	Section 13
	• a detailed description of the proposed water management system, water monitoring program and other measures to mitigate surface and groundwater impacts;	Section 13 and Appendix H
	• an assessment of potential downstream impacts from surface water runoff;	Section 13 and Appendix H
	Air – including an assessment of the likely air quality impacts of the development in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, having regard to EPA's requirements (Attachment 2). The assessment is to give particular attention to potential dust impacts on any nearby private receivers due to construction activities, the operation of the quarry and/or road haulage;	Section 10
	Noise and Blasting – including: • an assessment of the likely construction and operational noise and vibration impacts of the development in accordance with the *NSW Industrial Noise Policy* and the *Interim Construction Noise Guideline*, having regard to EPA and Council requirements (Attachment 2); • an assessment of the likely road noise impacts (traffic and haulage) of the development under the *NSW Road Noise Policy*; and • an assessment of the likely blasting and vibration impacts of the development, having regard to the relevant ANZEC guidelines and paying particular attention to impacts on people, livestock, heritage items and infrastructure;	Section 9
	Biodiversity – including: • accurate predictions of any vegetation clearing on site; • a detailed assessment of the potential biodiversity impacts of the development, paying particular attention to threatened species and/or populations (or their habitats), endangered ecological communities and groundwater dependent ecosystems, and having regard to OEH, DRE and Council requirements (Attachment 2); • a detailed description of the proposed measures to maintain or improve the biodiversity values of the site in the medium to long term, as relevant; and • an assessment of whether a Species Impact Statement is required;	Section 7
	Heritage – including: • an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage, having regard to OEH requirements (Attachment 2); and • identification of Historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the requirements of relevant policies and guidelines listed in Attachment 1;	Section 8

Table B1 – SEARs Checklist

Requirement		Section
	Transport – including: • an assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road networks, detailing the nature of the traffic generated, transport routes, traffic volumes and potential impacts on local and regional roads, having regard to RMS and Council requirements (Attachment 2); • a description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road network (particularly the proposed transport routes) over the life of the development; • evidence of any consultation with relevant roads authorities, regarding the establishment of agreed contributions towards road upgrades or maintenance; and - a description of access roads, specifically in relation to nearby Crown roads and fire trails;	Section 16
	Land – including: • an assessment of potential impacts on the quality and quantity of the soils and land capability of the site, including any likely disturbance of contaminated soils, and the proposed mitigation, management and remedial measures (as appropriate), having regard to EPA requirements (Attachment 2); • an assessment of the likely impacts on landforms and topography, including the long-term geotechnical stability of any new landforms; and • an assessment of the compatibility of the development with other land uses in the vicinity of the development, in accordance with the requirements of Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*, having regard to the requirements of DPI Agriculture (Attachment 2);	Section 15
	Waste – including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams, having regard to EPA requirements (Attachment 2);	Section 18
	Public Safety – including an assessment of the likely risks to public safety, paying particular attention to the transport, storage, handling and use of any hazardous or dangerous goods, and having regard to RFS requirements (Attachment 2);	Section 17.6
	Visual – including an assessment of the likely visual impacts of the development on any surrounding private landowners and key vantage points in the public domain, paying particular attention to impacts on any nearby private residences and road users;	Section 12
	Social & Economic – an assessment of the likely social and economic impacts of the development, including consideration of both the significance of the resource and the costs and benefits of the project; and	Section 20
	Rehabilitation – including: • a detailed description of the proposed rehabilitation measures that would be undertaken throughout the development and during quarry closure, having regard to the requirements of DRE, EPA and DPI Water (Attachment 2); • a detailed rehabilitation strategy, including justification for the proposed final landform and consideration of the objectives of any relevant strategic land use plans or policies; and • the measures that would be undertaken to ensure sufficient financial resources are available to implement the proposed rehabilitation strategy.	Section 3.2
Environmental Planning Instruments	The EIS must take into account all relevant State Government environmental planning instruments, guidelines, policies, and plans. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies and plans that may be relevant to the environmental assessment of this development. In addition, the EIS must assess the development against the *Parkes Local Environmental Plan 2012* and any relevant development control plans/strategies.	Section 5
Consultation	In preparing the EIS for the development, you should consult with relevant local, State or Commonwealth Government authorities, infrastructure and service providers and any surrounding landowners that may be impacted by the development.	Section 4

Table B1 – SEARs Checklist

Requirement		Section
	The EIS must describe the consultation that was carried out, identify the issues raised during this consultation, and explain how these issues have been addressed in the EIS.	
Parkes Shire Council	Council requests that development consent DA12097 is surrendered to prevent inconsistencies between consents.	Section 1.3
	Air quality impacts must be addressed in the EIS.	Section 10
	The EIS must assess haulage routes and confirm they are constructed to a standard suitable for their purpose.	Section 16
	The Applicant should consider the Parkes Shire Section 94 Contributions Plan.	Section 5.12
	Noise and vibration impacts must be addressed in the EIS.	Section 9
	A comprehensive investigation of the proposed areas of vegetation disturbance must be undertaken and detailed mitigation measures must be identified.	Section 7
NSW Department of Primary Industries – Agricultural Land Use Planning	Impact on Agricultural Land: • Review the farming operations in the area. • Determine the amount of land being removed from agriculture in the identified proposal area. • Undertake a soils and land capability assessment to determine: • Existing land value to plant and animal land uses both on the proposal site and adjacent lands to the proposed activity	Section 15
	Dust: • Undertake an inventory of potential impacts on adjacent farm residencies and farming operations. • Outline mitigating actions to minimize dust impact on adjacent farming enterprises.	Section 10
	Weed containment and management: • Update/develop a Weed Management Plan (particularly for any soil stockpiles to be used for future rehabilitation) and adjacent roadsides (to avoid spreading weeds off site).	Section 7.9
	Pest management: • Update/develop a Pest Management Plan.	Section 7.9
	Soil erosion and sedimentation: • Update/develop Erosion and Sediment Control Plan and a Stormwater Management Plan.	Appendix H
	Access and noise (Traffic): • Identify access routes and associated noise and traffic impacts on farm residences and farming operations in the vicinity and mitigation measures for these impacts.	Section 9
	Visual and Lighting: • Identify visual and lighting impacts on nearby farm residences and farming operations identified and describe mitigation measures.	Section 12
	Bushfire management: • Update/complete a bush fire risk assessment and develop a Bush Fire Management Plan	Section 17.1
	Rehabilitation planning: • Determine the impact of surrounding land uses by documenting end land uses and final landforms for the whole quarry operation.	Section 3.2

Table B1 – SEARs Checklist

Requirement		Section
	Consultation: • Show any consultation commitments regarding adjacent landholders and rural community regarding the operations and access details of the proposal. • Identify any past issues that have arisen and been resolved that may impact on the operation of this quarry proposal.	Section 1.4
NSW Department of Primary Industries – Water	It is recommended that the EIS be required to include:	
	• Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project) – addressing whether any licences or approvals may be required under the Water Management Act 2000 and Water Act 1912.	Section 5.7.5
	• The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.	Section 13 and Appendix H
	• Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.	Section 13 and Appendix H
	• A current assessment of immediate and cumulative impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts. This should include proposed surface and groundwater monitoring activities and methodologies.	Section 13
	• Details of proposed management systems for dirty and clean water including stormwater runoff and erosion and sediment control measures.	Section 13 and Appendix H
	• A detailed and consolidated site water balance.	Appendix H
	• A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework. Also refer to NSW Aquifer Interference Policy Fact Sheet 7 available at http://www.water.nsw.gov.au/water-management/law-and-policy/keypolicies/aquifer-interference	Section 13
	• Full technical details and data of all surface and groundwater modelling, and an independent peer review.	Groundwater modelling was not undertaken
	• Details of the final landform of the site, including final void management (where relevant) and rehabilitation measures.	Section 3.2
	• Details of works within 40 metres of a watercourse and measures put in place to protect the watercourse. Works may require a Controlled Activity Approval under the *Water Management Act 2000* and the works are to be in accordance with the Guidelines for Controlled Activities on Waterfront Land.	Section 5.7.5
	• Consideration of relevant policies and guidelines.	Section 5
	• A statement of where each element of the SEARs is addressed in the EIS (i.e. in the form of a table).	Addressed via this table

Table B1 – SEARs Checklist

Requirement		Section
NSW Department of Industry – Resources & Energy (incorporating advice from the Agriculture and Fisheries Branches)	The EIS should include a resource assessment (as detailed in Attachment A) which: • Documents the size and quality of the resource and demonstrates that both have been adequately assessed; and • Documents the methods used to assess the resource and its suitability for the intended applications. • Applications to modify, expand, extend or intensify an existing consent that has already been adequately reported using the above protocol in publicly available documents, may restrict detailed documentation to the additional resources to be used, if accompanied by a summary of past resource assessments and of past production.	Section 14
	Resource Assessment should contain:	
	• A summary of the regional and local geology including information on the stratigraphic unit or units within which the resource is located.	Section 14
	• The amount of material to be extracted and the method or methods used to determine the size of the resource (e.g. drilling, trenching, geophysical methods).	Section 14
	• Plans and cross-sections summarising this data, at a standard scale, showing location of drillholes and/or trenches, and the area proposed for extraction, should be included in the EA or EIS. Relevant supporting documentation such as drill logs should be included or appended. Major resource proposals should be subject to extensive drilling programs to identify the nature and extent of the resource.	No drilling sections, plans or logs available
	• Characteristics of the material or materials to be produced: • For hard rock aggregate proposals, information should be provided on properties such as grainsize and mineralogy, nature and extent of weathering or alteration, and amount and type of deleterious minerals, if any. • For other proposals, properties relevant to the range of intended uses for the particular material should be indicated. • Details of tests carried out to determine the characteristics of the material should be included or appended. Such tests should be undertaken by NATA registered testing laboratories.	Section 14
	• An assessment of the quality of the material and its suitability for the anticipated range of applications should be given.	Section 14
	The amount of material anticipated to be produced annually should be indicated. If the proposal includes a staged extraction sequence, details of the staging sequence needs to be provided. The intended life of the operation should be indicated.	Section 3
	If the proposal is an extension to an existing operation, details of history and past production should be provided.	Section 2
	An assessment of alternative sources to the proposal and the availability of these sources. The impact of not proceeding with the proposal should be addressed.	Section 14 and 23.2
	Justification for the proposal in terms of the local and, if appropriate, the regional context.	Section 23.2
	Information on the location and size of markets to be supplied from the site.	Section 23.2
	Route(s) used to transport quarry products to market.	Section 16
	Disposal of waste products and the location and size of stockpiles.	Section 18
	Assessment of noise, vibration, dust and visual impacts, and proposed measures to minimise these impacts.	Section 9, 10 and 12
	Proposed rehabilitation procedures during, and after completion of, extraction operations, and proposed final use of site.	Section 3.2
	Assessment of the ecological sustainability of the proposal.	Section 23.1

Table B1 – SEARs Checklist

Requirement		Section
	• In relation to the health & safety of mining and quarrying operations, the following issues should be addressed:	
	All operations are to comply with the following Acts & Regulations • Work Health & Safety Act 2011 • Work Health & Safety Regulations 2011 • Mine Health & Safety Act 2004 • Mine Health & Safety Regulations 2007	Section 17
	The mine holder must nominate the mine operator in writing on the prescribed form to the Chief Inspector as required by the *Mine Health & Safety Act 2004* Section 22 prior to the commencement of extraction.	Section 17.4
	The operator of the mine must appoint a production manager as required by the *Mine Health & Safety Regulation 2007* Clause 16 and the operator must notify the Chief Inspector of the appointment in writing as required by the *Mine Health & Safety Regulation 2007* Clause 18 prior to the commencement of extraction.	Section 17.4
	Any blasting operations carried out by the mine operator must comply with the Explosives Act 2003 and the *Explosives Regulations 2005*.	Section 17.4
	With respect to DPI – Fisheries requirements, the EIS must:	
	• Describe and discuss significant habitat areas within the study area;	Section 7
	• Outline the habitat requirements of threatened species likely to occur in the study area;	Section 7
	• Indicate the location, nature and extent of habitat removal or modification which may result from the proposed action;	Section 7
	• Discuss the potential impact of the modification or removal of habitat;	Section 7
	• Identify and discuss any potential for the proposal to introduce barriers to the movement of fish species	Section 7
	• Describe and discuss any other potential impacts of the proposal on fish species or their habitat	Section 7
NSW Environment Protection Authority	The EPA's key information requirements for the proposal include an adequate assessment of:	
	• **Air:** assessment of impacts during both construction and operation, including mitigation strategies and management of dust • **Water:** assessment of impacts of surface and groundwater, including proposed monitoring and mitigation measures to protect water. This must include water demand and management requirements.	Section 10 Section 13
	• **Noise & Vibration:** assessment of impacts during both construction and operation from noise and blasting related activities, including traffic noise. The assessment should address the impacts on nearby receptors and noise amenity in accordance with the NSW Industrial Noise Policy, and identify strategies to mitigate potential noise impacts.	Section 9
	• **Land:** assessment of impacts of land including management of contaminated soil, sediment and erosion control and proposed management and mitigation measure. This must account for any naturally occurring elements that may cause pollution of land and/or water.	Section 15
	• **Waste:** the impacts of potential acid generation from waste rock, including the proposed methods of encapsulation.	Section 18

Table B1 – SEARs Checklist

Requirement		Section
NSW Office of Environment & Heritage	The OEH's key information requirements for the proposal include an adequate assessment of:	
	• Impacts on flora, fauna, threatened species, populations, communities and their habitats;	Section 7
	• Impacts to Aboriginal cultural heritage objects.	Section 8
NSW Rural Fire Service	NSW RFS recommends that the preparation of the EIS is to include a bush fire assessment report prepared by a suitably qualified bush fire consultant that addresses the aim and objectives of *Planning for Bush Fire Protection 2006*.	Section 17.1
Roads & Maritime Services	RMS identify the following key issues to be addressed in the EIS:	
	A traffic impact study prepared in accordance with the methodology set out in Section 2 of the RTA's *Guide to Traffic Generating Developments 2002* and including: For the construction and operation of the quarry, road transport volumes and vehicle types broken down into: • origin and destination. • travel routes. • peak hours.	Section 16
	The study is to provide details of projected transport operations including: • traffic volumes, both proposed and cumulative. • materials to be transported and vehicle types used for transport. • physical constraints, risks and hazards on the haulage route(s). • measures to be employed to ensure a high level of safety for all road users interacting with construction and operational traffic. • Any over size and over mass vehicles and loads expected for the construction and operation of the project.	Section 16
	Temporary and permanent staff numbers (including employees and contractors) and staff parking arrangements during construction and operation of the project.	Section 3.1.15 and 3.1.8
	Measures to be employed to ensure traffic efficiency and safety on the public road network during construction and operation of the project. This includes an assessment of the cumulative impacts of existing and proposed quarry related traffic and existing background traffic on Wyatts Lane, Bogan Road and the intersection for Bogan Road and the Newell Highway (HW17).	Section 16.3
	Local climate conditions that may affect road safety during construction and operation of the project (e.g. dust, fog, wet weather, etc) and appropriate measures to mitigate the impacts of such conditions.	Section 16
	Access locations and treatments need to be identified and in accordance with Austroads Guide to Road Design and Roads and Maritime supplements, including safe intersection sight distance.	Section 16
	Details of required infrastructure work to support any increased demand on the road network as a result of the project.	Section 16

Appendix C

FLORA AND FAUNA ASSESSMENT

Goonumbla Quarry Expansion:

1105 Bogan Road, Goonumbla, NSW

FINAL REPORT

Prepared for Geolyse Pty Ltd on behalf of Cudal Lime Products Pty Ltd

2 March 2018

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- Department of the Environment and Energy for access to the Protected Matters Search Tool of the Australian Government.
- NSW Office of Environment and Heritage for access to the BioNet Atlas of NSW Wildlife.

Biosis staff involved in this project were:

- Alejandro Barreto & Sarah Allison (assistance in the field)
- Gareth Davies (mapping).

Contents

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Plates

Glossary

CBD	Central Business District
DBH	Diameter at breast height
DEE	Department of the Environment and Energy
DPI	Department of Primary Industry
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FM Act	*Fisheries Management Act 1994*
KTP	Key Threatening Process
LEP	Local Environment Plan
NSW	New South Wales
NV Act	*Native Vegetation Act 2003*
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SEPP 44	State Environmental Planning Policy No. 44 – Koala Habitat Protection
SIS	Species Impact Statement
study area	Total area of assessment including existing quarry area, road reserve in the southern boundary and native vegetation north of the subject site
subject site	The area of impact for the proposed works
TSC Act	*Threatened Species Conservation Act 1995*

Summary

Biosis Pty Ltd was commissioned by Geolyse on behalf of Cudal Lime Products to undertake a flora and fauna assessment of an area of land proposed for the expansion of an existing hard rock quarry and associated road (the project). The study area is located in farmland approximately 12 kilometres north of Parkes NSW and approximately 300 kilometres west of the Sydney (CBD).

The expansion of the quarry will allow the extraction and processing a maximum of 300,000 tonnes of basalt per year. The works required to achieve this objective includes the quarry expansion, a 30 metre wide bunding around the quarry extension, a five metre wide access road around the bunding and a seven metre wide road to a future rail siding site located further west of the study area (Figure 1). All access roads will be compacted gravel.

The project is deemed to be designated local development under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and will be assessed in accordance with Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment on 27 June 2016.

The subject site, defined by the expansion of an existing hard rock quarry, associated bunding and access road to the rail siding site, is surrounded by the study area which includes adjacent areas that may be directly or indirectly affected by the proposal and extends further north to include adjacent native vegetation. The subject site encompasses 3.6 hectares of native vegetation, while the remaining 1.6 hectares consist of disturbed areas (cropping and tracks) located within the Lot 32 DP816454.

Ecological values

A detailed review of available information pertaining to the subject site and locality was undertaken together with field investigations completed by Biosis botanists and zoologists.

Key ecological values identified within the subject site included:

- 3.6 hectares of *PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion* which is consistent with:
  - White box yellow box Blakely's red gum woodland Endangered Ecological Community (EEC) listed under the *Threatened Species Conservation Act 1995* (TSC Act).
  - White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands (Box Gum Woodland) Critically Endangered Ecological Community (CEEC) listed under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Three White Box Eucalyptus *albens* hollow-bearing trees and six mature Kurrajong *Brachychiton populneus* that provide foraging habitat for a variety of highly mobile species including some threatened species.
- Foraging habitat for threatened and non-threatened fauna.
- An unnamed Strahler Order 1 waterway.

The proposed development will result in the following residual impacts to ecological values:

- Removal of 3.6 hectares of PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland which is consistent with:

- White box yellow box Blakely's red gum woodland EEC
- Box Gum Woodland CEEC.

- Removal of three mature White Box and six mature Kurrajong trees that provide foraging habitat for a variety of highly mobile species including some threatened species.

No flora species or endangered populations listed under the EPBC Act or TSC Act were recorded during the field investigation or considered likely to occur within the subject site.

The subject site provides marginal foraging and some nesting/roosting habitat for several TSC Act and/or EPBC Act listed threatened fauna including Swift Parrot, Superb Parrot, Grey-crowned Babbler and Little Pied Bat.

Assessments of significance in accordance with Part 5A of the EP&A Act and Significant Impact Criteria assessments in accordance with Commonwealth of Australia (2013) were completed for threatened fauna likely to occur within the subject site as well as White box yellow box Blakely's red gum woodland EEC and EPBC Act listed Box Gum Woodland CEEC were completed. These assessments concluded the proposed quarry expansion is unlikely to result in any significant residual impacts on any TSC Act or EPBC Act listed fauna species or ecological community provided appropriate measures to avoid, minimise and mitigate impacts are implemented effectively.

The proposed development will implement a range of measures to avoid, minimise and mitigate impacts to White box yellow box Blakely's red gum woodland EEC / Box Gum Woodland CEEC and threatened fauna habitat within and adjoining the subject site.

Given the proposal is unlikely to have a significant residual impact on any TSC or EPBC Act listed fauna species and ecological communities, a Species Impact Statement or a Referral to the Commonwealth Minister of the Environment are not deemed necessary for the current proposal.

Government legislation and policy

The project has not been classified as State Significant Development and, as SEARs were issued for the project before the commencement of the *Biodiversity Conservation Act 2016* (BC Act) on the 25 August 2017, the project meets the definition of a *pending or interim planning application* under Part 7 (Section 27) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017.*

As the project application is intended to be submitted within 18 months following commencement of the BC Act, project approval is to be assessed in accordance with the former planning provisions (i.e. the provisions of the EP&A Act in force prior to commencement of the BC Act) and Part 7 of the BC Act does not apply.

An assessment of the project against key biodiversity legislation and policy is provided and summarised below.

Legislation / Policy	Relevant ecological feature	Permit / approval required
Environment Protection and Biodiversity Conservation Act 1999	One CEEC, White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands occurs within the subject site.	Biosis prepared a Significant Impact Criteria Assessment (SIC) (Appendix 3).

Legislation / Policy	Relevant ecological feature	Permit / approval required
Threatened Species Conservation Act 1995 (Repealed)	One EEC, White box yellow box Blakely's red gum woodland endangered ecological community occurs within the subject site.	Biosis prepared an Assessment of Significance (AoS) under Section 5A of the EP&A Act and Section 94 of the TSC Act (Appendix 3).
Environmental Planning & Assessment Act 1979	Threatened species and ecological communities occur.	Impacts to the threatened species and ecological communities present or likely to occur within the study area has been assessed through undertaking an AoS (Appendix 3).
Water Management Act 2000	One waterway occurs within 40 metres of the subject site and is classified as a 1st order stream.	No disturbance to riparian vegetation or the beds and banks of waterways are proposed.
Fisheries Management Act 1994	One first order stream in the north west portion of the subject site.	Based on the ecological assessment herein, no threatened species, populations or ecological communities listed under the FM Act are considered likely to occur within the study area. The first order stream and farm dam within the study area are not considered key fish habitat.
State Environmental Planning Policy No 44	SEPP44 applies to the current project as it exceeds more than one hectare, is located within the Parkes Local Government Area and a development application will be made (SEPP 44, Section 6). 3.6 hectares of Potential Koala habitat have been mapped within the subject site and will be impacted by the proposal. However, no core habitat was identified. Other areas of the subject site are unlikely to provide important habitat for this species.	No further consideration is required.
National Parks & Wildlife Act 1974	The project does not require the removal of vegetation within a National Park.	No permits or approvals are required under the current scope of works.
Biosecurity Act 2015	No priority Weeds for the Central West Region, which includes the Parkes Shire LGA that have been recorded in the study area.	Mitigation measures to prevent the spread of other environmental weeds is provided in Section 5.

Note: Guidance provided in this report does not constitute legal advice.

1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Geolyse on behalf of Cudal Lime Products to undertake a flora and fauna assessment of the subject site and broader study area (Figure 1). The proposed development consists of the expansion of an existing hard rock quarry, associated bunding and access road to a future rail siding site (subject site) at 1105 Bogan Road, Goonumbla, NSW (Lot 32 DP816454). The expansion of the quarry will allow the extraction and processing a maximum of 300,000 tonnes of basalt per year. The project is deemed to be designated local development under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and will be assessed in accordance with Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment on 27 June 2016.

The works required includes the quarry expansion, 30 metre wide bunding around the quarry extension, five metre wide access road around the bunding and a seven metre wide road to the future rail siding site located further west of the study area (Figure 1). All access roads will be compacted gravel.

1.2 Scope of assessment

The objectives of this investigation are to:

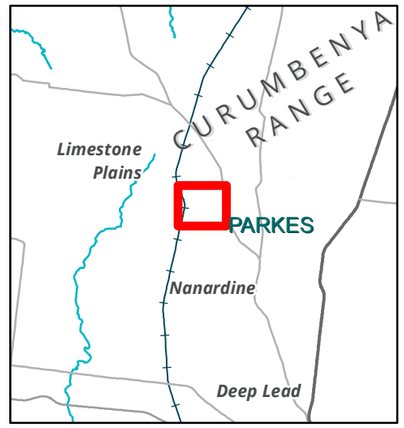
- Describe the vascular flora (ferns, conifers, and flowering plants), vertebrate fauna (birds, mammals, reptiles and frogs).
- Map native vegetation and other habitat features.
- Threatened flora or fauna species or populations (biota) assessment.
- Review the implications of relevant biodiversity legislation and policy.
- Identify potential implications of the proposed development and provide recommendations to assist with development design.
- Recommend any further assessments of the site that may be required (such as targeted searches for threatened biota).

1.3 Location of the study area

The study area is located approximately 12 kilometres north of Parkes (Figure 1). It encompasses 67.9 hectares of private land north of Wyatt's Lane, Goonumbla. The property is currently zoned RU1.

The study area is within the:

- NSW South Western Slopes Bioregion
- Lachlan catchment
- Central West Local Land Services (LLS) Management Area
- Parkes Shire Local Government Area (LGA).



Legend

- Study area
- Subject site

Strahler order

- 1
- 2
- Modified 2 (Does not reflect current topographic mapping)
- 3

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © Nearmap 2016

Figure 1: Location of the study area, NSW

0 50 100 150 200 250

Metres

Scale: 1:5,800 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Matter: 25563
Date: 22 February 2018,
Checked by: ABM, Drawn by: GD, Last edited by: lharley
Location:P:\25500s\25563\Mapping
25563_F1_Location

2 Legislative context

This section provides an overview of key biodiversity legislation and government policy considered in this assessment. Where available, links to further information are provided. This section does not describe the legislation and policy in detail and guidance provided here does not constitute legal advice.

2.1 Commonwealth

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's key piece of environmental legislation. The EPBC Act applies to developments and associated activities that have the potential to significantly impact on Matters of National Environmental Significance (NES) protected under the Act.

Nine Matters of NES are identified under the EPBC Act:

- world heritage properties
- national heritage places
- wetlands of international importance (also known as 'Ramsar' wetlands)
- nationally threatened species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- a water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, activities that have potential to result in significant impacts on Matters of NES must be referred to the Commonwealth Minister for the Environment for assessment.

Matters of NES relevant to the current project include nationally threatened species and ecological communities. Threatened species and ecological communities protected by the EPBC Act are outlined in Sections 4.2, 4.3 and summarised in Section 4.6. Significant impact criteria (SIC) assessments are provided in Appendix 3.

An assessment of potential impacts to all Matters of NES under the provisions of the EPBC Act, and whether referral of the project to the Commonwealth Minister for the Environment for assessment is provided in Section 7.1.

2.2 State

The project has not been classified as State Significant Development and, as SEARs were issued for the project before the commencement of the *Biodiversity Conservation Act 2016* (BC Act) on the 25 August 2017, the project meets the definition of a *pending or interim planning application* under Part 7 (Section 27) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017.*

As the project application is intended to be submitted within 18 months following commencement of the BC Act, project approval is to be assessed in accordance with the former planning provisions (i.e. the provisions of the EP&A Act in force prior to commencement of the BC Act) and Part 7 of the BC Act does not apply.

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the proper consideration and management of impacts of proposed development or land-use changes on the environment (both natural and built) and the community. The EP&A Act is administered by the NSW Department of Planning and Environment (DP&E).

The EP&A Act provides the overarching structure for planning in NSW and is supported by other statutory environmental planning instruments. Sections of the EP&A Act of primary relevance to the natural environment are outlined further below.

Assessment of Significance

Section 5A of the EP&A Act requires proponents and consent authorities to consider if a development will have a significant effect on threatened species, populations or communities listed under the TSC and *Fisheries Management Act 1994* (FM Act).

Section 5A (Section 94 of the TSC Act and Section 220ZZ of the FM Act) outlines seven factors that must be taken into account in an Assessment of Significance (formally known as the "7-part test"). Where any Assessment of Significance (AoS) determines that a development will result in a significant effect to a threatened species, population or community a Species Impact Statement (SIS) or preparation of a BioBanking statement application is required.

Threatened species, populations and communities listed under the TSC Act are discussed in Sections 4.2, 4.3 and summarised in Section 4.6. Assessments of Significance are provided in Appendix 4.

An assessment of whether the project will result in a significant effect to any threatened species, populations or communities listed under the TSC Act, and whether an SIS or preparation of a BioBanking statement application is required, is provided in Section 7.2.

State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are environmental planning instruments under the EP&A Act that outline policy objectives relevant to State or regional environmental planning issues. There are over 65 SEPPs; however, only those relevant to the proposed development have been considered and are detailed below.

SEPP No. 44 – Koala Habitat Protection

SEPP No. 44 aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in councils listed in Schedule 1 to the SEPP.

The project is within Parkes Shire LGA, a Schedule 1 listed Council. Therefore SEPP No. 44 is relevant to the current assessment and is discussed further in Section 7.2.

Local Environment Plans

Local Environment Plans (LEPs) are created by Councils in consultation with their community and guide planning decisions for LGAs. They apply either to the whole or part of a LGA and make provision for the protection or utilisation of the environment through zoning of land and development controls.

The study area is subject to the Parkes LEP 2012 and is zoned RU1. Elements of the LEP objectives are relevant to this assessment and are discussed further in Section 7.2.

2.2.2 Biodiversity Conservation Act 2016

The project has not been classified as State Significant Development and, as SEARs were issued for the project before the commencement of the BC Act on the 25 August 2017, the project meets the definition of a *pending or interim planning application* under Part 7 (Section 27) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*.

2.2.3 Threatened Species Conservation Act 1995 (Repealed)

The repealed TSC Act used to be the key piece of legislation providing for the protection and conservation of biodiversity in NSW through the listing of threatened species, populations and communities, key threatening processes and critical habitat for threatened species, populations and communities. Impacts to threatened species, populations and communities are assessed under Section 5A of the EP&A Act (see above). If assessment under Section 5A of the EP&A Act determines a project is likely to result in a significant effect to threatened species, populations or communities then a Species Impact Statement (SIS) or application for a BioBanking statement (see below) should be prepared.

Threatened species, populations and communities listed under the TSC Act are discussed in Sections 4.2 and 4.3 and summarised in Section 4.6. AoS are provided in Appendix 4. An assessment of whether the project will result in a significant effect to these threatened species, populations and communities is summarised in Section 7.3.

Biodiversity Banking and Offsets Scheme

Part 7A of the TSC Act establishes the Biodiversity Banking and Offsets (BioBanking) Scheme, which enables the establishment of biodiversity banking sites, the creation and trading of biodiversity credits and the use of credits to offset development otherwise impacting on ecological values. Under Section 120ZO of the TSC Act, development for which a BioBanking statement is issued is taken to be development that is not likely to significantly affect any threatened species, population or ecological community under this Act, or its habitat.

An assessment of the relevance of BioBanking to the project is provided in Section 7.3.

2.2.4 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) came into effect as of 1 July 2017 and repeals the *Noxious Weeds Act 1993*. The Biosecurity Act outlines biosecurity risks and impacts, which in relation to the current assessment includes those risks and impacts associated with weeds. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes:

- The introduction, presence, spread or increase of a pest into or within the State or any part of the State.
- A pest plant has the potential to:
  - Out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.
  - Harm or reduce biodiversity.

The Biosecurity Act introduces the concept of Priority Weeds. A priority weed is any weed identified in a local strategic plan, for a region that includes that land or area, as a weed that is or should be prevented, managed, controlled or eradicated in the region. Where a local strategic plan means a local strategic plan approved by the Minister under Division 2 of Part 4 of the *Local Land Services Act 2013*.

The Biosecurity Act also introduces the General Biosecurity Duty, which states:

> *All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.*

Priority Weeds are discussed further in Section 7.5.

2.2.5 Water Management Act 2000

The WM Act provides for the sustainable and integrated management of the state's water for the benefit of both present and future generations based on the concept of ecologically sustainable development. Under the WM Act an approval is required to undertake controlled activities on waterfront land, unless that activity is otherwise exempt under Section 91E. Waterfront land is defined within the Act as the bed of any river, lake or estuary and any land within 40 metres of the river banks, lake shore or estuary mean high water mark.

The WM Act is supported by a series of interpretation guidelines including *Controlled activities on waterfront land - guidelines for riparian corridors on waterfront land* (NSW Office of Water, 2012). This guideline defines a riparian management envelope referred to as the vegetated riparian zone (VRZ). The width of the VRZ within a riparian corridor has been pre-determined and standardised for first, second, third and fourth order and greater watercourses according to the Strahler System of ordering watercourses and is measured from the top of the highest bank on both sides of the watercourse. This guideline also presents the riparian corridor matrix that assists applicants for controlled activity approvals to identify certain works and activities that can occur on waterfront land and in riparian corridors. The guideline also includes overarching management measures for works on waterfront land.

One unnamed non-perennial stream (Strahler Order 1) traverses the proposed siding access road in the north west section of the subject site. This stream channel is undefined upstream of the subject site and remains poorly defined downstream. The stream is highly modified owing to its location within a routinely cropped and grazed agricultural landscape.

2.2.6 Fisheries Management Act 1994

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through the Assessment of Significance process under Section 221ZV of the FM Act. If assessment determines a project is likely to result in a significant effect to threatened species, populations or communities then a Species Impact Statement (SIS) should be prepared.

Two key objectives of the FM Act are to; conserve fish stocks and key fish habitats, and conserve threatened species, populations and ecological communities of fish and marine vegetation. When reviewing applications the Department of Primary Industries (DPI) will assess the likelihoods of impacts to waterways in relation to their sensitivity (TYPE) and waterway class (CLASS).

An assessment of the waterways is provided in Section 4.

3 Methods

3.1 Literature and database review

In order to provide a context for the study area, information about flora and fauna from within 10 kilometres (the 'locality') was obtained from relevant public databases. Records from the following databases were collated and reviewed:

- Department of the Environment and Energy (DEE) Protected Matters Search Tool for matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- NSW BioNet - *the database for the Atlas of NSW Wildlife*, Office of Environment and Heritage (OEH) (TSC Act).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2013 (BA).

Database searches were undertaken in January 2018.

Other sources of biodiversity information were also reviewed including:

- Central West / Lachlan Regional Native Vegetation Map Version 1.0 VIS ID 4358 (OEH 2015).
- Commonwealth Listing Advice on:
  - White Box – Yellow Box – Blakely's Red Gum grassy woodlands and derived native grasslands (TSSC 2006).Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (TSSC 2010).
- NSW Scientific Committee final determinations for threatened biota, including (but not limited to):
  - White box yellow box Blakely's red gum woodland - endangered ecological community listing (NSW Scientific Committee 2002).
  - Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (NSW Scientific Committee 2007).

3.1.1 Flora assessment

The flora assessment was undertaken on 22 January and 05 February 2018 using a combination of 20 x 20 metre quadrats, BioBanking (BBAM) transects, spot locations and random meanders to determine the vegetation types present.

General classification of native vegetation in NSW used in this report is based on the classification system in Keith (2004) which uses three groupings of vegetation: vegetation formation, vegetation class and vegetation type, with vegetation type the finest grouping. The grouping referred to in this report is Plant Community Type (PCT) as defined by the BBAM and commonly used across NSW since 2016.

The vegetation types were stratified into PCTs broadly based on previous vegetation mapping, and the vegetation boundaries marked with hand-held (uncorrected) tablet units (Samsung Galaxy Tab 3) using the ArcGIS Collector application and aerial photo interpretation. Appropriate PCTs were selected on the basis of species composition and structure, known geographical distribution, landscape position, underlying geology, soil type, and any other diagnostic features. A list of flora species was compiled for each vegetation type.

The general condition of native vegetation was observed as well as the effects of current seasonal conditions. Notes were made on specific issues such as weed infestations, evidence of management works, current grazing impacts and the regeneration capacity of the vegetation.

3.2 Field investigation

3.2.1 Fauna assessment

The study area was investigated on 22 January and 05 February 2018 to determine its values for fauna. These were determined primarily on the basis of the types and qualities of habitat present. All species of fauna observed during the assessment were noted and active searching for fauna was undertaken. This included direct observation, searching under rocks and logs, examination of tracks and scats and identifying calls. Particular attention was given to searching for threatened biota and their habitats. Fauna species were recorded with a view to characterising the values of the site and the investigation was not intended to provide a comprehensive survey of all fauna that has potential to utilise the site over time.

The study area was assessed for the presence of aquatic habitat. The proposed quarry expansion is situated on the slope of a hill and no obvious creeks or drainage lines were detected during habitat assessment. A small second order ephemeral stream runs from east to west outside the southern boundary of the study area. This creek line is currently impacted by damming on neighbouring farms, a public unsealed road and the drainage line has been diverted around the quarry disturbance area. A small first order stream traverses the proposed siding access road where the road diverts around a small farm dam.

All trees within the study area were inspected for any signs of Koala activity including inspecting trees for Koala's and searching for signs such as scratches. The base of all trees within the study area were searched within a 1 metre radius for scats. Biosis Research Standard Operating Procedures provide a comprehensive outline of methods used for fauna survey and are available on request.

Trees within the study area were assessed for hollows using the BBAM assessment methodology and any containing hollows were marked and details collected. Hollows located did not show signs of recent use by nesting birds such as chewing of the bark surrounding the hollow.

Targeted searches for the Pink-tailed Legless Lizard *Aprasia parapulchella* were undertaken in accordance with the relevant state and commonwealth guidelines (CoA 2011, DECC, 2004). Targeted searches for the Pink-tailed Legless Lizard were undertaken over two separate days due to adverse conditions during the initial field investigation. Surveys were undertaken in accordance with the commonwealth and state guidelines (CoA 2011, DECC, 2004). Survey undertaken on January 22 were conducted in sub-optimal conditions from 11am to 3pm and included a total of 163 partially embedded rocks rolled and dirt underneath carefully raked, in addition raking was conducted around some grass clumps adjacent to suitable rocks. Survey during 5 February was conducted between 6am and 9am under ideal conditions, a total of 318 partially embedded rocks were rolled within the study area with an additional 10 incidental rocks rolled during flora survey. Survey weather conditions are provided in Table 1 below.

Fauna records will be submitted to OEH for incorporation into the NSW BioNet Wildlife Atlas.

Table 1 Fauna survey weather conditions

Date	Time (24hr)	Temperature (Degrees C)	Cloud cover (eighths)	Wind (km/h)	Rain (ml)	Relative Humidity
22 Jan 2018	12:00	40	0	20	0	15
5 Feb 2018	9:00	22.8	1/8	13	0	44

3.2.2 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by the Office of Environment and Heritage under the *National Parks and Wildlife Act 1974* (SL100758). Fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee.

3.3 Qualifications and experience of survey personnel

Details of all staff undertaking the surveys, including qualifications, experience, mapping and assessment of impacts as part of the EIS are included in Appendix 5.

3.4 Limitations

Ecological surveys provide a sampling of flora and fauna at a given time and season. There are a number of reasons why not all species will be detected at a site during survey, such as species dormancy, seasonal conditions, ephemeral status of waterbodies and migration and breeding behaviours of some fauna. In many cases these factors do not present a significant limitation to assessing the overall ecological values of a site.

The current flora and fauna assessment was conducted in summer, which is an optimal time for survey. Database searches, and associated conclusions on the likelihood of species to occur within the study area, are reliant upon external data sources and information managed by third parties.

Weather conditions were not ideal for targeted fauna survey during the 22 January due to high temperatures, an extensive repeated survey on the 5 February was conducted to ensure optimal conditions for detection of target species.

3.5 Mapping

Aerial photography and site plans were supplied by Geolyse. Mapping was conducted using hand-held (uncorrected) GPS/Tablet Personal Computer units (GDA94) and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

Mapping has been produced using a Geographic Information System (GIS). Electronic GIS files containing the relevant flora and fauna spatial data are available to incorporate into design concept plans. However this mapping may not be sufficiently precise for detailed design purposes.

4 Results

The ecological values of the study area are described below and mapped in Figure 2.1 and 2.2.

4.1 Landscape context

The subject site is located in the hillcrest north of the existing quarry disturbance and extends along a siding access road (Figure 1). The subject site consists of isolated native trees and a groundcover dominated by exotic grasses where extensive past clearing of native vegetation and intensive grazing by cattle is evident. The proposed siding road runs along an existing unsealed gravel track.

The subject site occurs on an undulating slope of Late Ordovician Goonumbla Volcanics, Wombin Volcanics and small, intrusive monzonites of the Goonumbla Soil Landscape (King 1998), with soils characteristically shallow and stony with localised rock outcrops. Topsoils range from clay to sandy loams.

Native vegetation within the subject site is part of a larger 66.3 hectare patch of disturbed native vegetation occupying the ridge to the north of the current quarry area (Figure 3). Woodland along the Wyatt's Lane road reserve in the south provides connectivity to other remnant woodland along Bogan Road and in adjoining properties but is not included within the subject site.

4.2 Flora and fauna

Species recorded during the flora assessment are listed in Table A.1 of Appendix 1 (flora). Unless of particular note, these species are not discussed further. A list of threatened biota recorded or predicted to occur in the local area is also provided in those appendices, along with an assessment of the likelihood of the species occurring within the study area. During the site investigation no priority weeds as defined by DPI for the Parkes Shire LGA were recorded.

Species recorded during the fauna assessment are listed in Appendix 2, Table A.3 (fauna). Unless of particular note, these species are not discussed further. A list of threatened biota recorded or predicted to occur in the local area is also provided in those appendices, along with an assessment of the likelihood of the species occurring within the subject site.

4.3 Vegetation communities and fauna habitat

The vegetation and fauna habitat throughout the majority of the subject site has been modified by past disturbances which have included mining, cropping and grazing.

The subject site supports a range of ecological values including areas of remnant native vegetation, scattered hollow-bearing trees and rocky outcrops. The ecological values are described in Table 2, arranged by the vegetation communities within which they were recorded (refer also to Figure 2.1 and 2.2).

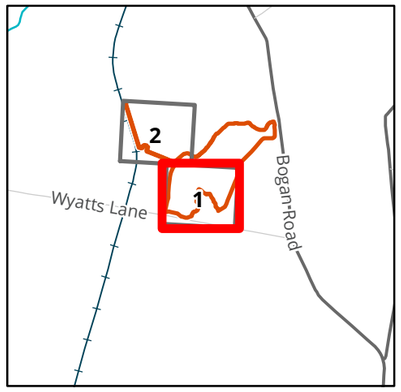
Table 2 Vegetation communities of the subject site

White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	
PCT	267
Extent within subject site	Approximately 3.6 ha of White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland was recorded within the planned quarry expansion area, proposed bunding, and siding road access.
Description including fauna habitat	This community is an open woodland remnant of the White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland where the canopy consists mainly of scattered White Box *Eucalyptus albens* and Kurrajong *Brachychiton populneus* trees. The shrub layer is absent suggesting past clearing. The ground cover is dominated by exotics species Bearded Oats *Avena barbata* and Saffron Thistle *Carthamus lanatus*. However, several native ground cover species are also present like Red Grass, *Bothriochloa macra* Queensland Bluegrass *Dichanthium sericeum*, Sprawling Bluebell *Wahlenbergia gracilis* and Umbrella Grass *Digitaria divaricatissima*. Three hollow-bearing trees recorded within the proposed quarry expansion area and rock outcropping are potential fauna habitat within this community.
Condition	The community is generally in poor condition due to previous clearing for grazing and cropping and prevalence of exotic annual grasses and forbs.
Associated soils, rainfall and landscape position	This community is located in a hill crest and rolling hills of the study area. The soils consist of stony volcanic clay loams.
Threatened ecological community	Commonwealth EPBC Act: Critically Endangered. NSW TSC Act: Endangered. Justification: The hill crest landscape position, location in the western slopes and dominance of White Box in the canopy is consistent with the NSW listed *White box yellow box Blakely's red gum woodland* endangered ecological community. Application of EPBC Act policy statement 3.5 (DEH 2006) flow chart for determining if land contains Box Gum CEEC identifies the presence of the EPBC Act listed ecological community on the basis that: • The presence of White Box; a listed common Box Gum overstorey species • The patch has a predominant native understorey (as defined by DEH 2006). • The patch is greater than 2 hectares. • There is natural regeneration of the dominant overstorey eucalypt (as defined by DEH 2006) within the patch. Note: The 'patch' here includes the approximately 66.3 hectares of vegetation extends beyond the subject site and is shown in Figure 3.
Threatened species habitat	This community is considered to provide marginal habitat for threatened flora and fauna species.

White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	
Picture: White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland within the subject site	

Disturbed land	
PCT	N/A
Extent within subject site	Approximately 1.6 ha of previously disturbed land was recorded along proposed access road sections and proposed siding road.
Description including fauna habitat	This area consist of the previously disturbed existing tracks. Most of the tracks are cleared of vegetation with some patches recolonised by exotic grasses, herbaceus species. And small numbers of native grasses. This area does not provide habitat for fauna species.
Condition	The area is in poor condition due to past clearing an existing track disturbance
Associated soils, rainfall and landscape position	This community is located in the floodplain transitional zone, at the foot slope of the study area as well as mid slopes along the access track to the pit and quarry expansion.
Threatened ecological community	Commonwealth EPBC Act: Not applicable NSW TSC Act: Not applicable
Threatened species habitat	This community is considered to provide negligible habitat for several threatened flora and fauna species.

Disturbed land	
Picture: Existing track (Disturbed land) along the proposed siding road	



Legend

- Study area
- Subject site
- Flora quadrats
- Hollow bearing trees

Threatened ecological community

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland EEC / Box Gum Woodland CEEC

Vegetation communities

- PCT267 - White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion
- Disturbed

Strahler order

- 2
- Modified 2 (Doesn't reflect current topographic mapping)
- 3

Figure 2.1: Ecological features of the study area

0 25 50 75 100 125

Metres

Scale: 1:2,700 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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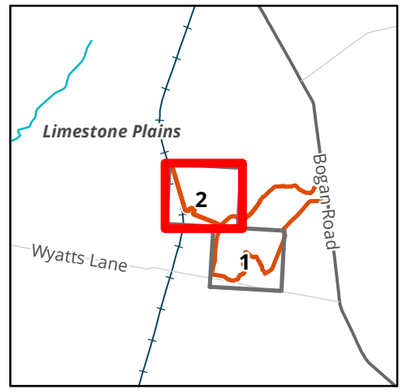
Location:P:\25500s\25563\Mapping
25563_F2_EcoFeatures_East

Acknowledgements: Basemap © Land and Property Information 2016



Legend

- Study area
- Subject site
- Flora quadrats
- Hollow bearing trees

Threatened ecological community

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland EEC / Box Gum Woodland CEEC

Vegetation communities

- Disturbed

Strahler order

- 1

Figure 2.2: Ecological features of the study area

0 25 50 75 100 125

Metres

Scale: 1:2,700 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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4.4 Aquatic habitats

One unnamed non-perennial stream (Strahler Order 1) traverses the proposed siding access road in the north west section of the subject site. This stream channel is undefined upstream of the subject site and remains poorly defined downstream. The stream is highly modified owing to its location within a routinely cropped and grazed agricultural landscape. No flowing or standing water was observed within the stream at the time of survey and aquatic habitat within the stream was lacking.

The first order stream feeds a small farm dam around the northern edge of which the siding access road travels. At the time of survey, the dam was edged by a small area of muddy substrate which transitioned in to dense grass sward of mostly exotic grasses. No fringing, or submerged native aquatic plants were observed nor were any instream habitat structures such as logs or rocks. The depth of the farm dam at time of survey is not known.

A second order unnamed stream traverses the existing quarry disturbance footprint to the south of the proposed quarry expansion area and does not traverse the subject site. The stream has been modified by agricultural land uses upstream of the existing quarry and has been diverted around the quarry disturbance area.

4.5 Groundwater Dependent Ecosystems

The study area sits within the Lachlan groundwater province. A review of the Groundwater Dependent Ecosystem (GDE) Atlas (Bureau of Meteorology 2018) did not identify any terrestrial GDEs in the study area or within a 10 kilometre radius of the study area. Woodland and derived grassland vegetation within the study area is considered '*Low potential GDE – from regional studies*'. The headwater of Cookopie Creek lies approximately 5 kilometres north of the study area and is identified on the GDE Atlas as '*Moderate potential GDE – from national assessment*'. The study area is not part of the Cookapie Creek catchment and the proposed development is therefore unlikely to directly or indirectly impact any GDE associated with Cookopie Creek.

Plate 1 Mapped unnamed waterway (Strahler order 1) crossing the subject site (proposed siding access road) upstream.

Plate 2 Existing dam and unnamed waterway (Strahler order 1) crossing the subject site (proposed siding access road) downstream.

4.6 Threatened biota

Threatened biota includes all flora and fauna species, populations and ecological communities listed under the EPBC Act and TSC Act. Lists of threatened biota recorded or predicted to occur within 10 kilometres of the study area are provided in Appendix 1 (flora) and Appendix 2 (fauna). Previous records of threatened biota within the locality are shown in Figure 4 (flora) and Figure 5 (fauna).

The subject site does not provide habitat for threatened flora due to a series of factors that include a lack of recent records in the locality, high level of degradation, incorrect habitat and soil type. An assessment of the likelihood of these species occurring in the study area, and an indication of the likelihood of the project resulting in a significant impact/effect, is included in this report.

The subject site provides limited habitat for threatened fauna species. The proposed access roads are within land that has been previously cleared, with sections that have been cropped and have existing tracks. As such the proposed access road sections of the subject site contain only marginal foraging habitat for some threatened fauna species such as raptors. The quarry expansion section of the subject site contains limited habitat for threatened fauna in the form of partially embedded rocks, rock outcrop, large flowering eucalypt foraging habitat and three hollow-bearing trees.

One threatened species, the Grey-crowned Babbler was recorded during field survey within the road reserve to the south of the study area.

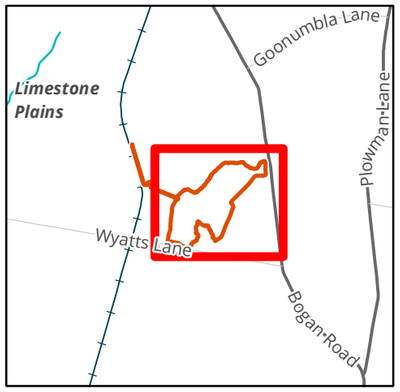
The Pink-tailed Legless Lizard was not detected during targeted survey and as such is considered to have a low likelihood of occurrence. White Box is listed as a secondary koala food tree species in the Central West Local Land Services area (OEH 2017a). However, no Koala's were observed feeding within the subject site and active searches for evidence of koala presence did not detect signs of activity.

No areas of critical habitat for flora or fauna have been declared within the study area. One EEC and four fauna species have been identified as having a medium or greater likelihood of occurrence. Table 3 discusses areas of value and potential impacts for all species with a medium or greater likelihood of occurrence, and determines the need for an assessment of significance.

Table 3 Threatened biota likely to occur in the subject site

Species name	EPBC status	TSC status	Relevance to study area and potential for impact
Ecological communities			
White box yellow box Blakely's red gum woodland	CEEC	EEC	The 3.6 hectares of *PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion* within the subject site is consistent with the TSC Act-listed White box yellow box Blakely's red gum woodland EEC and EPBC Act listed Box Gum Woodland CEEC. The EEC/CEEC is considered to be in low to moderate condition owing to the very sparse canopy and dominance of weeds in the groundcover.
Fauna			
Grey-crowned Babbler *Pomatostomus temporalis*		V	Recorded in roadside vegetation adjacent to existing quarry site. Study area contains moderate-quality habitat in the form of isolated paddock trees, development will not fragment habitat or movement corridors. This species has potential to forage within the subject site on occasion but is unlikely to nest or roost. Higher quality foraging habitat exists within the road reserve and it is unlikely the proposed development will have a significant impact on the local population.
Little Pied Bat *Chalinolobus picatus*		V	Likely to forage across the study area and may also roost within hollow-bearing trees within the study area. Roadside vegetation outside of the study area provides foraging habitat and contains abundant hollows likely to be suitable for roosting. It is unlikely that removal of the hollow-bearing trees within the subject site will significantly impact on the local population.
Supberb parrot *Polytelis swainsonii*	VU	V	3.6 hectares of marginal habitat occurs within the subject site. This species was previously recorded within 500 meters of the study area. This species may occasionally forage and rest within the study area, however, the road reserve to the south and east, and remnant vegetation on top of the hill to the north-west of the subject site provide abundant hollows for nesting and large eucalypts for foraging. It is unlikely that removal of isolated paddock trees within the subject site will significantly impact on this species.
Swift Parrot *Lathamus discolor*	CE	E1	May occasionally forage within the subject site, however, more abundant resources are available in the road reserve to the south and east of the study area, and remnant vegetation on top of the hill to the north-west. The Swift parrot breeding habitat is in Tasmania and it is unlikely that removal of habitat in the form of isolated paddock trees within the subject site will have a significant impact on this species.

Known habitats for migratory species have been considered and are considered and addressed in Appendix 2.



Legend

- Study area
- Subject site
- Flora quadrats
- Hollow bearing trees

Threatened ecological community

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland EEC / Box Gum Woodland CEEC

Strahler order

- 2
- Modified 2 (Does not reflect current topographic mapping)
- 3

Figure 3: Extent of native vegetation within the study area

0 50 100 150 200 250

Metres

Scale: 1:5,000 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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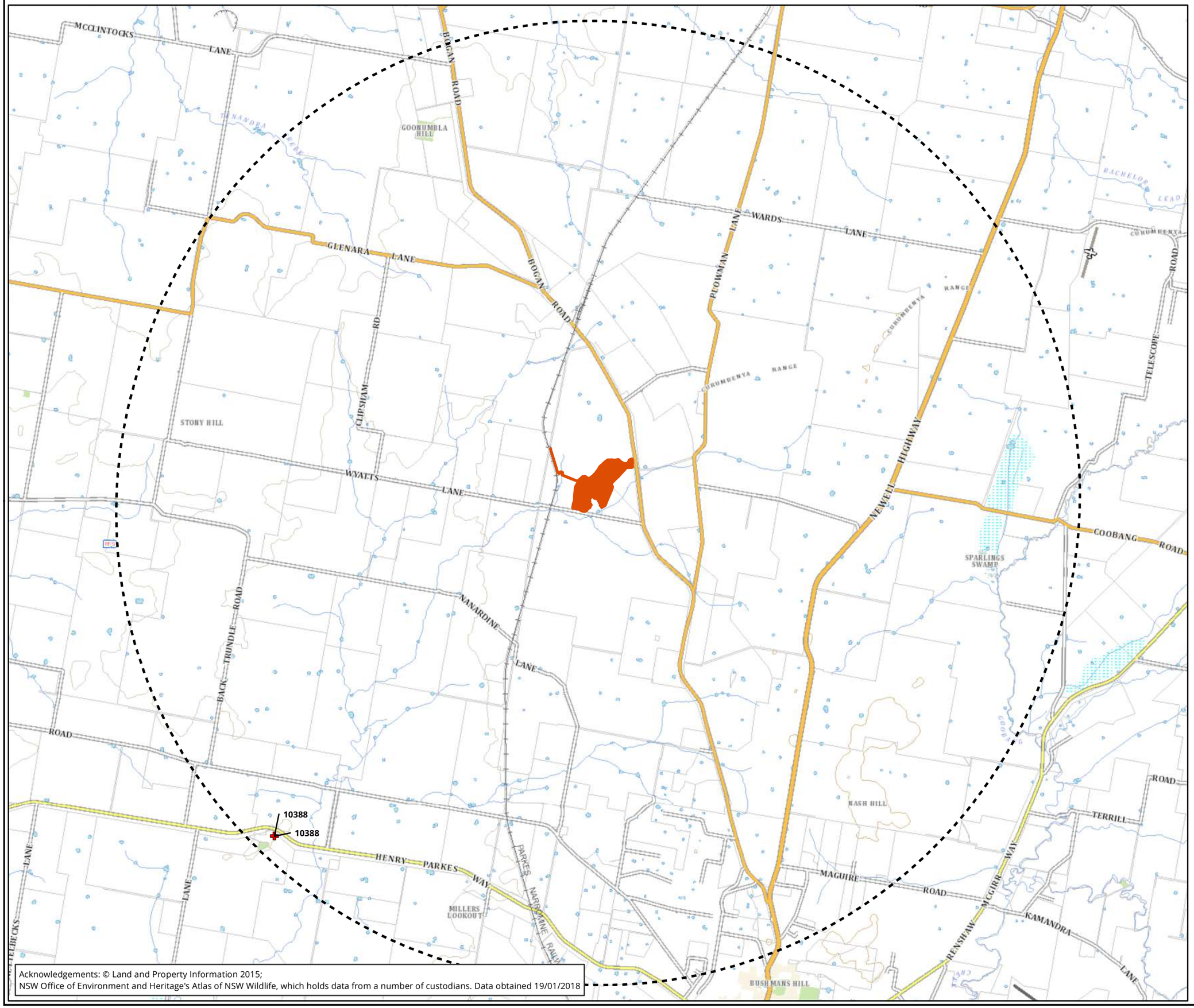

Legend

Study area

Search area

Threatened Flora

10388 - Austrostipa wakoolica

* Record is listed as sensitive under OEH's Sensitive Species Data Policy and cannot be shown at this scale

Acknowledgements: © Land and Property Information 2015;
NSW Office of Environment and Heritage's Atlas of NSW Wildlife, which holds data from a number of custodians. Data obtained 19/01/2018

Figure 4: Threatened flora species recorded within ten kilometres of the study area

0 800 1,600 2,400 3,200 4,000

Metres

Scale: 1:75,000 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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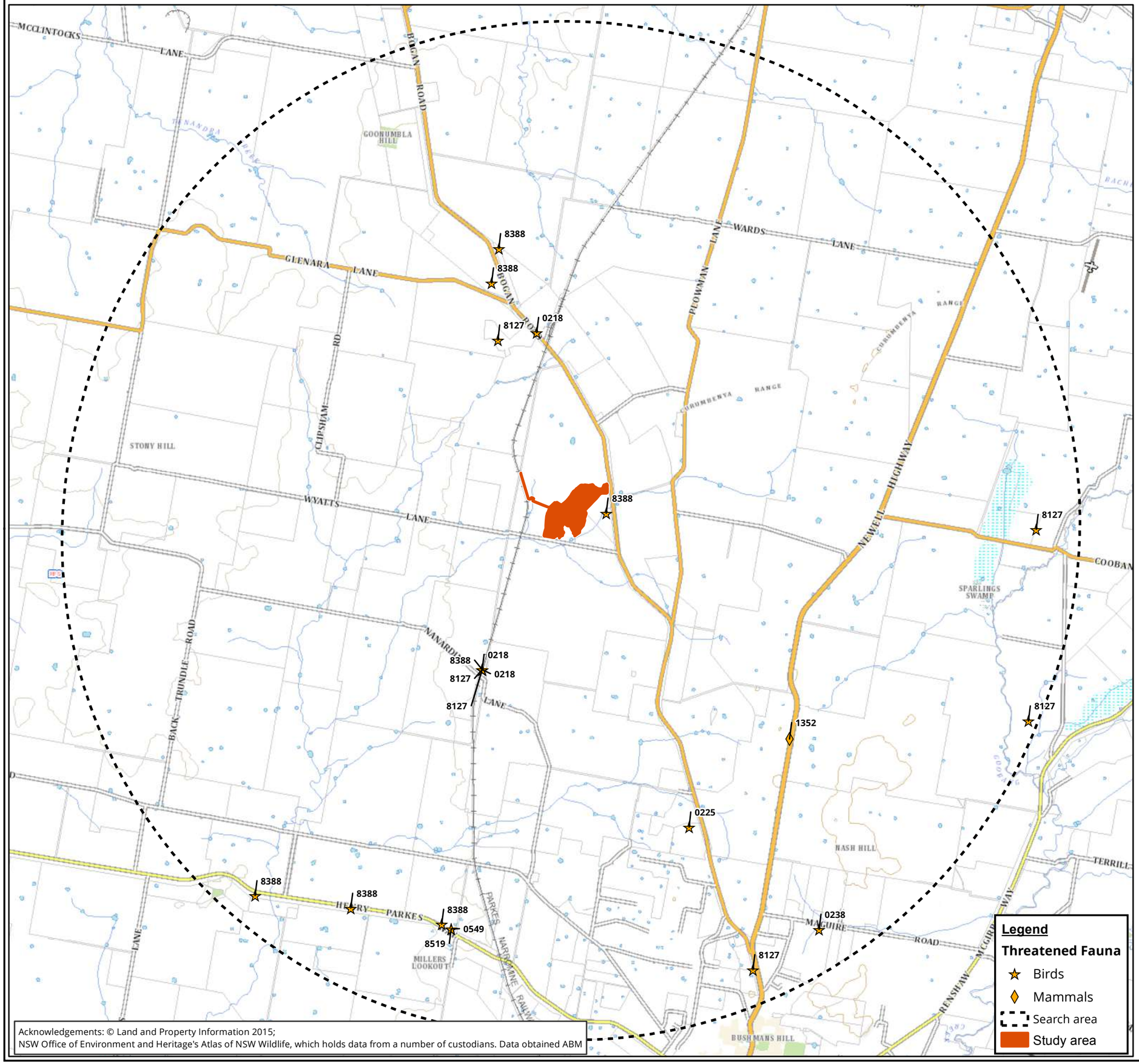

Acknowledgements: © Land and Property Information 2015;
NSW Office of Environment and Heritage's Atlas of NSW Wildlife, which holds data from a number of custodians. Data obtained ABM

Species list

Birds

0218 - Spotted Harrier
0225 - Little Eagle
0238 - Black Falcon
0277 - Superb Parrot*
0549 - Varied Sittella
0652 - Diamond Firetail
8127 - Brown Treecreeper (eastern subspecies)
8388 - Grey-crowned Babbler (eastern subspecies)
8519 - Dusky Woodswallow

Mammals

1352 - Little Pied Bat

* Record is listed as sensitive under OEH's Sensitive Species Data Policy and cannot be shown at this scale

Figure 5: Threatened fauna species recorded within ten kilometres of the study area

0 1,000 2,000 3,000 4,000

Meters
Scale: 1:75,000 @ A3
Coordinate System: GDA 1994 MGA Zone 55

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5 Ecological impacts and mitigation measures

This section identifies the potential impacts of proposed development on the ecological values of the study area and describes measures to avoid, minimise and mitigate potential direct and indirect impacts to ecological values arising from the proposed development.

The proposed development may result in the following impacts to ecological values including:

- Removal of 3.6 hectares of PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland which is consistent with:
  - White box yellow box Blakely's red gum woodland EEC
  - Box Gum Woodland CEEC.
- Removal of three hollow-bearing trees.
- Removal of three mature White Box and six mature Kurrajong trees that provide foraging habitat for a variety of highly mobile species including some threatened species.
- Increase in deposition of dust on native vegetation and flora and fauna habitat during construction and operation of the quarry expansion.
- Increase in noise and vibration impacts to fauna habitat surrounding the subject site.
- Increased prevalence of weeds or introduction of new weeds to retained native vegetation surrounding the subject site.

The principal means of reducing impacts to ecological values within the subject site and broader study area will be to minimise removal of native vegetation through siting of the development on already disturbed land. The design of the proposed development has been revised in response to the results of the ecological assessment in order to reduce direct impacts to native vegetation consistent with the White box yellow box Blakely's red gum woodland EEC and Box Gum Woodland CEEC. Specifically, early design options for the siding access road were revised so that the entire length of the proposed road follows existing disturbed tracks; avoiding potential direct and indirect impacts to the EEC / CEEC. The route was also modified to avoid impacts to hollow-bearing trees located adjacent to an earlier road alignment option immediately west of the existing quarry disturbance area.

A suite of management measures are to be incorporated in to the construction and operational phases of the proposed development to mitigate impacts to ecological values. A Construction Environmental Management Plan (CEMP) will guide construction of the quarry expansion and include measures to mitigate dust, erosion and sedimentation and to ensure protection of EEC / CEEC vegetation and associated habitats beyond the subject site. The CEMP will include on-site fauna management measures that will guide vegetation clearing activities and minimise the risk of injury or death to native fauna, in particular hollow-dependent species during tree removal. As far as practicable, the removal of hollow-bearing trees and other native vegetation will be undertaken at a time and in a manner that will cause least impact to fauna species with potential to occur within the subject site.

A site Operational Environmental Management Plan (OEMP) will be developed to guide on-going management of the quarry activities during operation. The effective management of weeds, dust, noise and vibration so as not to impact surrounding ecological values will be key objectives of the OEMP.

Impacts to White box yellow box Blakely's red gum woodland EEC and Box Gum Woodland CEEC will be mitigated, in part, by compensatory planting of locally native plants in the retained EEC / CEEC vegetation along the hill and ridge beyond the subject site. The plantings will aim to enhance the floristic and structural characteristics of the EEC / CEEC beyond the subject site and increase resilience of those areas.

A summary of potential implications of development of the subject site and measures to minimise and mitigate impacts during the construction and operation of the proposed development is provided in Table 4 below. The minimisation and mitigation measures are later summarised in a statement of biodiversity commitments in Section 6 .

Table 4 Ecological values, impacts and recommendations

Ecological value (Figure 3)	Impacts	Recommendations	
		Avoid	Minimise and mitigate
Native vegetation: White Box, Yellow Box Blakely's Red Gum EEC / Box Gum Woodland EEC.	• Removal of 3.6 hectares of *PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland* which is consistent with: o White box yellow box Blakely's red gum woodland EEC o Box Gum Woodland CEEC. • Potential for adverse impacts of dust to retained EEC / CEEC vegetation during construction and operation of the proposed development. • Potential introduction and spread of weeds within retained EEC / CEEC during construction and operation of the proposed development.	• Opportunities to avoid impacts within the proposed quarry expansion area are minimal due to constraints imposed by the existing quarry operation and landscape setting of the geological resource. • The proposed development avoids direct impacts to remnant bushland within the Wyatt's Lane road reserve by utilising the existing quarry access road for access and by siting the siding access road along existing tracks. • An updated Surface Water Management Plan (SWMP) will be prepared for the quarry expansion and will detail measures to minimise erosion and sedimentation impacts to biodiversity values beyond the subject site.	• Identifying the locations of retained EEC / CEEC vegetation (Figure 2) as 'No Go' zones in a project-specific CEMP or similar and on-site using appropriate exclusion fencing. • Communicate the EEC /CEEC 'No Go' zones during the inductions for all site construction and operations personnel. This should include discussion of regulatory implications of non-approved impacts on the EEC / CEEC. • Minimise soil transportation within, into or out of the study area to reduce the spread of weeds. • Implement general weed hygiene protocols during construction/operation. • Clearing and stripping will be undertaken such that only the minimum area necessary is cleared/stripped to conduct operations. All stripped soils are to be separated (topsoil and subsoils) and stockpiled in the proposed bunding area for future rehabilitation works. • Dust management measures will be set out in the CEMP and OEMP and will include; water sprays on crushing equipment and cessation of work during high wind conditions. • Compensatory planting of locally native plants will be undertaken by the proponent within retained EEC / CEEC vegetation west and north of the expanded quarry operations. Species consistent with Box Gum Woodland will be

Ecological value (Figure 3)	Impacts	Recommendations	
		Avoid	Minimise and mitigate
			selected and local provenance seed used to enhance the composition, structure and long-term resilience of remnant EEC / CEEC in the study area.
Hollow-bearing trees	• Removal of three hollow-bearing trees within the subject site. • Potential impact (large limb removal) of hollow-bearing tree along western section of the proposed siding road adjacent to existing pond.	• The proposed siding access road will be designed so as to avoid the need to remove or otherwise directly impact (e.g. lopping of limbs) hollow-bearing trees along the proposed siding access road route. • Retained trees are to be protected in accordance with Australian Standard AS4970 – 2009 Protection of trees on development sites (Standards Australia 2009) during project construction.	• Ideally, vegetation clearing should be undertaken when hollows are not being used for nesting by birds or breeding by microbats (September to November). • Pre-clearance surveys should be undertaken within 1 week before the removal of hollow-bearing trees. • If fauna are suspected to be utilising the hollow, the entrance should be blocked by the arborist and the hollow section carefully lowered to the ground for inspection by an ecologist so that fauna may be re-located. If bats are found to be roosting in the hollow,

Ecological value (Figure 3)	Impacts	Recommendations	
		Avoid	Minimise and mitigate
			the ecologist will be required to safely release bats at sunset. • Any wildlife rescued during vegetation clearing is to be relocated to the closest available area of habitat if uninjured. If wildlife is injured during vegetation clearing they must be taken to the nearest available wildlife carer or veterinarian immediately. • The above measures are to be included in the project-specific CEMP. • Information on ecological features to be included in site inductions and pre-start meetings.
Unnamed first order waterways.	• The proposed development will not directly affect either first order waterway as impacts will be located within areas of existing disturbed land. Indirect impacts of sedimentation and erosion beyond the subject site may occur in the absence of appropriate mitigation measures.	• Direct impacts to waterways are avoided by utilising the existing quarry access road for access and by siting the siding access road along existing tracks.	• An updated Surface Water Management Plan (SWMP) will be prepared for the quarry expansion and will detail measures to minimise erosion and sedimentation impacts to biodiversity values beyond the subject site, including both first order streams.
Flora and fauna habitat associated with retained native vegetation beyond the subject site.	• Potential for adverse impacts of dust to habitat associated with retained EEC / CEEC vegetation. • Potential introduction and spread of weeds within habitat associated with retained EEC / CEEC during construction and	• The proposed development avoids direct impacts to remnant bushland within the Wyatt's Lane road reserve by utilising the existing quarry access road for access and by siting the siding access road along existing tracks.	• Refer to measures described for Native vegetation: White Box, Yellow Box Blakely's Red Gum EEC / Box Gum Woodland EEC. • The OEMP will describe noise mitigation measures such as lining of plant hopper feed bin and use of a rock drill with a shroud to minimise noise.

Ecological value (Figure 3)	Impacts	Recommendations	
		Avoid	Minimise and mitigate
	operation of the proposed development. • Noise and vibrations upon native fauna as a result of the operation of the expanded quarry.	• Direct impacts to flora and fauna habitat beyond the subject site are to be avoided by utilising the existing quarry access road for access and by siting the siding access road along existing tracks. • An updated Surface Water Management Plan (SWMP) will be prepared for the quarry expansion and will detail measures to minimise erosion and sedimentation impacts to biodiversity values beyond the subject site.	• Blasting will be limited to approximately 6 blasts per year between 0900 and 1700 hours.

Cumulative impacts to biodiversity

The subject site contains 3.6 hectares of relatively low condition White box yellow Box Blakely's red gum woodland EEC / Box Gum Woodland CEEC which is part of a much larger 66.3 hectare patch extending across the low hill and ridge to the west, north and east of the subject site.

Areas mapped as PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion and the related derived grassland PCT 250 Derived tussock grassland of the central western plains and lower slopes of NSW by OEH (2015) occur to the north, south, east and west of the subject site. As has been shown within the subject site and on the adjoining hill slope and ridge, areas mapped as containing these PCTs are likely to be consistent with White box yellow Box Blakely's red gum woodland EEC / Box Gum Woodland CEEC thus indicating the community is well represented in the local area. TSSC (2006) estimate the extent of Box Gum Woodland in the Central Lachlan region (within which the subject site is situated) at approximately 20,900 hectares and the extent across NSW at 250,729 hectares.

The proposed removal of 3.6 hectares or approximately 5.25% of the existing EEC / CEEC patch will contribute to the ongoing incremental decline of both listed communities in NSW and nationally. However, the EEC / CEEC within the subject site is already substantially modified and the proposed development is not expected to further fragment the local ECC / CEEC extent nor is it likely to exacerbate indirect impacts such as dust, erosion and sedimentation or weed invasion. The proposed development is therefore unlikely to substantially exacerbate the decline of White box yellow Box Blakely's red gum woodland EEC or Box Gum Woodland CEEC in the local area or more broadly across the range of either community.

The removal of 3 hollow-bearing trees and 3.6 hectares of foraging resources will contribute to the incremental reduction of habitat for threatened hollow-dependent fauna and highly mobile species in the local landscape. The foraging, roosting and nesting resources directly impacted by the proposed development are all well represented beyond the subject site and as such, the loss is not expected to significantly impact any dependent threatened species.

The expansion of the quarry and addition of a siding access road may, overtime, lead to an increase in traffic, dust and noise and vibration generation in the locality which may in turn impact ecological values surrounding the subject site. Air quality modelling results indicate only minor changes to air quality relative to the current values associated with the existing quarry operations (AMG 2018a). Noise and vibration arising from the proposed quarry expansion will be effectively minimised and mitigated by application of measures recommended in AMG (2018b). Impacts associated with the future use of the proposed siding access road are not considered here and will be dealt with by a future DA modification. Nevertheless, potential impacts of future use of the proposed siding access road may be avoided and/or minimised through appropriate management measures.

6 Statement of commitments relating to biodiversity

Risk of impacts to the rest of the White box yellow box Blakely's red gum woodland EEC / Box Gum woodland CEEC will be managed by incorporating appropriate safeguards during further planning and when carrying out the construction works (Table 4). Aspects of initial designs were identified as resulting in potential minor impacts to native vegetation and hollow-bearing trees along the road reserve. Redesign and removal around these features was undertaken to avoid further impacts to biodiversity.

The proponent has committed to undertaking compensatory planting using locally native species within the White box yellow box Blakely's red gum woodland EEC / Box Gum woodland CEEC retained beyond the subject site. These plantings will aim to restore some landscape functionality in parts of the currently degraded patch that maintain some resilience.

Table 5 Statement of commitments relating to biodiversity

Commitment	Description	Biodiversity outcome	Timeframe for implementation	Responsibility for implementation	Accountability for outcomes
Avoidance of *White Box, Yellow Box Blakely's Red Gum EEC / Box Gum Woodland EEC.*	The proposed development avoids direct impacts to remnant bushland within the Wyatt's Lane road reserve by utilising the existing quarry access road for access and by siting the siding access road along existing tracks.	Good condition remnant woodland providing habitat for a variety of threatened and non-threatened flora and fauna is excluded from the subject site and will not be impacted by the quarry expansion.	Prior to construction	Cudal Lime Products	Cudal Lime Products
Avoidance of hollow-bearing trees along the proposed siding access route.	The proposed siding access road will be designed so as to avoid the need to remove or otherwise directly impact (e.g. lopping of limbs) hollow-bearing trees along the proposed siding access road route. Retained trees are to be protected in accordance with Australian Standard AS4970 – 2009 Protection of trees on development sites (Standards Australia 2009) during project construction.	Nesting and roosting habitat for threatened fauna is maintained in the locality.	Prior to construction	Cudal Lime Products	Cudal Lime Products
Avoidance of impacts to first order streams	Direct impacts to waterways are avoided by utilising the existing quarry access road for access and by siting the siding access road along existing tracks.	Impacts to aquatic habitats downstream of the subject site area avoided.	Prior to construction	Cudal Lime Products	Cudal Lime Products
Construction Environmental Management Plan (CEMP)	A project CEMP will be developed and implemented and will include: • Site fencing and signage to delineate limits of clearing.	All construction related impacts are confined to subject site with no direct or indirect impacts to biodiversity values in adjoining areas.	During construction	Cudal Lime Products / Construction contractor	Cudal Lime Products

Commitment	Description	Biodiversity outcome	Timeframe for implementation	Responsibility for implementation	Accountability for outcomes
	• Procedures for storage and re-use of topsoil. • Weed hygiene protocols and weed management measures. • Sediment and erosion control measures (described within a Surface Water Management Plan). • Dust control measures. • Noise and vibration mitigation measures. • Site personnel induction requirements. • Schedule of monitoring and maintenance.				
Flora and fauna management measures as part of the CEMP	The CEMP and will describe management measures specific to biodiversity. Measures will include: • Requirements and methods for pre-clearance fauna surveys by qualified person. • Procedures for unexpected threatened species finds and fauna handling. • Biodiversity specific component of site induction and toolbox talks. • Tree protection measures for retained habitat trees proximal to the subject site. • Fauna-sensitive tree-felling protocols for removal of all habitat trees.	All construction related impacts are confined to subject site with no direct or indirect impacts to biodiversity values in adjoining areas. Habitat trees beyond the subject site will be adequately protected.	During construction	Cudal Lime Products / Construction contractor	Cudal Lime Products
Operational Environmental Management	A project OEMP will be developed and implemented and will include:	All potential indirect impacts from operation of the project are confined to subject site with no indirect impacts to biodiversity values in	During operation	Cudal Lime Products	Cudal Lime Products

Commitment	Description	Biodiversity outcome	Timeframe for implementation	Responsibility for implementation	Accountability for outcomes
Plan (OEMP)	• Site fencing and signage to prevent access to off-site areas. • Stormwater management measures (described within a Surface Water Management Plan). • Dust control measures. • Noise and vibration mitigation measures. • Schedule of monitoring and maintenance.	adjoining areas.			
Supplementary planting of local native plant species	Compensatory planting of locally native plants will be undertaken by the proponent within retained White Box, Yellow Box Blakely's Red Gum EEC / Box Gum Woodland EEC vegetation west and north of the expanded quarry operations. Species consistent with the EEC / CEEC will be selected and local provenance seed used to enhance the composition, structure and long-term resilience of remnant EEC / CEEC in the study area. Revegetation of post-construction landforms within the subject site will be undertaken using local native plant species consistent with White Box, Yellow Box Blakely's Red Gum EEC / Box Gum Woodland EEC.	Resilience of White Box, Yellow Box Blakely's Red Gum EEC / Box Gum Woodland EEC at the locality will be enhanced.	During construction	Landscaping contractor	Cudal Lime Products

7 Assessment against key biodiversity legislation

7.1 Environmental Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed development on Matters of NES, against heads of consideration outlined in Commonwealth of Australia (2013) was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment is required. Matters of NES relevant to the project are summarised in Table 6.

Table 6 Assessment of the project against the EPBC Act

Matter of NES	Project specifics	Assessment against Commonwealth of Australia (2013)
Threatened species (flora and fauna)	Six flora species and 16 fauna species have been recorded or are predicted to occur in the locality. An assessment of the likelihood of these species occurring in the study area is provided in Table A.2 of Appendix 1 (flora) and Table A.4 of Appendix 2 (fauna). Most of these species are not likely to occur within the study area and development is unlikely to constitute a significant impact.	Not applicable
Threatened ecological communities	The EPBC Act listed TEC Box Gum woodland CEEC is mapped within the subject site. The project will result in the permanent removal of 3.6 ha of this CEEC.	Assessments against the Significant Impact Criteria (CoA 2013) have been prepared for this TEC (Appendix 3) concluded that a significant impact was not likely to result from the project.
Migratory species	Nine migratory species have been previously recorded or are predicted to occur in the locality (Table A.5 of Appendix 2).	While some of these species would be expected to use the subject site on occasions, some may do so regularly and others may be resident, the subject site does not provide important habitat for an ecologically significant proportion of any of these species.

On the basis of criteria outlined in Commonwealth of Australia (2013) it is considered unlikely that a significant impact on a Matter of NES would result from the project.

7.2 Environmental Planning and Assessment Act 1979

An assessment of the project against the relevant sections of the EP&A Act is provided below.

Assessment of Significance

Assessments of Significance were completed for one ecological community; White Box, Yellow Box Blakeley's Red Gum Woodland EEC, considered a medium or greater likelihood of occurrence within the study area

(Appendix 4). The assessment indicate that a significant effect is not likely to result from the project. A Species Impact Statement (SIS) is therefore not required.

Assessment of significance were completed for Little Pied-bat, Grey Crowned Babbler, Superb Parrot and Swift Parrot which were considered to have a medium likelihood of occurrence within the subject site. These assessments are provided in Appendix 2 and indicate that a significant effect is not likely to result on these species. A Species Impact Statement (SIS) is therefore not required.

State Environmental Planning Policies

SEPP No. 44 – Koala Habitat Protection

The study area supports one tree species, White Box *Eucalyptus albens* which is a Koala feed tree species as defined in Schedule 1 of the SEPP. Koala feed trees, identified above, make up 15 per cent of the total number of trees in the upper or lower strata of the tree component. Therefore the vegetation within the study area would be considered potential Koala habitat as defined under SEPP No. 44.

Under SEPP No. 44, as the vegetation in the study area has been identified as potential Koala habitat, determination of whether the land constitutes core Koala habitat is required. The field investigation included diurnal searches for Koala's and active searching for any indirect evidence of use by Koalas such as scratches and faeces. This assessment did not identify a resident population of Koalas within the study area. Therefore the vegetation in the study area does not constitute core Koala habitat as defined under SEPP No. 44.

No further consideration is required.

Local Environment Plans

The study area is subject to the Parkes Local Environment Plan and is zoned RU1. The relevant objectives of RU1 zoning are to:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
- *To encourage eco-tourism enterprises that minimise any adverse effect on primary industry production.*
- *To permit non-agricultural uses that support the primary production purposes of the zone.*
- *To permit small scale rural tourism uses associated with primary production and environmental conservation with minimal impact on primary production and the scenic amenity of the area.*
- *To encourage the provision of tourist accommodation in association with agricultural activities.*
- *To provide opportunities for employment-generating development that adds value to local agricultural production and integrates with tourism.*

The project is considered consistent with the objectives of RU1 zoning.

7.3 Threatened Species Conservation Act 1995

An assessment of the likelihood of threatened biota occurring within the study area is provided in Appendix 1 (flora) and Appendix 2 (fauna) along with an assessment of whether the project has potential to result in a

significant effect. These assessments determined that one ecological community and four fauna species have a medium or greater likelihood of occurring within the study area. AoS have been prepared for the threatened biota that are deemed likely to be subject to negative impacts and are provided in Appendix 4.

AoS indicate that a significant effect is not likely to result from the proposal. A Species Impact Statement is therefore not required.

Biodiversity Banking and Offsets Scheme

As the project is unlikely to result in a significant effect to threatened biota, consideration of the BioBanking Scheme is not warranted.

7.4 Biosecurity Act 2015

No priority weeds for the Central West Region, which includes the Parkes Shire LGA, have been recorded in the study area.

7.5 Fisheries Management Act 1994

Based on the ecological assessment herein, no threatened species, populations or ecological communities listed under the FM Act are considered likely to occur within the study area. The first order streams and farm dam within the study area are not considered key fish habitat.

8 Conclusion

This report is an assessment of the potential impacts of the proposed quarry expansion and associated siding access road on the ecological values within and adjoining the subject site in accordance with the EP&A Act, TSC Act, FM Act, WM Act and the EPBC Act.

The proposed development will result in the following residual impacts to ecological values:

- Removal of 3.6 hectares of PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland which is consistent with:
  - White box yellow box Blakely's red gum woodland EEC
  - Box Gum Woodland CEEC.
- Removal of three hollow-bearing trees.
- Removal of three mature White Box and six mature Kurrajong trees that provide foraging habitat for a variety of highly mobile species including some threatened species.

No flora species or endangered populations listed under the EPBC Act or TSC Act were recorded during the field investigation or considered likely to occur within the subject site.

PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion, mapped by Biosis within the study area, is consistent with the final determination for the of TSC Act listed White box yellow box Blakely's red gum woodland EEC and EPBC Act listed Box Gum Woodland CEEC. A total of 3.6 hectares of the EEC / CEEC within the subject site would be removed by the proposed works, representing approximately 5% of the local extent of this EEC / CEEC.

The subject site provides marginal foraging habitat for several TSC Act and/or EPBC Act listed threatened fauna including Swift Parrot, Superb Parrot, Grey-crowned Babbler and Little Pied Bat. Hollow-bearing trees to be removed as part of the proposed quarry expansion also provide potential roosting and nesting habitat for Superb Parrot and Little Pied Bat.

Assessments of significance in accordance with Part 5A of the EP&A Act and Significant Impact Criteria assessments in accordance with Commonwealth of Australia (2013) were completed for threatened fauna likely to occur within the subject site as well as White box yellow box Blakely's red gum woodland EEC and EPBC Act listed Box Gum Woodland CEEC were completed. These assessments concluded the proposed quarry expansion is unlikely to result in any significant residual impacts on any TSC Act or EPBC Act listed fauna species or ecological community provided appropriate measures to avoid, minimise and mitigate impacts are implemented effectively.

The proposed development will implement a range of measures to avoid, minimise and mitigate impacts to White box yellow box Blakely's red gum woodland EEC / Box Gum Woodland CEEC and threatened fauna habitat within and adjoining the subject site. These measures are detailed in Section 5 and 6 of this report and include; design of the siding access road to avoid impacts to the EEC / CEEC and hollow-bearing trees, the implementation of a CEMP and OEMP to guide manage and reduce impacts of weeds, dust, noise and vibration during construction and operation of the expanded quarry and the undertaking of compensatory planting within retained EEC / CEEC beyond the subject site to enhance the condition and resilience of retained EEC / CEEC.

Given the proposal is unlikely to have a significant residual impact on any TSC or EPBC Act listed fauna species and ecological communities, a Species Impact Statement or a Referral to the Commonwealth Minister of the Environment are not deemed necessary for the current proposal.

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Appendices

Appendix 1 Flora

Appendix 1.1 Flora species recorded from the study area

Notes to tables:

Status – EPBC Act: CE – Critically Endangered EN – Endangered VU – Vulnerable	**Status – TSC Act:** E1 – endangered species (Part 1, Schedule 1) E2 – endangered population (Part 2, Schedule 1) E4 – presumed extinct (Part 4, Schedule 1) E4A – critically endangered V – vulnerable (Part 1, Schedule 2)
Status – Exotic # – Native species outside natural range * – priority weed species declared under the Biosecurity Act 2015	

Table A.1 Flora species recorded from the study area

Family	Scientific name	Common Name	Plot number	Location	Cover %
Amaranthaceae	*Alternanthera pungens**	Khaki Weed	2	Subject site	1%
			3	Study area	1%
			4		1%
Asteraceae	*Bidens bipinnata**	Bipinnate Beggar's Ticks	1	Subject site	1%
			2		1%
			3	Study area	3%
			4		1%
			6		2%
Asteraceae	*Brachycome ciliaris*	Variable Daisy	6	Study area	1%
	Brachycome multifida		4	Study area	1%
	*Carthamus lanatus**	Saffron Thistle	1	Subject site	2%
			2		15%
			3	Study area	5%
			4		60%
			5		30%
			6		1%
	*Centaurea solstitialis**		1	Subject site	1%
			6	Study area	5%
	*Chondrilla juncea**	Skeleton Weed	1	Subject site	2%
			4	Study area	1%
			5		2%
			6		1%
	*Lactuca serriola**	Prickly Lettuce	1	Subject site	1%
			2		1%

Family	Scientific name	Common Name	Plot number	Location	Cover %
			3	Study area	5%
			5		1%
			6		1%
	Leiocarpa panaetioides	Wooly Buttons	1	Subject site	1%
	Leiocarpa tomentosa	Woolly Plover-daisy	2	Subject site	1%
Boraginaceae	*Echium plantagineum**	Patterson's Curse	2	Subject site	1%
			6	Study area	1%
	*Heliotropium supinum**	Prostrate Heliotrope	1	Subject site	1%
			3	Study area	1%
			4		1%
			5		1%
			6		3%
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell	1	Subject site	1%
			2		2%
			3	Study area	1%
			4		1%
			5		2%
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	2	Subject site	1%
	Enchylaena tomentosa	Ruby Saltbush	2	Subject site	1%
			3	Study area	2%
			6		1%
Cucurbitaceae	*Citrullus lanatus**	Camel Melon	6	Study area	1%
	*Cucumis myriocarpus**	Paddy Melon	5	Study area	1%
			6		1%
Fabaceae (Faboideae)	*Glycine stenophita*		3	Study area	2%
	Glycine tabacina	Variable Glycine	3	Study area	1%
Lamiaceae	*Marrubium vulgare**	White Horehound	1	Subject site	1%
			2		1%
			2		1%
			3	Study area	2%
			6		2%
Malvaceae	*Malva parviflora**	Small-flowered Mallow	6	Study area	1%
	Sida corrugata	Corrugated Sida	1	Subject site	1%
			2		2%
			3	Study area	1%
			4		5%
Myrtaceae	*Eucalyptus albens*	White Box	2	Subject site	15%
			3	Study area	15%
Poaceae	*Amphipogon caricinus*	Long Greybeard Grass	4	Study area	1%
			1	Subject site	1%
	Aristida ramosa	Purple Wiregrass	1	Subject site	1%
			2		1%
	Austrostipa nodosa	A Speargrass	6	Study area	1%

Family	Scientific name	Common Name	Plot number	Location	Cover %
	Austrostipa scabra	Speargrass	1	Subject site	2%
			2		1%
			3	Study area	2%
			4		1%
			5		1%
	Austrostipa setacea	Corkscrew Grass	3	Study area	1%
	Austrostipa setacea	Corkscrew Grass	6	Study area	1%
	*Avena barbata**	Bearded Oats	1	Subject site	25%
			2		60%
			3	Study area	25%
			4		3%
			5		55%
			6		40%
	Bothriochloa macra	Red Grass	1	Subject site	15%
			2		1%
			3	Study area	5%
			4		1%
			5		1%
			6		1%
	Chloris truncata	Windmill Grass	6	Study area	1%
	Dichanthium sericeum	Queensland Bluegrass	1	Subject site	10%
			1		1%
	Digitaria divaricatissima	Umbrella Grass	1	Subject site	2%
			4	Study area	1%
	Panicum effusum	Hairy Panic	6	Study area	1%
	Paspalidium constrictum	Knottybutt Grass	1	Subject site	1%
			2		1%
			3	Study area	2%
			4		1%
			6		1%
	Rytidosperma caespitosum	Ringed Wallaby Grass	1	Subject site	1%
			2		1%
			4	Study area	1%
Polygonaceae	*Rumex brownii*	Swamp Dock	1	Subject site	1%
			2		1%
			5	Study area	1%
			6		1%
Solanaceae	*Solanum nigrum**	Black-berry Nightshade	6	Study area	1%
Sterculiaceae	*Brachychiton populneus*	Kurrajong	3	Study area	10%
			4		1%
			6		15%

Appendix 3.2 Threatened flora species and ecological communities

The following table includes a list of the threatened flora species that have potential to occur within the study area. The list is based on database searches outlined in Section 3.1.

Notes to tables:

Conservation status – EPBC Act:	**Conservation status – TSC Act:**
CR – Critically Endangered EN – Endangered VU – Vulnerable	E1 – endangered species (Part 1, Schedule 1) E2 – endangered population (Part 2, Schedule 1) E4 – presumed extinct (Part 4, Schedule 1) E4A – critically endangered V1 – vulnerable (Part 1, Schedule 2)
Most recent record # species predicted to occur by the PMST (not recorded on other databases). ## species predicted to occur based on natural distributional range and suitable habitat despite lack of records in the databases searched. 2017 recorded during current survey.	

Examples of criteria for determining the likelihood of occurrence for threatened biota as a guide for writing the rationale for likelihood have been listed below.

Likelihood of occurrence	Potential criteria
High	• Species/ecological communities recorded in study area during current or previous assessment/s. • Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. • Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). • Study area is within species natural distributional range (if known). • Species has been recorded within 10 kilometres or from the relevant catchment/basin.
Medium	• Records of terrestrial biota within 10 kilometres of the study area or of aquatic species in the relevant basin/neighbouring basin. • Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	• No records within 10 kilometres of the study area or for aquatic species, the relevant basin/neighbouring basin. • Marginal habitat present (low quality & extent). • Substantial loss of habitat since any previous record(s).
Negligible	• Habitat not present in study area • Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. • Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table A.2 Threatened flora species recorded / predicted to occur within 10 kilometres of the study area

Scientific name	Common name	Conservation status		Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC					
Austrostipa metatoris	A Spear-grass	VU	V	#		Low	No records within 10 kilometres of the study area. Marginal habitat present in the study area.	Perennial grass found growing in locations throughout the Murray Valley including Cunninyeuk Creek, Stony Crossing, Kyalite State Forest and Lake Benanee. Also found in scattered locations in Central NSW including Lake Cargelligo, east of Goolgowi, Condobolin and south-west of Nymagee. Grows on sandhills, sandridges, undulating plains and mallee country in a variety of communities including Western Slopes Dry Sclerophyll Forest, Floodplain Transition Woodlands, Sand Plain Mallee Woodlands and Western Peneplain Woodlands. Grows in red to brown clay loam and sandy loam soils.
Austrostipa wakoolica	A spear-grass	EN	E1	1992#		Negligible	Habitat not present in study area. .	Densely-tufted perennial grass restricted to the Murray River tributaries of central-western and south-western NSW. Grows on floodplains, on the edges of lignum swamp, creek banks and lignum sandy-loam flats in a variety of communities including Western Slopes Dry Sclerophyll Forests, Floodplain Transition Woodlands, Riverine Plain Woodlands and Western Peneplain Woodlands. Grows in a variety of soils including silty clays and sandy loams.
Philotheca ericifolia		VU	-	#		Negligible	Habitat not present in study area. .	Medium sized shrub distributed throughout the Central Western Slopes from the Upper Hunter Valley, to Pilliga and to the Peak Hill District. Found growing on damp sandy flats, drainage areas and gullies in dry sclerophyll open forests and woodlands. Grows on sandstone substrates in sand soils or alluvial deposits of coarse gravel on creek

Scientific name	Common name	Conservation status		Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC					
								beds.
Prasophyllum petilum	Tarengo Leek Orchid	EN	E1	#		Low	Marginal habitat present in the study area.	Terrestrial orchid restricted to five sites within NSW at Boorowa, Captains Flat, Ilford, a Travelling Stock Route at Delegate and 10 kilometres south-east of Muswellbrook. Found growing in open sites and patchy forest in Natural Temperate Grassland, Box-Gum Woodlands, Temperate Montane Grasslands, Southern Tableland Grassy Woodlands, Subalpine Woodlands, Tableland Clay Grassy Woodlands, Western Slopes Grassy Woodlands. This species is cryptic and most visible when flowering between October and December. Grows in fertile soils.
Swainsona recta	Small Purple-pea	E	E1	#		Low	No records within 10 kilometres of the study area. Marginal habitat present in the study area.	Small erect perennial herb with a scattered distribution at Carcoar, Culcairn and Wagga Wagga from which it is possibly extinct and from Queanbeyan and Wellington - Mudgee areas where it is still extant. Found growing on stony hillsides and in the grassy understorey of Upper Riverina Dry Sclerophyll Forests, Western Slopes Dry Sclerophyll Forests, Temperate Montane Grasslands, Floodplain Transition Woodlands, Southern Tableland Grassy Woodlands and Western Slopes Grassy Woodlands.

Scientific name	Common name	Conservation status		Most recent record	Other sources	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC					
Tylophora linearis		EN	V	#		Low	No records within 10 kilometres of the study area. Marginal habitat present in the study area.	Slender, hairless twiner distributed throughout the central western region of NSW with records from Goonoo, Pilliga West, Pilliga East, Bibblewindi, Cumbil and Eura State Forests, Coolbaggie Nature Reserve, Goobang National Park and Hiawatha State Forest. Found growing at low elevations on flats in a variety of communities including North-west Slopes Dry Sclerophyll Woodlands, Yetman Dry Sclerophyll Forests, Floodplain Transition Woodlands and Western Slopes Grassy Woodlands. Grows in sedimentary soils.

* - habitat descriptions have been adapted by qualified ecologists from the DEE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

Appendix 2 Fauna

Appendix 2.1 Fauna species recorded from the study area

Below is a list of fauna species recorded from the study area during the present assessment and a list of threatened fauna species recorded or predicted to occur within 10 kilometres of the study area.

Fauna species in these tables are listed in alphabetical order within their taxonomic group.

Notes to table:

Status – EPBC Act: CE – Critically Endangered EN – Endangered VU – Vulnerable	**Status – TSC Act:** E1 – endangered species (Part 1, Schedule 1) E2 – endangered population (Part 2, Schedule 1) E4 – presumed extinct (Part 4, Schedule 1) E4A – critically endangered V – vulnerable (Part 1, Schedule 2)

Table A.3 Vertebrate fauna recorded from the study area (current assessment)

Scientific name	Common name	Commonwealth status	NSW status
Birds			
Corcorax melanorhamphos	White-winged Chough		
Cracticus tibicen	Australian Magpie		
Cracticus tibicen	Australian Magpie		
Eolophus roseicapillus	Galah		
Falco cenchroides	Nankeen Kestrel		
Malurus cyaneus	Superb Fairy-wren		
Manorina melanocephala	Noisy Miner		
Northiella haematogaster	Blue Bonnet		
Platycercus eximius	Eastern Rosella		
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)		V
Struthidea cinerea	Apostlebird		
Egretta novaehollandiae	White-faced Heron		
Mammals			
Lepus europaeus	European Hare		
Vulpes vulpes	Red Fox		

Scientific name	Common name	Commonwealth status	NSW status
Reptiles			
Lampropholis sp.	Unidentified garden skink		
Ctenotus sp.	Unidentified Ctenotus skink		

Appendix 2.2 Threatened fauna species

The following table includes a list of the threatened fauna species that have potential to occur within the study area. The list is based on database searches outlined in Section 3.1.

Notes to tables:

Conservation status – EPBC Act:	**Conservation status – TSC Act:**
CR – Critically Endangered EN – Endangered VU – Vulnerable	E1 – endangered species (Part 1, Schedule 1) E2 – endangered population (Part 2, Schedule 1) E4 – presumed extinct (Part 4, Schedule 1) E4A – critically endangered V1 – vulnerable (Part 1, Schedule 2)
Most recent record # species predicted to occur by the PMST (not recorded on other databases). ## species predicted to occur based on natural distributional range and suitable habitat despite lack of records in the databases searched. 2017 recorded during current survey.	

Examples of criteria for determining the likelihood of occurrence for threatened biota as a guide for writing the rationale for likelihood have been listed below.

Likelihood of occurrence	Potential criteria
High	• Species recorded in study area during current or previous assessment/s. • Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. • Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). • Study area is within species natural distributional range (if known). • Species has been recorded within 10 kilometres or from the relevant catchment/basin.
Medium	• Records of terrestrial species within 10 kilometres of the study area or of aquatic species in the relevant basin/neighbouring basin. • Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	• No records within 10 kilometres of the study area or for aquatic species, the relevant basin/neighbouring basin. • Marginal habitat present (low quality & extent). • Substantial loss of habitat since any previous record(s).
Negligible	• Habitat not present in study area • Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. • Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.
Transient/ Nomadic	• Migratory or nomadic fauna species/individuals that may occur in the study area from time to time, but are not considered resident.

Table A.4 Threatened fauna species recorded, or predicted to occur, within 10 kilometres of the study area

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
Mammals							
Chalinolobus picatus	Little Pied Bat		V	2003	High	Previous record within 10km, potential roost sites within study area, water available outside of study area in farm dams and ephemeral creeklines.	Occurs in mallee, dry open forest and woodland. This species roost mainly in tree hollows, but may also roost in abandoned buildings. It often occurs in areas of highly ephemeral surface water, and may travel up to 34 km in a night between the roost and water sources.
Nyctophilus corbeni	Corben's Long-eared Bat	VU	V	#	Low	Habitat marginal – open grassland/ cropping and degraded woodland with some hollows, no understorey. No previous records within 10km.	Restricted to the Murray-Darling basin and western slopes. Found in a range of habitats including tall Eucalypt forests, mallee, open savanna and Black Box woodland, preferring habitats with a distinct canopy and cluttered, dense understorey. Roost in tree hollows and fissures and under exfoliating bark.
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala	VU	V	#	Low	Habitat within the study area is considered potential Koala habitat, however, no records within 10km of the study area and no direct or indirect signs of Koala were observed during field assessment.	In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region. Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include *Eucalyptus robusta, E. tereticornis, E. punctata, E. haemostoma* and *E.*

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
							signata. They are solitary with varying home ranges.
Pteropus poliocephalus	Grey-headed Flying-fox	VU	V	#	Low	May occasionally forage across the study area on Eucalypts, no camps were identified during field survey, no previous records within 10km.	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies, commonly in dense riparian vegetation.
Birds							
Anthochaera phrygia	Regent Honeyeater	CE	E4A	#	Low	May occasionally forage on the site, no previous records within 10km.	Regent Honeyeaters are semi-nomadic, occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests. Nectar and fruit from mistletoes are also eaten. This species usually nest in tall mature eucalypts and sheoaks.
Artamus cyanopterus cyanopterus	Dusky Woodswallow		V	2006	Low	Habitat within the study area is unsuitable as there is no woody debris, no understorey. Limited suitable habitat adjacent to the study area in the north-west, more suitable habitat along road reserve to the south and east.	Primarily inhabits dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
							occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.
Botaurus poiciloptilus	Australasian Bittern	EN	E1	#	Negligible	No suitable habitat within the study area.	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including Typha sp. and Eleoacharis sp. Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense vegetation on a flattened platform of reeds.
Calidris ferruginea	Curlew Sandpiper	CE	E1	##	Negligible	No suitable habitat within the study area.	Inhabits sheltered intertidal mudflats. Also non-tidal swamps, lagoons and lakes near the coast. Infrequently recorded inland.
Circus assimilis	Spotted Harrier		V	1990	Low	Habitat within the study area is suitable for foraging and may be suitable for nesting. Most recent record within 10km >10 years old. No raptor nests were identified within the study area during field	The Spotted Harrier is found throughout Australia but rarely in densely forested and wooded habitat of the escarpment and coast. Preferred habitat consists of open and wooded country with grassland nearby for

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
						assessment.	hunting. Habitat types include open grasslands, acacia and mallee remnants, spinifex, open shrublands, saltbush, very open woodlands, crops and similar low vegetation. The Spotted Harrier is more common in drier inland areas, nomadic part migratory and dispersive, with movements linked to the abundance of prey species. Nesting occurs in open or remnant woodland and unlike other harriers, the Spotted Harrier nests in trees.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)		V	2011	Low	Habitat marginal in the form of relatively isolated paddock trees, ground cover of long grass and weeds. Higher quality habitat occurs within the road reserve to the south and east of the site.	Lives in eucalypt woodlands, especially areas of relatively flat open woodland typically lacking a dense shrub layer, with short grass or bare ground and with fallen logs or dead trees present.
Daphoenositta chrysoptera	Varied Sittella		V	2006	Low	Habitat marginal in the form of relatively isolated paddock trees with moderately rough bark. Higher quality habitat occurs within the road reserve to the south and east of the site.	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts. The

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
							Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.
Falco subniger	Black Falcon		V	1999	Low	Highly mobile species with large home ranges, may occasionally forage over study area, no nests observed within the study area, previous records within 10km are >10 years old.	Mainly occur in woodlands and open country where can hunt. Often associated with swamps, rivers and wetlands. Nest in tall trees along watercourses.
Grantiella picta	Painted Honeyeater	VU	V	#	Low	May occasionally occur within the study area during dispersal, habitat considered marginal, no mistletoe observed within study area, no previous records within 10km.	Found mainly in dry open woodlands and forests, where it is strongly associated with mistletoe. Often found on plains with scattered eucalypts and remnant trees on farmlands.
Hieraaetus morphnoides	Little Eagle		V	1999	Low	Highly mobile species with large home ranges, may occasionally forage over study area, no nests observed within the study area, previous records within 10km are >10 years old.	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests.
Lathamus discolor	Swift Parrot	CE	E1	#	Moderate	One species of favoured feed tree	The Swift Parrot occurs in woodlands

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
						is present within the study area, may occasionally forage within the study area during winter months. Breeding occurs in Tasmania. No previous records within study area.	and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis*. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.
Leipoa ocellata	Malleefowl	VU	E1	#	Low	No suitable habitat within the study area.	The malleefowl occurs in tall, dense mallee with a mean annual rainfall of 300 to 450mm (NPWS 1996). This species prefers areas with a light sandy to sandy loam soil, a dense but discontinuous canopy cover, dense and variable herb layer and open ground for easy of movement (NPWS 1996).
Melanodryas	Hooded Robin		V	1999	Low	Habitat not suitable, lacking	Prefers lightly wooded country, usually

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
cucullata						structural components including shrubs and fallen timber. The road reserve adjacent to the study area may provide more suitable habitat.	open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, territories 10 hectares in breeding season (July-November) up to 30 hectares in the non-breeding season.
Numenius madagascariensis	Eastern Curlew	CE		##	Negligible	No suitable habitat within study area.	Occurs in sheltered coasts, especially estuaries, embayments, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats often with beds of seagrass.
Pandion cristatus	Osprey	Mi	V	#	Low	No large waterbodies or rivers within the vicinity of the study area, no foraging habitat within the study area and site is unlikely to be used for breeding.	Found in coastal waters, inlets, estuaries and offshore islands. Occasionally found 100 km inland along larger rivers. It is water-dependent, hunting for fish in clear, open water. The Osprey occurs in terrestrial wetlands, coastal lands and offshore islands. It is a predominantly coastal species, generally using marine cliffs as nesting and roosting sites. Nests can also be made high up in dead trees or in dead crowns of live trees, usually

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
							within one kilometre of the sea.
Polytelis swainsonii	Superb Parrot	VU	V	2005#	Moderate	May occasionally utilise the site for foraging, low-quality potential breeding habitat is present on site in hollow-bearing trees, preferred breeding habitat is timbered waterways which are not present within the study area. Adjacent land may provide more suitable breeding habitat	Found mainly in open, tall riparian River Red Gum forest or woodland. Often found in farmland including grazing land with patches of remnant vegetation. Forages primarily in grassy box woodland, feeding in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)		V	2018	High	Recorded adjacent to study area within road reserve during study. Study area provides limited remnant vegetation, roadside vegetation provides larger area of well-connected vegetation with suitable foraging and nesting resources.	The eastern sub-species occurs on the western slopes of the Great Dividing Range, the western plains, woodlands in the Hunter Valley and locations on the north coast of NSW. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine, open Box Woodlands on alluvial plains and woodlands on fertile soils in coastal regions. Feeds on invertebrates and builds dome-shaped nests.
Rostratula australis	Australian Painted Snipe	EN	E1	#	Negligible	No suitable habitat within study area.	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, but have been recorded in brackish waters. Forages on mud-flats and in shallow water. Feeds on worms,

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
							molluscs, insects and some plant-matter.
Stagonopleura guttata	Diamond Firetail		V	1978	Low	Previous record is > 10 years old, habitat within study area is low quality with no shrubs and only sparse paddock trees. No watercourses are located within the study area, may occasionally use the site when dispersing or foraging only. Adjacent habitat more suitable with shrubby re-growth and more vegetated ephemeral creek lines.	The Diamond Firetail is widely distributed, found in a range of habitat types including open eucalypt forest, mallee and acacia scrubs. Often occur in vegetation along watercourses. Feeds exclusively on the ground on ripe grass and herb seeds, green leaves and insects.
Fish							
Maccullochella peelii	Murray Cod	VU		#	Negligible	No water sources within the study area.	The Murray Cods natural distribution extends throughout the Murray-Darling basin ranging west of the divide from south east Queensland, through NSW into Victoria and South Australia. It is found in the waterways of the Murray–Darling Basin in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers, billabongs and large deep holes. Murray Cod is entirely a freshwater species and will not tolerate high salinity levels.
Macquaria	Macquarie perch	EN	FM	#	Negligible	No water sources within the	Macquarie Perch are found in the

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	TSC				
australasica			Act EN			study area.	Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven catchments. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries
Reptiles							
Aprasia parapulchella	Pink-tailed Legless Lizard	VU	V	#	Low	Habitat contains suitable shelter in the form of medium-size, partially or shallow embedded rocks, little tree cover and leaf litter and grassy groundcover predominately introduced species. No previous records within 10kmand species not detected during targeted survey.	Fossorial species, which lives beneath surface rocks and occupies ant burrows. It feed on ants, particularly their eggs and larvae. Thought to lay eggs within the ant nests under rocks that it uses as a source of food and shelter. Key habitat features are a cover of native grasses, particularly Kangaroo Grass (*Themeda australis*), sparse or no tree cover, little or no leaf litter, and scattered small rock with shallow embedment in the soil surface.

Appendix 4.3 Migratory species (EPBC Act listed)

The following table includes a list of migratory species that have potential to occur within the study area. The list is based on database searches outlined in Section 3.1.

Bold denotes species recorded in the study area during the current assessment.

Table A.5 Migratory fauna species recorded or predicted to occur within 10 kilometres of the study area

Scientific name	Common name	Most recent record
Actitis hypoleucos	Common Sandpiper	#
Apus pacificus	Fork-tailed Swift	#
Calidris acuminata	Sharp-tailed Sandpiper	#
Calidris melanotos	Pectoral Sandpiper	#
Gallinago hardwickii	Latham's Snipe	#
Hirundapus caudacutus	White-throated Needletail	#
Merops ornatus	Rainbow Bee-eater	1999
Motacilla flava	Yellow Wagtail	#
Myiagra cyanoleuca	Satin Flycatcher	#

* - habitat descriptions have been adapted by qualified ecologists from the DSEWPaC Species Profile for listed migratory species, references within the above table are provided within the report reference list.

Appendix 3 Significant Impact Criteria assessments

White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands

EPBC Act policy statement 3.5 - White box - yellow box - Blakely's red gum grassy woodlands and derived native grassland (DEH 2006) provides guidelines for determining whether vegetation at a site constitutes the Box Gum Woodland CEEC. Application of the DEH (2006) guidelines to vegetation within the subject site identified the degraded woodland remnant present as consistent with the CEEC listing on the basis that:

- The overstorey is dominated by White Box, a listed Box Gum overstorey species.
- The understorey vegetation is predominant native (as defined by DEH 2006).
- Vegetation within the subject site is part of a patch greater than 2 hectares in area.
- There is natural regeneration of the dominant overstorey eucalypt (as defined by DEH 2006) within the patch to which vegetation within the subject belongs.

Box Gum Woodland CEEC within the subject site is generally in poor condition due to previous clearing for grazing and cropping and prevalence of exotic annual grasses and forbs. The condition of the vegetation is considered to be at the lower end of what meets the threshold for Box Gum Woodland CEEC but due to the size of the patch (approximately 66.3 hectares) and the presence of natural regeneration, does qualify as the CEEC.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will result in the following.

Will the action reduce the extent of an ecological community?

The subject site contains 3.6 hectares of relatively low condition Box Gum Woodland which is part of a much larger 66.3 hectare patch of Box Gum Woodland extending across the low hill and ridge to the west, north and east of the subject site.

Areas mapped as *PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion* and the related derived grassland PCT 250 *Derived tussock grassland of the central western plains and lower slopes of NSW* by OEH (2015) occur to the north, south, east and west of the subject site. As has been shown within the subject site and on the adjoining hill slope and ridge, areas mapped as containing these PCTs are likely to be consistent with Box Gum Woodland CEEC thus indicating Box Gum Woodland CEEC is well represented in the local area. TSSC (2006) estimate the extent of Box Gum Woodland in the Central Lachlan region (within which the subject site is situated) at approximately 20,900 hectares and the extent across NSW at 250,729 hectares.

TSSC (2006) notes the extent of occurrence of the Box Gum Woodland CEEC is very large and the community extends from Queensland, through NSW and the ACT down to Victoria along the western slopes and tablelands of the Great Dividing Range. The remaining extent of the ecological community consist of isolated and highly fragmented patches within a cleared environment, or within a landscape of other disturbed woodlands (TSSC 2006).

Given the large extent of occurrence of Box Gum Woodland EEC across its range and the relatively small area to be impacted by the proposed action relative to the extant area in NSW, the Central Lachlan region and the local area, the proposed action is not expected to reduce the extent of the community.

Will the action fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?

The area of this CEEC to be impacted is along the edge of existing quarry disturbance. The proposal would not result in the fragmentation or isolation of the existing patch of CEEC at the locality and is unlikely to fragment habitat for any flora and fauna that inhabit the community within the locality.

Will the action adversely affect habitat critical to the survival of an ecological community?

'Habitat critical to the survival of a species or ecological community' is defined by DEH (2006) as areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- To maintain genetic diversity and long term evolutionary development; or,
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act (DEH 2006).

Box Gum Woodland CEEC within the subject site is degraded and not considered a high quality remnant. Native plant species richness is low; consisting mainly of disturbance tolerant native grasses, and its function as habitat for threatened flora and fauna is limited. The area of this community within the subject site is not considered important for the long-term maintenance of Box Gum Woodland CEEC in the local area as large tracts of similar or better condition Box Gum Woodland exists beyond the subject site and will not be impacted by the proposed action. Moreover, the depauperate native species richness and dominance of disturbance tolerant species suggests vegetation within the subject site is not important for maintenance of genetic diversity and is not an important location for recovery of the community.

Will the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?

The proposal would result in the removal of 3.6 hectares of the CEEC that is in relatively poor condition. The action is not likely to modify or destroy abiotic factors that are necessary for the survival of the remaining patches of this CEEC in the vicinity of the study area, as the disturbance area will be restricted and will not result in disturbance to the soil profile of the adjoining vegetation. The action will not significantly impact on existing watercourses or drainage patterns. As the ecological community is not considered groundwater dependent, localised changes to groundwater, if they occur, are not expected to impact retained vegetation adjoining the subject site. The disturbance of 3.6 hectares of this CEEC is not considered likely to impact on the survival of the community in the locality.

Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?

Given the existing levels of disturbance and clearing surrounding the project, and the low species richness recorded within the subject site, it is unlikely the project would result in a substantial decline in species composition or loss of functionally important species. The majority of native plant species recorded within the subject site were recorded elsewhere within the 66.3 hectare Box Gum Woodland CEEC patch that extends beyond the subject site.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- Assisting invasive species, that are harmful to the listed ecological community, to become established; or
- Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?

Box Gum Woodland CEEC within the subject site is degraded and in relatively poor condition owing to disturbance from current and past agricultural land uses. The broader Box Gum Woodland CEEC patch which extends beyond the subject site is similarly degraded.

The proposed action will implement a variety of management measures (e.g. weed hygiene protocols, dust management, etc.) to ensure impacts are limited to within the subject site. As such, the proposed action is unlikely to cause a substantial reduction in the quality or integrity of the local occurrence of the community.

Will the action interfere with the recovery of an ecological community?

Given the current condition and small area of impacts resulting from the proposal, it is considered unlikely that the proposal would interfere with the recovery of the CEEC in the locality. Management measures, including compensatory planting of native plant species outside the subject site, will support the recovery of Box Gum Woodland CEEC in the locality.

Conclusion

Based on the above assessment, Box Gum Woodland CEEC is unlikely to be significantly impacted by the proposal and, as such, a Referral under the provisions of the EPBC Act is not required for this ecological community.

Swift parrot Lathamus discolor

The Swift Parrot is listed as critically endangered under the EPBC Act 1999, this species is also listed as endangered under the TSC Act 1999.

Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of a population?

The swift parrot is a highly nomadic species that occurs in woodlands and forests in New South Wales (OEH 2017d). They migrates in response to food availability and seasonal changes often returning to foraging sites on a cyclic basis depending on food availability (TSSC 2016), the Swift Parrot migrates to south-eastern Australia from Tasmania from March to October (OEH 2017d).

The action will remove 3.6 hectares of marginal foraging habitat. The Swift Parrot may occasionally forage across the subject site during winter migration, however, there are no previous records of this species within 10km of the subject site and habitat is considered marginal due to previous clearing and farming activities. Foraging resources within the subject site include 3 White Box and may include an additional 6 Kurrajong *B. populneus* (Saunders and Tzaros 2011). The Swift Parrot breeds in Tasmania and the action will remove a small number of foraging resources within previously disturbed land and there is no breeding habitat within the study area. Taking these factors into consideration the proposed action will not lead to a long-term decrease in the size of the population.

Is there a real chance or a possibility that the action will reduce the area of occupancy of the species?

The action will remove 3.6 hectares of marginal foraging habitat. This species is highly mobile and migrates between foraging resources through the winter months, higher quality foraging habitat occurs within road

reserves to the south and east of the subject site. Taking this into consideration the proposed action is unlikely to reduce the area of occupancy of the species.

Is there a real chance or a possibility that the action will fragment an existing population into two or more populations?

The proposed action will remove 3.6 hectares of potential habitat. The Swift Parrot is a highly mobile and seasonally nomadic species, and the subject site does not occur within the upper or lower limits of its range. Given the availability of resources in the surrounding landscape, the small area of the proposed action and the highly mobile nature of the species it is considered highly unlikely that the proposed action will fragment an existing population.

In addition the action will not fragment habitat as the southern boundary of the subject site is adjacent to the existing quarry and the eastern boundary is adjacent to previously cleared and cropped/grazed farmland.

Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of a species?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. A Register of Critical Habitat is maintained by the Minister under the EPBC Act. To date, no critical habitat has been declared for the swift parrot.

Breeding habitat of the Swift Parrot may also be considered habitat critical to the survival of this species, breeding habitat is known only from Tasmania and will not be affected by the proposed action.

Is there a real chance or a possibility that the action will disrupt the breeding cycle of a population?

The Swift Parrot breeds in Tasmania in spring and summer (TSSC, 2016), they migrate to mainland Australia during the winter months for foraging (OEH, 2017). The proposed action will not directly impact on breeding habitat.

The proposed action will remove a small number of trees providing potential foraging resources. There are no previous records of the Swift Parrot within 10km of the subject site and breeding habitat will not be affected. Taking these factors into consideration, it is highly unlikely the proposed action will result in a significant impact on the breeding cycle of this species.

Is there a real chance or a possibility that the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

A total of 3.6 hectares of native vegetation will be removed from the subject site, this includes a total of 3 White Box and 6 Kurrajong trees.

The quarry expansion section of the subject site is located north of the existing quarry with cleared farmland to the east and remnant woodland with evidence of past clearing to the north and west which is well connected to native vegetation within the Wyatt's Lane road reserve. The siding access road is to be located on previously cleared land on an existing track through cropped fields. The proposed action therefore will not fragment or isolate existing habitat.

White Box and Yellow Box are preferred foraging resources for the Swift Parrot, the habitat within the study area has been previously cleared and only three White Box and six Kurrajong remain within the subject site. The habitat is considered to be low quality due to the history of disturbance, higher quality habitat in the form of large White Box and Yellow Box trees is located on the hill and ridge above the subject site and within the Wyatt's Lane road reserve. Given the scale of vegetation removal and the availability of nearby resources it is unlikely the proposed action will significantly impact the species to the extent that the species is likely to decline.

Is there a real chance or a possibility that the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?

Feral cats are a major threat to the Swift parrot, it is likely that feral cats currently occur across the area given the level of disturbance of the site and surrounding farm land.

One invasive fauna species that may impact on the Swift Parrot, the Red Fox, was recorded during field investigation. Red Fox is likely already well established in the local area given the modified landscape and prevailing agricultural land uses.

In addition to introduced species some native species may exclude the Swift parrot from foraging resources within the study area, Noisy Miners and Rainbow Lorikeets are listed in the National Recovery Plan as potential competition threats to feeding resources in disturbed areas (Saunders and Tzaros, 2011), and both of these species were recorded on the subject site.

Given the degraded nature of habitat within the subject site, the known presence of invasive and pest species and ongoing agricultural land use practices, the removal of 3.6 hectares of habitat including seven potential forage trees is unlikely to result in the establishment of further invasive species harmful to the Swift Parrot.

Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?

The proposed action is unlikely to introduce disease as it will result in complete removal of habitat, resulting use of the land will be an extension to the existing quarry.

Is there a real chance or a possibility that the action will interfere with the recovery of the species?

The national recovery plan for this species lists a number of threats to the Swift Parrot, of relevance to this assessment is the threat of 'Clearing of native vegetation'. The proposed action will result in the clearing of 3.6 hectares of native vegetation including nine feed trees within the subject site.

The proposed action will contribute to the cumulative impact of native vegetation clearing across the state and this in turn may contribute to the cumulative effects of other key threats to the Swift Parrot across the state (Saunders and Tzaros, 2011).

It is unlikely that the proposed action will interfere with the recovery of the species directly. The small scale of habitat removal is unlikely to cause significant interference with the recovery of the species as good-quality habitat and foraging resources are, and will remain, available in the locality.

Conclusion

Habitat within the subject site does not constitute breeding resources, foraging habitat is considered to be of low-quality due to the low number of isolated paddock trees. Higher quality foraging habitat occurs in the surrounding area.

The removal of 3.6 hectares of potential foraging habitat is unlikely to:

- Lead to Long-term decrease in the size of the population,
- Reduce the area of occupancy,
- Fragment an existing population into two or more populations,
- Adversely affect habitat critical to the species survival,
- Disrupt the breeding cycle,

- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,
- Result in invasive species establishment on site,
- Introduce disease that may cause the species to decline, or
- Interfere with the recovery of the species.

As such it is considered unlikely that the proposed action will significantly impact the Swift Parrot and a referral is not required.

Superb Parrot Polytelis swainsonii

The Superb Parrot is listed as vulnerable under the EPBC Act 1999.

The Superb Parrot nests in tall riparian River Red Gum Forest or Woodland in the Riverina and in open Box-Gum Woodland or isolated paddock trees on the South-West slopes. There are three hollows within the subject site that may potentially be used by the Superb Parrot, no obvious signs of occupancy such as chewing of bark around the entrance or feather below the tree were observed during field assessment.

Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of an important population of a species?

The Superb Parrot population occurs as a single continuous population (DEE, 2017).

Foraging resources within the subject site are limited, habitat consists of previously cleared areas with a grassy groundcover dominated by weeds and isolated paddock trees including White Box and Kurrajong. Foraging habitat within the site is considered marginal for the Superb Parrot due to weed invasion and previous disturbance.

Studies on the breeding of Superb Parrots have found that hollows used by the Superb Parrot have an average entrance size of 110mm and occur in or proximal to the main trunk (Rayner et al, 2017). Hollows within the subject site include three medium (50-149mm) and two small (<50mm) size hollows and occur in limbs. Two trees within the subject site with a total of three hollows of suitable size are therefore considered potential habitat for breeding. Superb Parrots show high site fidelity, breeding within the same areas each year (Reynar et al, 2017). They have specific breeding requirements which include hollows in large trees within River Red Gum forest (DEE, 2017). One previous record of Superb Parrot within 10km of the study area is greater than 10 years old (2003), It is therefore considered unlikely that the subject site is an important breeding area for the Superb Parrot due to a lack of records, past history of clearance and the existence higher quality habitat in the form of abundant hollows present within Yellow Box trees within the road reserve to the south of the study area.

Taking these factors into consideration it is unlikely that the action will lead to a long-term decrease in the size of the population.

Is there a real chance or a possibility that the action will reduce the area of occupancy for an important population?

The proposed action will result in the clearing of 3.6 hectares of native vegetation including three trees within the subject site. This species is highly mobile and vegetation removal at such a small scale will not significantly reduce the area of occupancy for the population.

Is there a real chance or a possibility that the action will fragment an existing important population into two or more populations?

The proposed action will remove potential habitat to the north of an existing quarry, the eastern boundary is adjacent to previously cleared and cropped or grazed farmland. This species is highly mobile, the area to be cleared is small (3.6 hectares) and the proposed action will therefore not fragment the existing population.

Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of a species?

Critical habitats are areas of land that are crucial to the survival of listed threatened species, populations or ecological communities. A Register of Critical Habitat is maintained by the Minister under the EPBC Act. To date, no critical habitat has been declared for the Superb Parrot.

Breeding habitat of the Superb Parrot may also be considered habitat critical to the survival of this species, breeding resources include hollow-bearing trees which are typically large, contain medium (50-149mm) size hollows and occur in or proximal to the main trunk (Rayner et al, 2017). The Superb parrot appears to have high site fidelity to breeding areas (DEE, 2017). Three hollows within the subject site have potential to be used for breeding, however due to past history of disturbance, lack of previous records of breeding and the position of these hollows in each tree (i.e. in limbs away from the main trunk) it is considered unlikely that the site would be utilised for breeding. It is therefore unlikely that the proposed action will adversely affect habitat critical to the survival of the Superb Parrot.

Is there a real chance or a possibility that the action will disrupt the breeding cycle of an important population?

Breeding habitat of the Superb Parrot is known from two distinct areas in the Riverina area of NSW, it is likely that foraging and breeding habitat overlap in the south-west slopes area where the study area is located (DEE, 2017).

Breeding habitat includes hollow-bearing trees which are typically large, contain medium (50-149mm) size hollows and occur in or proximal to the main trunk (Rayner et al, 2017). The Superb parrot appears to have high site fidelity to breeding areas (DEE, 2017). Three hollows within the subject site have potential to be used for breeding, however due to past history of disturbance, lack of previous records of breeding and the location of these hollows (in limbs) it is considered unlikely that the site would be utilised for breeding.

It is therefore unlikely that the proposed action will have a significant impact on the breeding cycle of the Superb Parrot.

Is there a real chance or a possibility that the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

A total of 3.6 hectares of native vegetation will be removed from the subject site, this includes a total of 3 White Box and 6 Kurrajong trees.

The quarry expansion section of the subject site is located north of the existing quarry with cleared farmland to the east and remnant woodland with evidence of past clearing to the north and west which is well connected to native vegetation within the road reserve. The access road sections of the subject site is located on previously cleared land on an existing track through cropped fields. The proposed action therefore will not fragment or isolate existing habitat.

The habitat within the subject site is considered marginal due to past history of disturbance and clearing. Due to the small scale, the proposed action is unlikely to remove any habitat to the extent that the Superb Parrot is likely to decline.

Is there a real chance or a possibility that the action will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

One Invasive fauna species that may impact on the Swift Parrot, the Red Fox, was recorded during habitat assessment. This species is already present in the area and is most likely well established.

Given the history of disturbance, degraded habitat, known invasive species and existing on-site threats to this species and the removal of 3.6 hectares of habitat including seven potential forage trees, it is unlikely the proposed action will result in the establishment of further invasive species.

Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?

The proposed action is unlikely to introduce disease as it will result in complete removal of habitat within the subject site. The resulting use of the land will be an extension to the existing quarry.

Is there a real chance or a possibility that the action will interfere substantially with the recovery of the species?

Threats to the superb parrot include clearing of foraging habitat and of corridors connecting breeding areas to foraging habitat.

The proposed action will remove 3.6 hectares of marginal Superb Parrot habitat. No corridors will be impacted. The proposed action is therefore unlikely to interfere with the recovery of the species.

Conclusion

Habitat within the subject site provides marginal breeding resources, foraging habitat is considered to be of low-quality due to the low number of isolated paddock trees. Higher quality foraging habitat occurs in the surrounding area.

The removal of 3.6 hectares of potential foraging habitat is unlikely to:

- Lead to Long-term decrease in the size of the population,
- Reduce the area of occupancy,
- Fragment an existing population into two or more populations,
- Adversely affect habitat critical to the species survival,
- Disrupt the breeding cycle,
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,
- Result in invasive species establishment on site,
- Introduce disease that may cause the species to decline, or
- Interfere with the recovery of the species.

As such it is considered unlikely that the proposed action will significantly impact the Superb Parrot and a referral is not required.

Appendix 4 Assessments of Significance

The following section provides for AoS according to the seven factors outlined in Section 5A of the EP&A Act for all species listed as a medium likelihood or greater in Appendix 1 and Appendix 2.

White box yellow box Blakely's red gum woodland endangered ecological community.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable

(***c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or,

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The subject site contains 3.6 hectares of relatively low condition White box yellow box Blakely's red gum woodland EEC which is part of a much larger 66.3 hectare patch of White box yellow box Blakely's red gum woodland EEC extending across the low hill and ridge to the west, north and east of the subject site.

Areas mapped as *PCT 267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion* and the related derived grassland *PCT 250 Derived tussock grassland of the central western plains and lower slopes of NSW* by OEH (2015) occur to the north, south, east and west of the subject site. As has been shown within the subject site and on the adjoining hill slope and ridge, areas mapped as containing these PCTs are likely to be consistent with White box yellow box Blakely's red gum woodland EEC thus indicating Box Gum Woodland CEEC is well represented in the local area. The proposed removal of 3.6 hectares or approximately 5.25% of the existing EEC patch within the study area is unlikely to impact the EEC such that its local occurrence is placed at risk of extinction.

White box yellow box Blakely's red gum woodland EEC within the subject site is already modified as a result of current and past agricultural land use practices. Given the existing levels of disturbance and clearing surrounding the existing quarry, and the low species richness recorded within the subject site, it is unlikely the proposed development substantially and adversely modify the composition of the EEC such that its local occurrence is likely to be placed at risk of extinction. The majority of native plant species recorded within the subject site were recorded elsewhere within the 66.3 hectare EEC patch that extends beyond the subject site.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and,

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and,

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Approximately 66.3 hectares of White box yellow box Blakely's red gum woodland EEC has been mapped within the study area. The proposal would therefore result in direct impacts to approximately 3.6 hectares, or 5.25%, of the EEC extent in the study area. The implementation of a suite of management measures (e.g. weed hygiene protocols, dust management, erosion and sedimentation controls, etc.) will ensure there are no indirect impacts to retained White box yellow box Blakely's red gum woodland EEC beyond the subject site.

The proposed quarry expansion area is an extension of an existing disturbed land. The subject site intersects the south-eastern edge of a 66.3 hectare patch of EEC in similar or better condition, and will not cause the patch to be fragmented in to two or more smaller patches. The propose clearing within the subject site will therefore not result in the further fragmentation or isolation of any White box yellow box Blakely's red gum woodland EEC.

Vegetation to be removed within the subject site is not considered important to the long term survival of the White box yellow box Blakely's red gum woodland EEC as it is:

- In relatively poor condition; having a groundcover stratum dominated by weeds and containing mostly disturbance tolerant native grasses.
- Located at the edge of existing quarry disturbance and in a position that contributes little to the maintenance of connectivity of White box yellow box Blakely's red gum woodland EEC patches across the landscape.
- Part of a much larger (66.3 hectares) patch of White box yellow box Blakely's red gum woodland EEC which is mostly in similar and, in some areas, better condition than that within the subject site.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared for White box yellow box Blakely's red gum woodland.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The national recovery plan (DEE 2010) objective is to promote the recovery and prevent the extinction of the critically endangered ecological community, known as White box yellow box Blakely's red gum woodland. The specific objective to be achieved within the life-span of this recovery plan is to minimise the risk of extinction of the ecological community through:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- Increasing protection of sites with high recovery potential;
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;

- Increasing transitional areas around 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 proposed removal of 3.6 hectares of White box yellow box Blakely's red gum woodland EEC within a patch of 66.3 hectares will not result in a reduction in the extent of occurrence of this EEC in NSW or Nationally. Vegetation within the subject site is disturbed and owing to past and current agricultural land use history, cannot be considered to have high recovery potential. The proponent has committed to undertaking compensatory planting using locally native species within White box yellow box Blakely's red gum woodland EEC retained beyond the subject site. These plantings will aim to restore some landscape functionality in parts of the currently degraded patch that maintain some resilience. The proposed planting regime will be undertaken with the cooperation of the landowner and will help to foster changes in land manager attitudes to sustainable land management practices.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

'Clearing of native vegetation' is listed as a Key Threatening Process (KTP). The proposal will involve the removal of 3.6 hectares of the White box yellow box Blakely's red gum woodland EEC.

'*Invasion of native plant communities by exotic annual grasses and annual herbs"* is also listed as a KTP. Given the presence of Bearded Oats and Saffron Thistle around the existing quarry disturbance areas and within the subject site, there is potential for further weed dispersal following soil disturbance during quarry activities if appropriate mitigation measures are not implemented. The proponent has committed to implementation of a strict weed hygiene protocol at all stages of the proposed quarry operation which will substantially reduce the risk of new exotic perennial grasses being introduced in to retained vegetation beyond the subject site.

Conclusion

The proposed quarry expansion will have only minor impacts on the fragmented and modified edge of the White box yellow box Blakely's red gum woodland. The proposal is considered unlikely to have a significant effect on this EEC. A SIS is not considered to be required.

Little Pied Bat Chalinolobus picatus

The Little Pied Bat *Chalinolobus picatus* is listed as vulnerable under the TSC Act. The Little Pied Bat roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings (OEH, 2017b). This species occurs in dry areas including open forest, open woodland, mulga woodland, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands and can tolerate high temperatures, however, access to open water is required (OEH, 2017). In NSW the species has been recorded in mulga woodlands, patches of *E. largiflorens* woodlands and riverine *E. camaldulensis* dominated communities (CoA, 1999).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The subject site contains three relatively isolated paddock trees bearing a total of five hollows that may be suitable for use by the Little Pied Bat. Beyond the subject site, the road reserve to the south and east

contains a linear strip of more intact remnant vegetation containing an abundance of suitable hollows in which this species may roost. The road reserve will not be directly impacted by the proposed development. Farm dams beyond the subject site provide water for foraging Little Pied Bats.

There is one previous record of this species within 10 km of the subject site from 2003, this record is 5.8km from the subject site in a location with larger patches of timbered areas and a number of farm dams close by.

There is little knowledge of the breeding requirements for Little Pied Bat, however, it is unlikely a maternity roost is located within hollow-bearing trees in the subject site as higher quality habitat in the form of a more in-tact native vegetation community with abundant hollow-bearing trees occurs within the road reserve. There are also larger patches of remnant native vegetation in surrounding properties.

Given the abundances of breeding resources located adjacent to the site, historical records and lack of cover for potential roost sites, it is considered unlikely that removal of hollow-bearing trees from the subject site would have a significant impact on the life-cycle of Little Pied Bat such that a local population was likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable

(***c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

> ***(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or,***
>
> ***(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

Not applicable

(d) in relation to the habitat of a threatened species, population or ecological community:

> ***(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and,***
>
> ***(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and,***
>
> ***(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

A total of 3.6 hectares of low to moderate condition woodland including up to three hollow-bearing trees will be removed by the proposed action. Approximately 66.3 hectares of similar condition woodland and derived grassland habitat occupies the ridge to the west and north of the subject site and similar or better quality patches of remnant woodland vegetation occur along Wyatt's Lane to the south, Bogan Road to the east and in neighbouring properties to the west and east. The proposed development will therefore impact on a small proportion of habitat available to Little Pied Bat in the locality.

The quarry expansion part of the subject site is located north of the existing quarry with cleared farmland to the east and remnant woodland with evidence of past clearing to the north and west which is well connected to native vegetation within the road reserve. The siding access road is located on an existing cleared track. The upgrade of the existing track may lead to an increase in truck traffic in the

future however this is unlikely to isolate woodland habitat along the ridge from road-side remnant woodland along Wyatt's Lane given the high mobility of the Little Pied Bat.

The habitat to be removed contains isolated paddock trees with a predominantly weedy ground cover. There is evidence of past clearing in the area and the habitat is considered to be marginal for many species. Woodland located in adjacent road reserves provides much more extensive remnants of native vegetation with an abundance of large mature trees and hollows. Habitat within the subject site is therefore considered sub-optimal and of low importance in the landscape context for the survival of the local population.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared for Little Pied Bat.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The proposed action will remove 3.6 hectares of native vegetation including three hollow-bearing trees which may provide roost sites for the Little Pied Bat. There is currently no recovery plan for the Little Pied Bat.

The Little Pied Bat is listed as a landscape managed species under the Saving our Species program, species listed under this management stream are subject to threatening processes at the landscape scale rather than at distinct definable locations. There are currently no relevant threat abatement plans for the Little Pied-bat, activities to assist this species listed by OEH are the control of feral cats, retain foraging and roosting habitat, minimise the use of pesticides within or adjacent to areas where insectivorous bats occur (OEH, 2017c)

The proposed action will contribute to two threats to the species, the loss or modification of habitat and the removal of large trees containing hollows. The removal of vegetation including paddock trees within the subject site is unlikely to interfere with the recovery of this species as it will occur on a small-scale within relatively poor condition habitat. Higher quality habitat will be maintained in the area surrounding the subject site and is more likely to be utilised by this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The Little Pied Bat is assigned to the Landscape species management stream under the saving our species program. The key threatening processes listed for this landscape-managed species are loss, fragmentation and degradation of habitat.

Other threats listed for the Little Pied Bat (OEH, 2017c) include:

- Loss or modification of habitat,
- Predation by Cats,
- Application of pesticides in or adjacent to foraging areas,
- Inappropriate fire regimes,
- Removal of large trees containing large hollows needed for nesting, including dead trees and paddock trees and

- Lack of knowledge of locations of key breeding habitat and breeding ecology and success.

The proposed action will result in the removal of 3.6 hectares of native vegetation providing habitat for the Little Pied Bat, it will also involve removal of paddock trees with hollows suitable for roosting. This action forms part of the listed key threatening process, however, due to the small scale and relative abundance of suitable habitat in adjacent road reserves it is not likely to substantially increase the impact of this key threatening process for a local population of Little Pied Bat or for the species as a whole.

Conclusion

The proposed action will remove 3.6 hectares of native vegetation, including paddock trees containing hollows. The subject site contains habitat that is considered of low-quality due to the degradation from clearing and past land uses including farming. Surrounding land contains higher quality habitat including an abundance of hollows observed within yellow-box *Eucalyptus melliodora* trees within the road reserve. Removal of the habitat within the subject site is unlikely to have a significant impact on the local population of Little Pied Bat due to the small scale of clearing, habitat will not be fragmented and is considered low quality, and as this species is highly mobile with higher quality habitat present in areas adjacent to the subject site.

Grey-crowned Babbler Pomatostomus temporalis temporalis

The Grey-crowned Babbler is listed as vulnerable under the TSC Act. The Grey-crowned Babbler occurs in Box-Gum woodlands, Box-Cypress-pine and open Box Woodlands on alluvial plains, they have distinctive rufous patches on the wings which differentiate them from other babbler species (OEH, 2017a). Grey-crowned babblers form family groups and are territorial, they feed on insects in trees and within leaf litter and grass tussocks on the ground, birds generally hop up trees and glide to the next and are generally unable to cross large open areas (OEH, 2017a). A group of Grey-crowned Babblers was recorded within the road reserve to the south of the subject site during field survey on the 22 January 2018.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The proposed action will remove 3.6 hectares of native vegetation of low- moderate quality for the Grey-crowned Babbler. Previous land use has included clearing and may have included grazing, cropping or both on all or part of the site. Foraging resources within the subject site are limited for this species and occur in the form of isolated paddock trees.

The removal of this vegetation is unlikely to impact on the Grey-crowned Babbler due to the small impact area of low-quality habitat, the relative isolation of paddock trees and the larger areas of higher-quality habitat located outside of the impact area within the road reserve to the south and east.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(***c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or,

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and,

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and,

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

A total of 3.6 hectares of native vegetation in a substantially modified condition will be removed by the proposed action.

The quarry expansion section of the subject site is located north of the existing quarry with cleared farmland to the east and remnant woodland with evidence of past clearing to the north and west, the subject site is not well connected to native vegetation within the road reserve for this species as the distance between trees within the subject site and the study area situated a minimum of 75 meters apart and as the Grey-crowned Babbler is unlikely to cross large open areas (OEH, 2017a). The proposed siding access road is located on previously cleared land on an existing track. The proposed development is unlikely to fragment or isolate any areas of habitat for Grey-crowned Babbler.

Habitat within the subject site is considered marginal, isolated paddock trees may occasionally provide foraging resources but are unlikely to be utilised for nesting due to the distance from higher-quality habitat located within the road reserves. Removal of the vegetation within the subject site is therefore unlikely to significantly impact the local population of Grey-crowned Babbler.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared for Grey-crowned Babbler.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is no specific recovery plan or threat abatement plans for the Grey-crowned Babbler that are relevant to this proposal. The Grey-crowned Babbler is listed under the landscape species management stream under the *Saving our Species* program, as it is subject to threats at the landscape scale rather than at distinct, definable locations. The key threats to this species relevant to the proposed action are loss, fragmentation and degradation of habitat.

The proposed action will occur at a small scale and impact marginal habitat for this species. Good quality habitat in which this species was observed during field survey will not be impacted. As such, the proposed development is not likely to substantially interfere with the recovery of this species under the Saving our Species program.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes known to affect the Grey-crowned Babbler and relevant to the proposed action include Loss, degradation and fragmentation of woodland habitat on high fertility soils.

Habitat to be removed has undergone substantial modification as a result of historic clearing and farming activities. Habitat will not be fragmented by the proposed action as the subject site is adjacent to the current quarry and previously cleared land. The proposed action will remove 3.6 hectares of native vegetation and, while this constitutes part of the listed key threatening process, the relatively small extent and modified state of habitat to be removed suggests the proposed development will not substantially increase the impact of habitat loss on the local population or the species as a whole.

Conclusion

The proposed action will result in the removal of 3.6 hectares of native vegetation in the form of isolated paddock trees and mixed native and exotic groundcover. This species was recorded in the Wyatt's Lane road reserve to the south of the subject site where higher quality habitat remains. The subject site may occasionally provide some foraging resources but is unlikely to be suitable for breeding of Grey-crowned Babbler.

Due to the relatively small extent of proposed clearing, the marginal quality of habitat within the subject site and the presence of higher quality habitat outside of the subject site, the proposed action is unlikely to significantly impact the Grey-crowned Babbler.

Superb parrot Polytelis swainsonii, Swift parrot Lathamus discolor

The Superb Parrot is listed as Vulnerable and the Swift Parrot is listed as Endangered under the TSC Act.

The Superb Parrot nests in tall riparian River Red Gum Forest or Woodland in the Riverina and in open Box-Gum Woodland or isolated paddock trees on the South-West slopes. There are five hollows within the study site that may potentially be used by the Superb Parrot, however no obvious signs of occupancy (e.g. chewing of bark around the entrance or feathers below the tree) were observed during field assessment and no individuals were recorded.

The Swift parrot breeds in Tasmania in spring and summer and migrates to south-eastern Australia including NSW during autumn and winter. They feed in winter in areas where eucalypts are flowering profusely and abundant lerp infestations. A favored food tree White Box *Eucalyptus albens* was recorded on site.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Foraging resources within the subject site are limited, habitat consists of previously cleared areas with a grassy groundcover dominated by weeds and isolated paddock trees including White Box and Kurrajong. Foraging habitat within the site is considered marginal for both the Superb Parrot and Swift parrot due to previous disturbance.

The Swift parrot is a winter visitor to NSW and breeds in Tasmania, the removal of hollows within the subject site therefore would not impact on breeding resources for this species. Higher-quality foraging habitat within larger patches of remnant woodland exists along Wyatt's lane road reserve and on the top of the ridge to the north-west within remnant woodland. The proposed action will remove 3.6 hectares

of potential foraging habitat and is therefore unlikely to substantially reduce foraging resources for the Swift Parrot.

Studies on the breeding of Superb Parrots have found hollows used by this species have an average entrance size of 110 millimetres and are typically located close to the main trunk (Rayner et al, 2017). Hollows within the subject site include three medium (50-149mm) and two small (<50mm) size hollows and occur in limbs. The Superb Parrot may nest in isolated paddock trees within the subject site as these were found to offer small hollows in some limbs.

Superb Parrots show high site fidelity, breeding within the same areas each year (Reynar et al, 2017). One previous record of Superb Parrot within 10km of the study area is greater than 10 years old (2003), It is therefore considered unlikely that the subject site is an important breeding area for the Superb Parrot due to a lack of records, past history of clearance and the existence higher quality habitat in the form of abundant hollows present within Yellow Box trees within the road reserve to the south of the study area.

Hollows within the study area did not show signs of recent use such as chewing of bark around the entrance and no Superb Parrot individuals were observed within the subject site or adjoining areas during field investigations. Habitat within the subject site is considered low-quality and is unlikely to be utilised for breeding given past disturbance and the presence of higher-quality breeding habitat outside of the subject site, within the road reserve.

Habitat located within road reserves contain abundant hollows and provides higher quality foraging resources, some trees within the road reserve occur along an ephemeral creek line and are likely to provide more resources for foraging. Removal of the vegetation within the subject site is unlikely to significantly impact a local population of either the Superb Parrot or Swift Parrot.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(***c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

> ***(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or,***
>
> ***(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:

> ***(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and,***
>
> ***(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and,***
>
> ***(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

A total of 3.6 hectares native vegetation in a modified condition including three hollow-bearing trees will be removed by the proposed action.

The quarry expansion section of the subject site is located north of the existing quarry with cleared farmland to the east and remnant woodland with evidence of past clearing to the north and west which is well connected to native vegetation within the road reserve. The proposed siding access road is located on previously cleared land on an existing track. The proposed action will therefore not fragment or isolate any areas of habitat for the highly mobile Superb Parrot and Swift Parrot.

Habitat within the subject site is considered marginal for foraging by both the Superb Parrot and Swift Parrot due to previous disturbance and the limited availability of nectar sources relative to nearby areas beyond the subject site. The Swift Parrot breeds within Tasmania therefore no breeding habitat will be impacted by the proposed development.

White Box remnant canopy trees and native grass may occasionally provide foraging resources for both parrot species however, the removal of nine potential feed trees and a relatively small area of perennial native grass cover is unlikely to result in significant impact to these species.

Two trees with a total of three hollows present within the subject site are considered potential habitat for breeding by the Superb Parrot. Given that Superb Parrot shows high site fidelity to nest sites, the low number of potential nesting hollows and the lack of previous records within the locality, the subject site is considered to be of low importance for the long-term survival of the local population of the Superb Parrot.

Taking these factors into consideration it is unlikely that the removal of habitat within the subject site will significantly impact the long-term survival of either the Superb Parrot or Swift Parrot.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared for Superb Parrot or Swift Parrot.

Critical habitat may also refer to resources required for breeding as these are required for long-term survival of the population. The habitat is considered unlikely to be used for breeding by the Superb Parrot due to the previous history of disturbance and the abundant resources within higher-quality habitat located to the south and east of the subject site in the form of remnant vegetation along the road reserve.

The Swift Parrot breeds in Tasmania and breeding resources will not be impacted by the proposed action.

Taking this into consideration it is unlikely that the proposed action will have an adverse effect on habitat critical to the survival of these species.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The Swift Parrot is listed under the landscape species management stream under the *Saving our Species* program. A national recovery plan has also been developed for this species, key threats include clearing of native vegetation and management objectives include protection of mass roosting sites, identification and protection of priority habitats in New South Wales and conservation measures on private properties (Saunders Et al, 2011). The proposed action is not consistent with the objectives of the recovery plan,

however, the habitat to be removed is on a small scale, is of low-quality and areas surrounding provide higher-quality resources for this species in the form of large mature trees within the road reserve.

The Superb Parrot is listed under the landscape species management stream under the *Saving our Species* program. The Superb Parrot relies on hollow-bearing trees dispersed across the landscape. Management at the landscape scale (e.g. promoting retention of paddock trees) is required to secure the species (OEH, 2017c). The proposed action will remove paddock trees which is not consistent with the objectives of the recovery plan. The potential breeding resources within these paddock trees is limited, three suitable hollows within two trees will be removed by the quarry expansion. Surrounding areas were observed to have a high occurrence of hollows and it is considered unlikely the removal of these trees will contribute significantly to the decline of the species.

It is unlikely that the proposed action will interfere with the recovery of the species directly given the small extent of impact on foraging and nesting resources, however, removal of the native vegetation within the subject site will contribute to cumulative loss of vegetation and nesting resources in the landscape.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threats to the Superb Parrot which are relevant to the proposed action include loss of living and dead hollow-bearing trees, loss of breeding and foraging habitat.

Key threats listed by OEH to the Swift Parrot which are relevant to the proposed action include habitat loss and fragmentation from forest harvesting, residential/industrial development, agricultural clearing, senescence and dieback. The national recovery plan for this species lists a number of threats to the Swift Parrot, of relevance to this report is the threat; 'Clearing of native vegetation'.

The proposed action will result in the clearing of 3.6 hectares of native vegetation including nine feed trees within the subject site, this action constitutes part of the key threatening processes for the Superb and Swift Parrot.

In NSW, the key threatening processes listed for the Superb Parrot and Swift parrot are listed as landscape-scale threatening processes for these threatened parrots. Removal of vegetation will occur on a small scale, will not impact breeding habitat of the swift parrot and is unlikely to impact breeding habitat of the Superb Parrot as: there are no previous records of breeding nearby; higher quality habitat occurs directly outside of the subject site; and, only a few suitable hollows are proposed to be impacted. It is therefore considered unlikely that the proposed action will substantially increase the extent or intensity of any listed key threatening processes for either threatened parrot.

Conclusion

The proposed action will result in the removal of 3.6 hectares of native vegetation in the form of isolated paddock trees and grassy groundcover. The subject site may occasionally provide some foraging resources for both the Superb and Swift Parrot but does not contain breeding habitat for the Swift parrot and is unlikely to be utilised for breeding by the Superb Parrot.

Due to the small area of proposed works, the marginal quality of habitat within the site and the presence of higher quality habitat outside of the subject site, the proposed action is unlikely to significantly impact the Superb Parrot or the Swift Parrot.

Appendix 5 Staff Qualifications

Name	Skills	Role in the project
Samuel Luccitti (Senior Botanist) BAM Accredited Person (BAAS17015) BEnvSc (Hons)	Botany, threatened flora surveys, vegetation monitoring programs, vegetation management plans, Biobanking assessment.	Day-to-day project management, co-ordination of ecology team members, impact assessment and reporting.
Alejandro Baretto (Botanist) BBiotech Bot, DipCALM	Botany, threatened flora surveys, vegetation mapping, assisting with data collection under the Biodiversity Assessment Method.	Botanical field surveys, ground truthing of vegetation communities, impact assessment and reporting.
Sarah Allison (Field Zoologist) BSc (Hons)	Zoology, threatened mammals, frogs, birds and microbats.	Zoological field surveys including targeted threatened species surveys, impact assessment and reporting.
Anthony Cable (Aquatic Ecologist) BEnvSc, DipCALM	Aquatic Ecology, AusRivAs survey methodology	Data interpretation, aquatic ecology impact assessment.
Lauren Harley (GIS operator) BA IntSt; BSc EnvBio, GCert EnvMgt AUSRIVAS Accredation (modules 1,2 &4)	Mapping using GIS, data interpretation.	GIS management and mapping.

Appendix D

HERITAGE ASSESSMENT

Goonumbla Quarry expansion: Aboriginal and non-Aboriginal cultural heritage archaeological survey report

FINAL REPORT

Prepared for Geolyse

1 March 2018

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Final version 01	To be confirmed	To be confirmed

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- Chloe Bigg, Geolyse Pty Ltd

Biosis staff involved in this project were:

- Lian Flannery – Quality Assurance
- Samuel Luccitti – Project Management
- Samantha Keats – Background research and reporting
- Ashleigh Keevers-Eastman – Field survey and reporting
- Lauren Harley – GIs and mapping

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Glossary

AHIMS	Aboriginal Heritage Information Management System
ARTC	Australian Railway Track Corporation
Due diligence code	*Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010)
EP&A Act	*Environmental Planning and Assessment Act 1979*
GSV	Ground Surface Visibility
ICOMOS	International Council on Monuments and Sites
LEP	Local Environment Plan
LGA	Local Government Area
NPW Act	*National Parks and Wildlife Act 1974*
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PAD	Potential Archaeological Deposit
Study area	The existing quarry and the proposed quarry expansion (including the associated bunding and access road), located within the southern portion of Lot 32 DP816454, and the proposed siding access road following the southern and western boundaries of Lot 32 DP816454.
The Code	The *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010)

Summary

Biosis Pty Ltd has been commissioned by Geolyse to undertake an Aboriginal and non-Aboriginal cultural heritage due diligence assessment for the proposed expansion of an existing hard rock quarry at 1105 Bogan Road, Goonumbla, NSW (the Project). The Project involves the expansion of the quarry to allow for the extraction and processing of a maximum of 300,000 tonnes of basalt per year.

An assessment in accordance with the due diligence code has been undertaken for the study area in order to inform responsibilities with regards to Aboriginal cultural heritage in the area. In addition to the basic tasks required for a due diligence assessment, an extended background review, as well as an archaeological survey in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010) (the Code) was conducted to adequately map areas of high, moderate and low archaeological sensitivity. This assessment will also determine the heritage significance of historical items within the site (if present), determine the curtilage for any heritage items, provide management recommendations relating to identified heritage values and outline any constraints for the proposed expansion of the quarry.

Background research identified 72 Aboriginal sites registered with Aboriginal Heritage Information Management System (AHIMS) within a 10 kilometre search area; however, none are located *within* the study area. An archaeological survey was conducted on 22 January 2018. The overall effectiveness of the survey for examining the ground for Aboriginal sites was considered to be low, due to poor ground surface visibility (GSV) and high levels of disturbance by both human and natural agents.

This report has assessed the study area and has determined there are no known Aboriginal sites within or in the vicinity of the study area which may be impacted upon by the proposed development. Through an assessment of environmental conditions, ethnohistory, the findings of previous assessments and an archaeological survey it has been possible to ascertain that the study area has a low potential of containing Aboriginal objects or places (see Figure 9).

Historical background research included a review of the NSW State Heritage Register (SHR), NSW Heritage Database, Commonwealth Heritage List, Register of National Estate, National Trust Heritage Register, and Schedule 5 of the Parkes LEP 2012. No known items of state or local significance are located within the study area in the vicinity surrounding the study area. The archaeological survey conducted also included the inspection of potential heritage items; however, this assessment has identified that the study area does not contain any heritage items.

The following recommendations were made:

Recommendation 1: No further archaeological assessment is required in areas of low archaeological potential

No further archaeological work is required in the study area due to the entire study area assessed as having low archaeological potential.

Recommendation 2: Discovery of unanticipated Aboriginal objects

All Aboriginal objects and Places are protected under the *National Parks and Wildlife Act 1974*. It is an offence to knowingly disturb an Aboriginal site without a consent permit issued by the Office of Environment and Heritage (OEH). Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations. These may include notifying the OEH and Aboriginal stakeholders.

Recommendation 3: Discovery of Aboriginal Ancestral Remains

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity you must:

1. Immediately cease all work at that location and not further move or disturb the remains.
2. Notify the NSW Police and OEH's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location.
3. Not recommence work at that location unless authorised in writing by OEH.

Recommendation 4: Unexpected finds protocol

In the event that unanticipated non-Aboriginal heritage items are encountered, the archaeological remains should be assessed by an archaeologist to determine whether the suspected find constitutes a relic under the *NSW Heritage Act 1977* and whether NSW Heritage Council should be notified.

1 Introduction

1.1 Project background

Biosis Pty Ltd has been commissioned by Geolyse to undertake an Aboriginal and non-Aboriginal cultural heritage due diligence assessment for the proposed expansion of an existing hard rock quarry at 1105 Bogan Road, Goonumbla, NSW (the Project). The Project involves the expansion of the quarry to allow for the extraction and processing of a maximum 300,000 tonnes of basalt per year.

An assessment in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010a) has been undertaken for the study area in order to inform responsibilities with regards to Aboriginal cultural heritage in the area. In addition to the basic tasks required for a due diligence assessment, an extended background review, as well as an archaeological survey in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b) ('the Code') was conducted, in order adequately map areas of high, moderate and low archaeological sensitivity.

1.2 Location of the study area

The study area is located within the Parkes Local Government Area (LGA), Parish of Goonumbla, County of Ashburnham (refer to Figure 1). The study area is located within Lot 32 DP 816454, and is bounded by pastoral land to the north, Wyatts Lane to the south, Bogan Road to the east and Parkes Narromine railway line to the west (refer to Figure 2).

1.3 Planning approvals

The project is deemed to be a designated local development under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and will be assessed in accordance with Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment on 27 June 2016. Other relevant legislation and planning instruments that will inform the assessment include:

- *National Parks and Wildlife Act 1974* (NSW) *(*NPW Act)
- *National Parks and Wildlife Amendment Act 2010* (NSW)
- *Parkes Local Environmental Plan 2012* (LEP)

Figure 3 shows the proposed works to be carried out within the study area.

1.4 Scope of the assessment

The following is a summary of the major objectives of the assessment:

- Conduct background research in order to recognise any identifiable trends in site distribution and location, including a search of the Aboriginal Heritage Information Management System (AHIMS).
- Undertake archaeological survey as per Requirement 5 of the Code, with particular focus on landforms with high potential for heritage places within the study area, as identified through background research.

- Record and assess sites identified during the survey in compliance with the guidelines endorsed by the OEH.
- Determine levels of archaeological and cultural significance of the study area.
- Make recommendations to mitigate and manage any cultural heritage values identified within the study area.

1.5 Aboriginal consultation

Biosis notes that OEH in their response to SEARs, require that consultation in accordance with the *Aboriginal community consultation requirements for proponents* (SEARs) is required where impacts to Aboriginal objects may occur. As such, the Peak Hill Local Aboriginal Land Council were contacted prior to the archaeological survey to invite a representative to attend. Lynette Bell accompanied Ashleigh Keevers-Eastman from Biosis Pty Ltd for the entirety of the field survey, although no feedback or cultural information regarding the study area was provided.

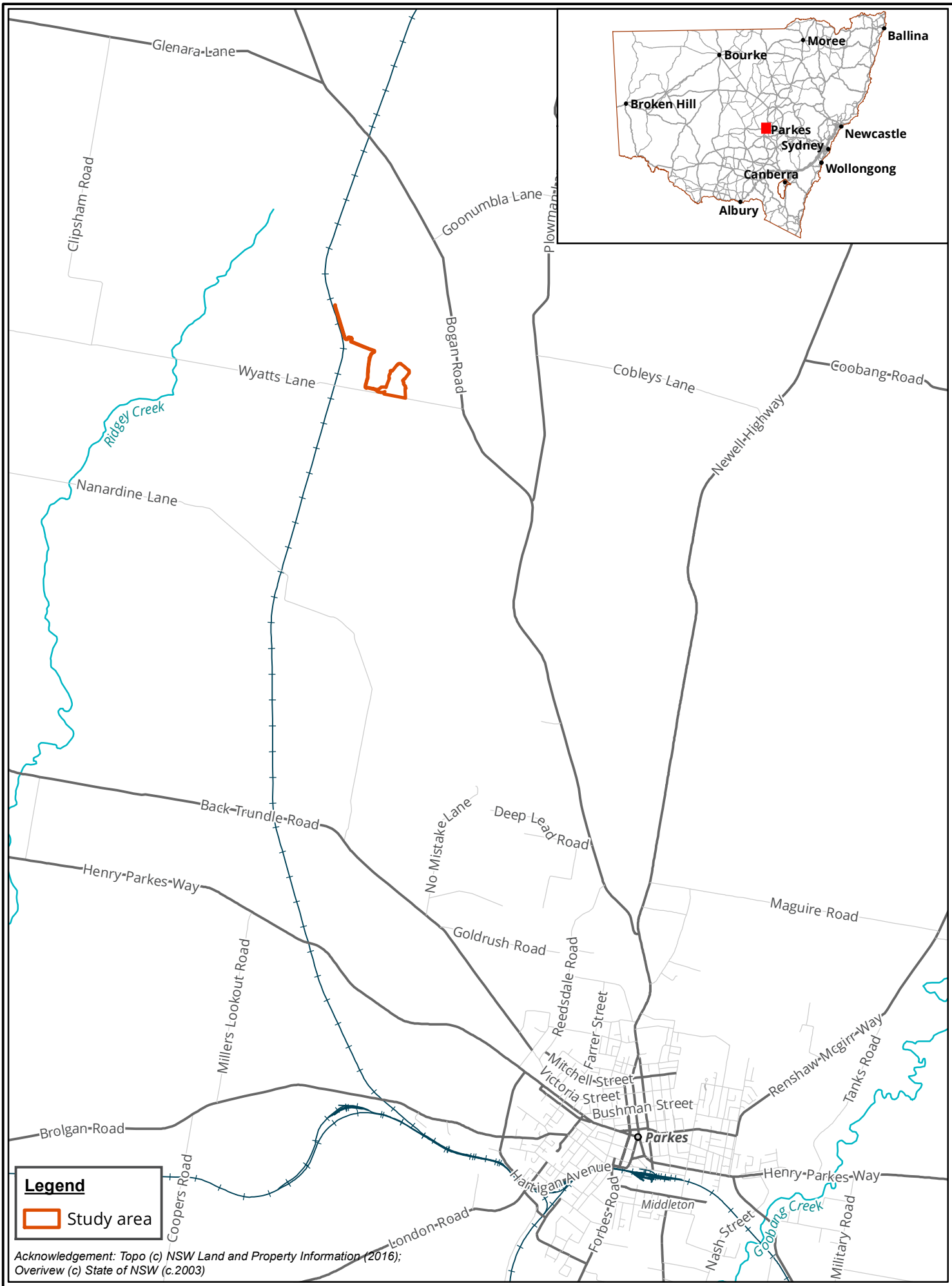

Figure 1: Location of the study area

Biosis Pty Ltd
Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Matter: 25564
Date: 22 February 2018,
Checked by: SJK, Drawn by: LH, Last edited by: lwilson
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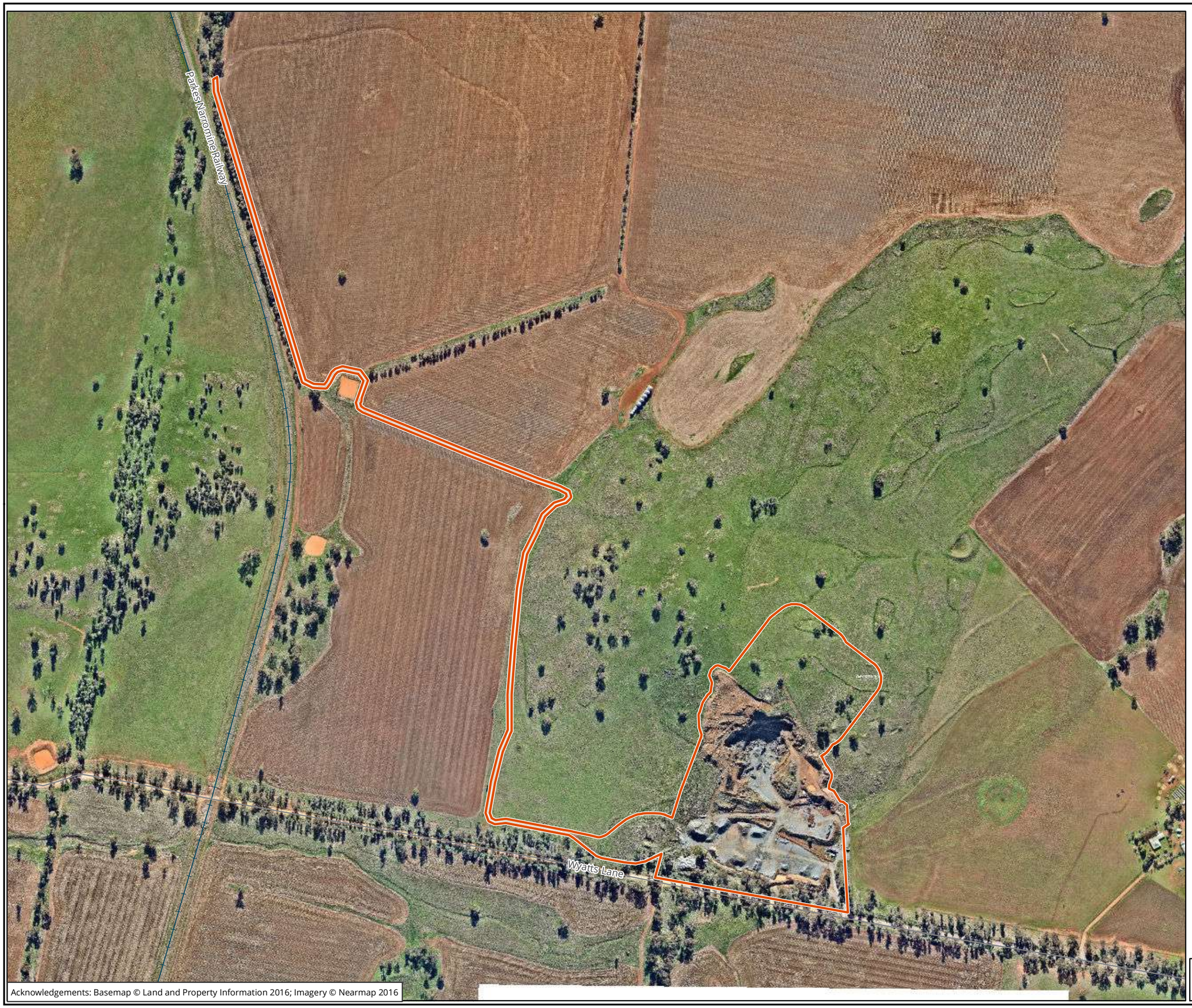

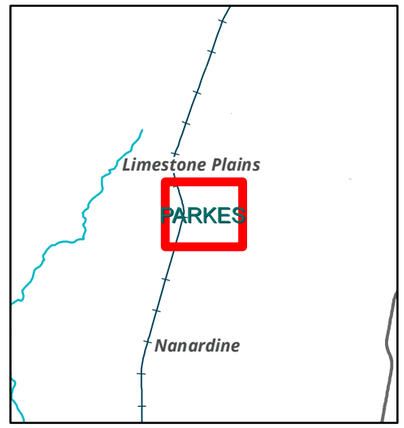

Legend

Study area

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © Nearmap 2016

Figure 2: Study area detail

0 50 100 150 200 250

Metres

Scale: 1:6,000 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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Matter: 25564
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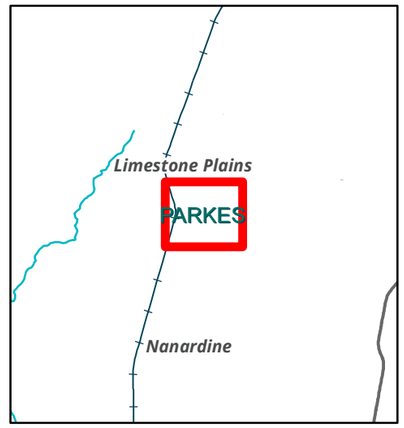

Legend

- Study area
- Access road
- Siding access road
- Proposed bunding
- Planned mining area
- Existing quarry

Figure 3: Proposed works

0 50 100 150 200 250

Metres

Scale: 1:6,000 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

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2 Desktop assessment

A desktop assessment has been undertaken to review existing archaeological studies for the study area and surrounding region. This information has been synthesised to develop some Aboriginal site predictive statements for the study area and identify known Aboriginal sites and/or Places recorded in the study area. This desktop assessment has been prepared in accordance with requirements 1 to 4 of the Code.

2.1 Landscape context

The study area is located within the South Western Slopes bioregion, approximately 12 kilometres north-west of Parkes. This bioregion is an extensive area of foothills and isolated ranges comprising of the lower inland slopes of the Great Dividing Range, and extends from Cowra in the north through to southern NSW into western Victoria. The NSW portion of the bioregion covers an area of 8,657,426 hectares and occupies about 10.1 per cent of the state (OEH 2016).

2.2 Geology, soils and landforms

The study area is located within the eastern part of the Lachlan Fold Belt, which consists of a complex series of north to north westerly trending folded bodies of Cambrian to Early Carboniferous sedimentary and volcanic rocks. Granites are common and mostly located in large scale up-folded bodies of rock. Granite landscapes occur either as central basins surrounded by steep hills formed on contact metamorphic rocks, or as high blocky plateau features with rock outcrops and tors (OEH 2018).

Soil landscapes have distinct morphological and topological characteristics that result in specific archaeological potential. Because they are defined by a combination of soils, topography, vegetation and weathering conditions, soil landscapes are essentially terrain units that provide a useful way to summarise archaeological potential and exposure. There are two soil landscapes present within the study area (Figure 5).

The Goonumbla soil landscape dominates the study area and is characterised by crests, ridges and undulating side slopes on Ordovician Goonumbla Volcanics (see Figure 4) (King 1998, p. 84). Slope gradients range up to 15% and slope lengths up to 3000 metres. Rock outcrop occurs on some crests and upper slopes, with elevation ranging from 280 to 460 metres. This is an erosional soil landscape with shallow soils of up to 50cm in depth (Table 1). The erosion hazard is moderate to high.

Within the southern reaches of the study area the Cooks Myalls soil landscape occupies a large section of the proposed siding road. The Cooks Myalls landscape is characterised by undulating plains and rises on intermediate volcanics, chert, sandstones, siltstone, conglomerates and limestones (King 1998, p. 71). Slope gradients range from 3 – 8%, and soil deposits moderately deep (Table 1). Minor rocky outcrops occur upon some crests and upper slopes within this soil landscape. Small areas of gilgai soils have also been extensively cultivated and no longer display gilgai mircorelief within the Cooks Myall landscape. Cooks Myall landscape is prone to seasonal waterlogging and presents as a water erosion hazard.

In the south eastern and south westerns corners of the study area, a small portion of Brolgan Plain soil landscape is present (King 1998, p. 171). This soil landscape is dominated by level to gently undulating plains on Quaternary alluvium. Slope gradients range from 0-2%, with a local relief of less than 10 metres and an elevation of between 225-340 metres. Rare flooding occurs within the Brolgan soil landscape, from flood overflows of the Goobang Creek system located approximately 10 kilometres east of the study area (Table 1). This is an alluvial soil landscape with a low to moderate erosion hazard.

Table 1 Soil landscape characteristics (King 1998)

Soil Material	Description
Goonumbla 1 (go1)	0-10 cm dark reddish brown (5YR 3/3) clay loam; hardsetting, earthy, massive, brittle, few (2-10%) fine gravels and coarse gravels of andesite, pans absent; segregations absent; abrupt boundary.
Goonumbla 2 (go2)	10-50 cm reddish brown (5YR 4/6) medium clay; moderately pedal, angular blocky smooth-faced peds (10-20 mm), common (10-20%) fine gravels and gravels of andesite, pans absent; segregations absent; grades into strongly; weathered andesite bedrock at 50 cm.
Cooks Myall 1 (ck1)	0-12 cm dull reddish brown (5YR 4/3) sandy clay loam, weakly pedal, non-sticy, non-plastic, coarse fragments absent; segregations absent; clear boundary.
Cooks Myall 2 (ck2)	12-60+ cm reddish brown (5YR 4/6) medium clay; moderately pedal, smooth-faced peds, coarse fragments; segregations absent.
Brolgan Plain 1 (bp1)	0-5 cm dark brown (7.5YR 3/4) clay loam, weakly pedal, smooth-faced peds, slightly plastic, nonsticky, moderately firm (moist), crumbly; abrupt boundary.
Brolgan Plan 2 (bp2)	5-45 cm dark brown (7.5YR 3/4) medium-heavy clay, moderately pedal, smooth-faced peds, moderately plastic, slightly sticky; abrupt boundary.
Brolgan Plan 3 (bp3)	45-90+ cm brown (10YR 4/6) medium clay, moderately pedal, smooth-faced peds, moderately plastic, moderately sticky; few fine to medium calcareous segregations.

There are a number of hydrological features surrounding the study area, primarily in the form of small creeks and streams (Figure 6). Inland streams pass across the slopes of the South Western Slopes bioregion in confined valleys with terraces and local areas of sedimentation. A second order unnamed non-perennial creek runs through the south eastern corner of the study area where the current day quarry is situated. An unnamed first order non-perennial watercourse also runs through the north western portion of the study area. An artificial dam has interrupted the natural flow of this unnamed watercourse.

Stream order is recognised as a factor which helps the development of predictive modelling in Aboriginal archaeology in NSW. Predictive models which have been developed for the region have a tendency to favour permanent water courses as the locations of campsites as they would have been more likely to provide a stable source of water and by extension other resources which would have been used by Aboriginal groups.

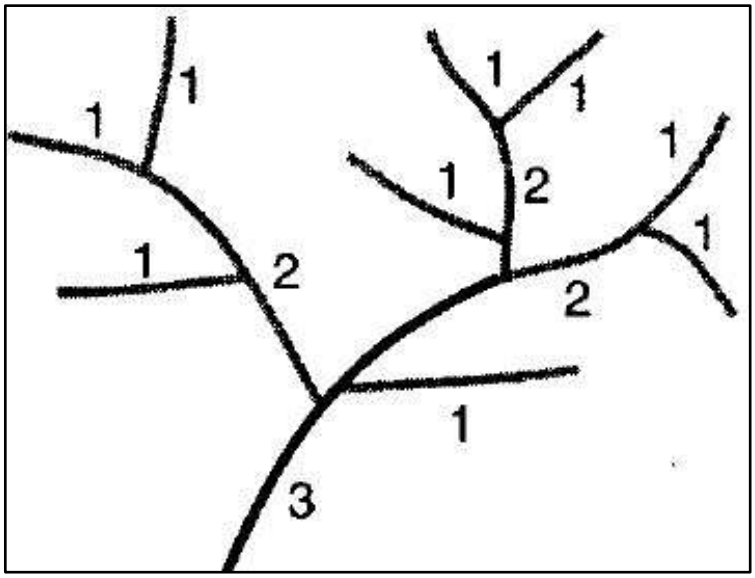


Plate 1 Diagram showing Strahler stream order (Ritter et al. 1995, p. 151)

The stream order system used for this assessment was originally developed by Strahler (1964). It functions by adding two streams of equal order at their confluence to form a higher order stream, as shown in Plate 1. As stream order increases, so does the likelihood that the stream would be a perennial source of water. The closest fourth order creek, Goobang Creek, lies 10 kilometres to the east of the study area.

2.3 Flora and fauna

The study area comprises of extensively cleared open-woodland. Remnant tree species include kurrajong, western grey box, cypress pine, and yellow box. Understoreys have various shrubs such as Deane's wattle, silver cassia, eastern cottonbush, quena, wilga, purple burr-daisy, black roly poly, sticky hopbush and wingless fissure weed. Wild oats, Queensland bluegrass, wimmera ryegrass, red grass, pitted bluegrass, paspalum and horehound are common grass layer species on cleared pasture and cropping country.

Plant resources were used in a variety of ways. Fibres were twisted into string, which was used for many purposes, including the weaving of nets, baskets and fishing lines. String was also used for personal adornment. Shelters were made of bark built over a circular frame, with references from the wider area suggesting that bark sheets were used for smaller shelters and larger "thatched shelters were used by larger groups of people (Pearson 1981).

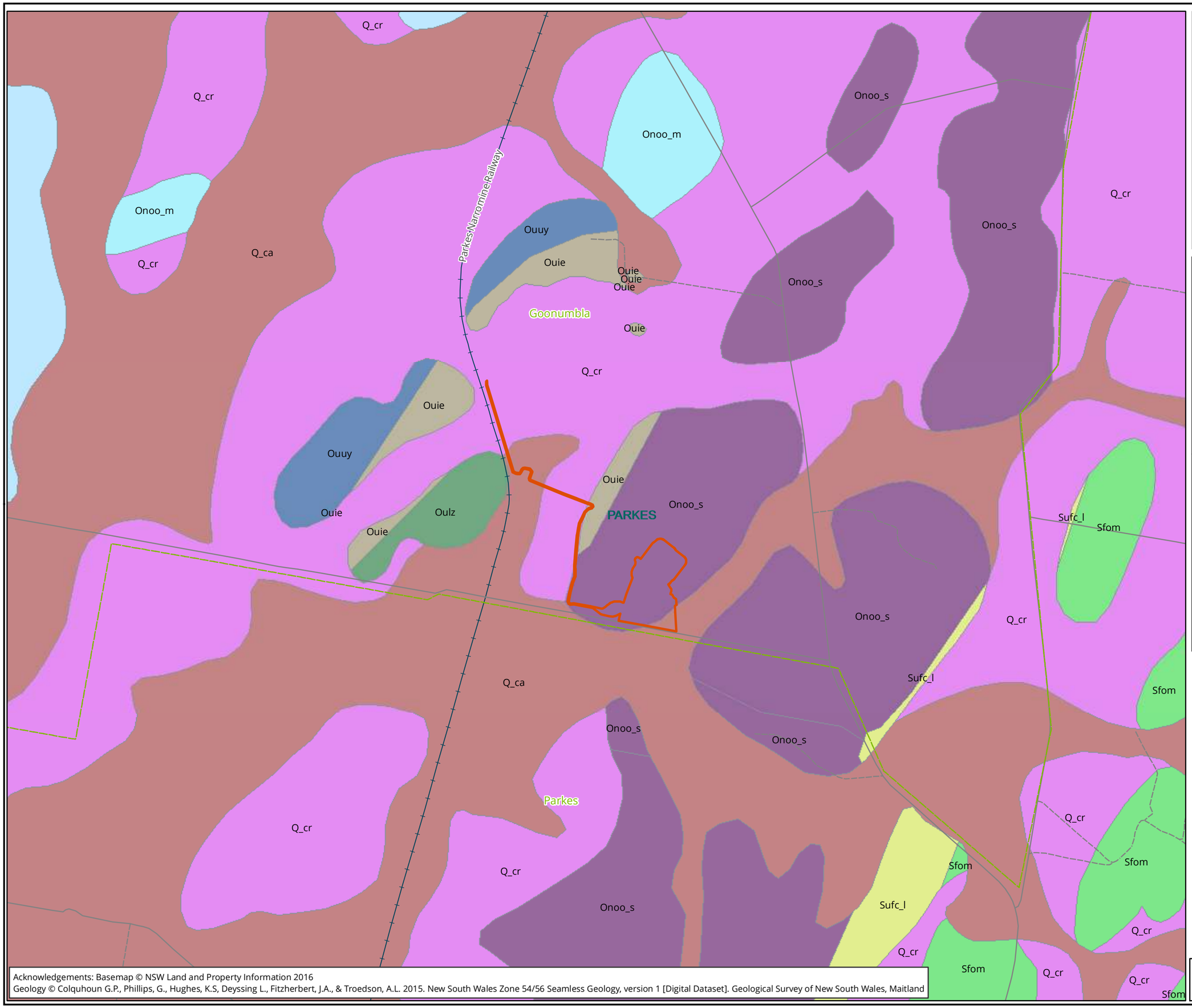
The Parkes locality would have generally provided a number of resources used by Aboriginal inhabitants: however, these resources would be largely tied to seasonal variations and the flow of the nearby rivers. The Wiradjuri people, who were the original inhabitants of this area, relied on staple food resources provided by the major rivers in their country – the Macquarie, Lachlan and Murrumbidgee Rivers. In the dry season, the food from the rivers were supplemented with meat (kangaroo and emus) and vegetables such as fruit, nuts, yam daises, wattle seeds and orchid tubers (OEH 2016). Pearson (1981) compiled a list of all foods which had been recorded by early observers and those noted within in the region, with most of these being associated with the riverine environment. Oxley had noted the presence of mussel shells at Aboriginal camps along a watercourse in the vicinity of Peak Hill (Pearson 1981), while Graham (1879) mentioned that Aborigines on the Macquarie River ate "a kind of freshwater muscle".

A selection of resources has been compiled into Table 2 to give an indication of the resources available to local Aboriginal groups. Notably, the majority of the food sources mentioned in Table 2 are located within or in close proximity to rivers and lakes. This has partially to do with the greater availability of resources in these

environments, particularly in the summer months, but it is also tied to early ethnographic observations made by explorers and surveyors.

Table 2 Landscape resources available to local Aboriginal groups

Plant / Animal	Aboriginal use
Emus / emu eggs	Food source (Allen 1974; Mitchell 1835)
Kangaroo	Food source (Mitchell 1835)
Fish species	Food source, fat from these animals could also be used in medicine (Martin 2010). Fish and crayfish were taken from the rivers from September to May.
Freshwater snail	Food source (Martin 2010)
Marsh clubrush	Food source (Martin 2010)
Possum	Possums and larger grazing animals were hunted throughout the year. (Mitchell 1835)
Red / grey kangaroo	Food source, also used to make bags to hold seeds or water (Allen 1974), bone was used for bone points, and the teeth for fish hooks (Martin 2010)
River mussel/ Lake mussel	Food source (Martin 2010; Mitchell 1835)
Snakes and lizards	Food source (Martin 2010)
Waterfowl / other aquatic birds	Food source available in summer months in Riverine environments (Allen 1974)
Bracken fern	Food source (NTSCORP 2012)
Yabbies	Food source (NTSCORP 2012)



Legend

Study area

Geological units

- Onoo_m Goonumbla Volcanics - lower member
- Onoo_s Goonumbla Volcanics - upper member
- Ouie Nelungaloo Volcanics
- Oulz Unnamed monzonite - Parkes-Bogan Gates area
- Ouuy Yarrimbah Formation
- Q_ca Mixed colluvial, alluvial and aeolian deposits
- Q_cr Colluvial and residual deposits
- Sfom Mumbidgle Formation
- Sufc_l Cotton Formation - lower unit

Figure 4: Geology of the study area

0 200 400 600 800 1,000

Metres

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

N

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Albury, Ballarat, Melbourne,
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Acknowledgements: Basemap © NSW Land and Property Information 2016
Geology © Colquhoun G.P., Phillips, G., Hughes, K.S, Deyssing L., Fitzherbert, J.A., & Troedson, A.L. 2015. New South Wales Zone 54/56 Seamless Geology, version 1 [Digital Dataset]. Geological Survey of New South Wales, Maitland

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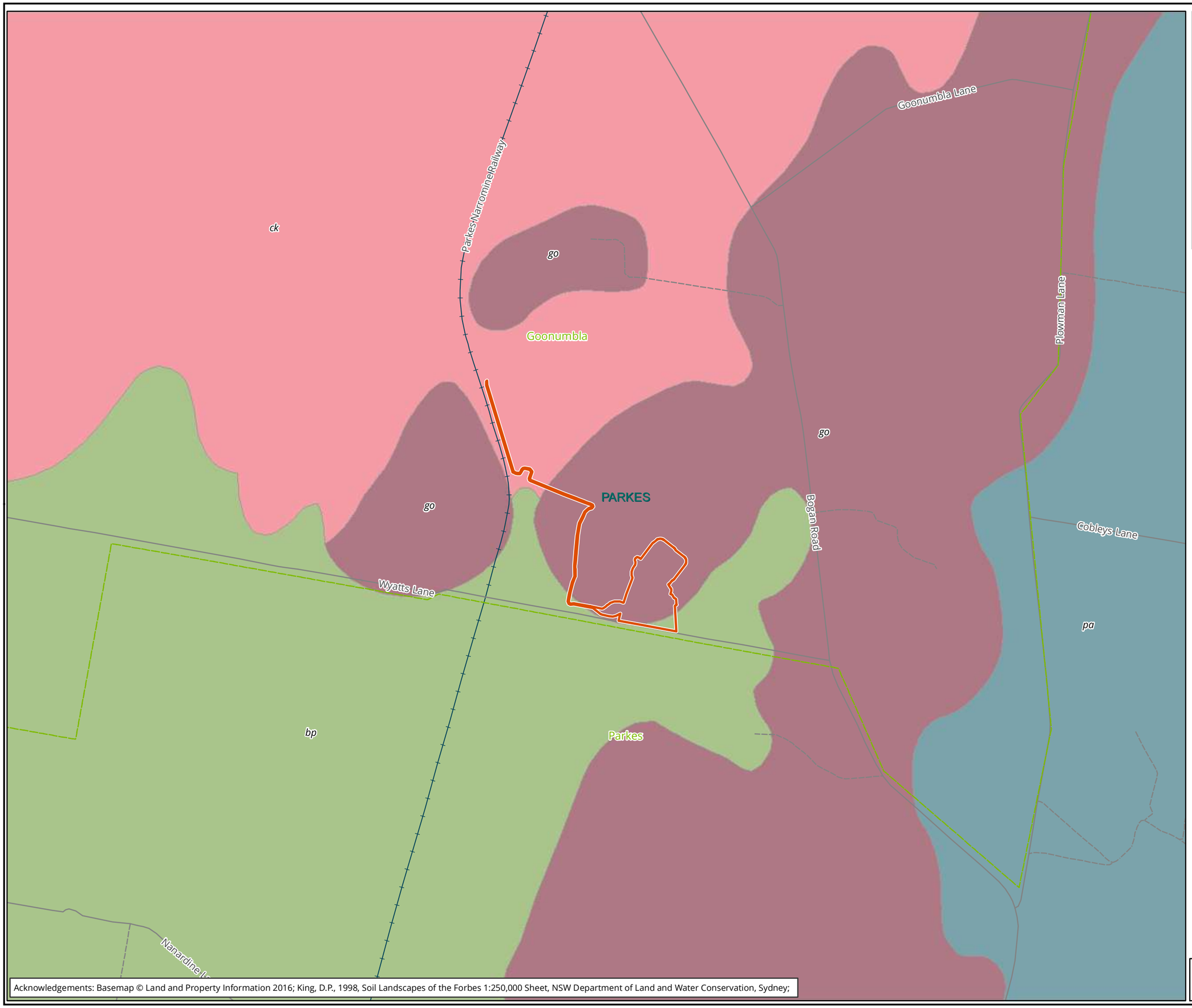

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Study area

Soil Landscape units

- bp - BROLGAN PLAIN
- ck - COOKS MYALLS
- go - GOONUMBLA
- pa - PARKES

Acknowledgements: Basemap © Land and Property Information 2016; King, D.P., 1998, Soil Landscapes of the Forbes 1:250,000 Sheet, NSW Department of Land and Water Conservation, Sydney;

Figure 5: Soil landscapes in the study area

0 200 400 600 800 1,000

Metres

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

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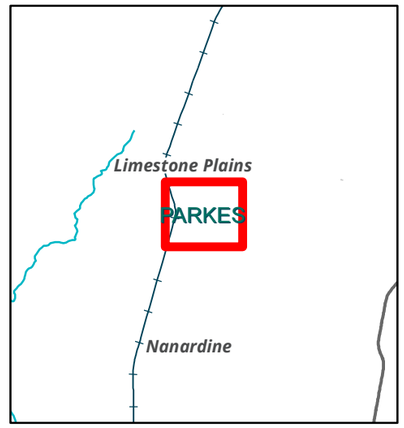

Legend

Study area

Dam

Perenniality

Non-Perennial

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © Nearmap 2016

Figure 6: Hydrology of the study area

0 50 100 150 200 250

Metres

Scale: 1:6,000 @ A3

Coordinate System: GDA 1994 MGA Zone 55

N

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Matter: 25564
Date: 22 February 2018,
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25564 ADD_F9_Hydrology

3 Aboriginal context

3.1 Ethnohistory and contact history

The study area falls within an area identified by Tindale (1974) as being within the boundaries of the Wiradjuri linguistic group. The Wiradjuri linguistic group covers a large portion of the central west. It was closely related to the Ngiyampaa language to the west and Gamilaraay to the north. Linguists refer to the three languages as the Wiradjuri group. The Wiradjuri language was the predominate language spoken in the areas around Dubbo and Mudgee in the north, close to Albury in the south, from Bathurst in the east and as far west as Hay. It is not known if Wiradjuri was always the superordinate language name in the area or whether it had come to be used predominantly during the early period of European settlement. Owing to the disturbance of Aboriginal culture by the arrival and colonisation of Australia by Europeans in the 18th and 19th centuries, the actual boundaries of these groups are difficult to identify with great confidence.

The spiritual beliefs of the Wiradjuri were organised around sacred sites associated with mythical *jin*, which could be associated with a particular animal or plant. A persons *jin* was inherited from their mother, along with the responsibly of maintaining the sacred sites associated within it. Individuals learnt the stories and songs associated with their *jin* and were not allowed to eat or damage them. There are also other stories connected to specific *jins* movements in the landscape as well as other mythological figures included Biami, his emu wife Goobeorangalnaba and the giant serpent Kurrea (NTSCORP 2012).

An analysis of the early ethnographic literature suggests that day to day, small groups of approximately 20-40 closely related people occupied local creeks and river valleys. They would move around in these small groups, using the river flats, open land and waterways with some regularity through the seasons, as indicated by the archaeological material that has accumulated in these areas. Traditionally, Wiradjuri people travelled to the alpine regions of the South Eastern Highlands and Australian Alps for the annual summer feast of Bogong moths (Flood 1980).

The first explorers to enter the region also documented the Wiradjuri people. John Oxley's expedition left Bathurst on 20 April 1817 and headed west, following the major waterways. Oxley described the environmental conditions as

> *'... the flats covered with acacia pendula; the last three miles were rather more elevated: the soil in general a loose, red, sandy loam, with small cypress, box, and acacia trees; a few acres in patches had been burned, occasionally relieving to the eye from the otherwise barren scrubby appearance of the country. We passed through two or three small eucalyptus scrubs, and upon getting out of one, having gone thirteen miles and a quarter, we fortunately happened to fall in a native well, containing a few gallons of water sufficient for our own supply; whilst the open level land which the scrub led to having been burnt, we hoped would afford succulent herbage sufficient for the horses, and prevent them from suffering from want of water...'* (Oxley 1817).

Oxley's party encountered Aboriginal people in the Trundle area, north-west of Orange:

> *'... the country became more open; the grass had been burnt, and marks of the mogo or stone hatchet on the trees, made by the wandering natives of these deserts in search of food, gave us renewed hopes of soon coming to water.' '...several transitory encampments of the natives were found, but none that had been inhabited within these four or six months; by all of them found abundance of the pearl muscle-shell so common on the Lachlan."* (Oxley 1817)

Sir Thomas Mitchell was another explorer who followed Oxley's path into the central west in the 1835. In Goobang Valley, Mitchell encountered a number of local Aboriginal people, which was descried as follows;

'...at length the sound of natives' hatches was heard, and one came forward to meet me. We learned from him we were on BURANBILL Creek, and that its course was SW towards Clare, or Lachlan River...' (Mitchell 1935).

Mitchell also described in his diary the diet and fishing practices of the Aboriginal people:

'... the principle food of these various tribes consisted of opossum, kangaroo and emu. Fishing was left entirely to the 'gins', was effectually, yet simply performed by a moveable dame of long twisted dry grass, through which water only could pass... The 'gins' further used to gather fresh water muscles by lifting the shell out of the mud with their toes...' (Mitchell 1935).

A distinctive feature of Wiradjuri country were clusters of carved trees, which marked burials and initiation sites. The trees were decorated with geometric and figurative designs. One example is at Yuranigh's grave (Yuranigh's was a guide for Sir Thomas Mitchell) on Gamboola Station near Molong, which was marked by five carved trees (NTSCORP 2012) (see Plate 2).

Plate 2 Example of carved tree (SLNSW: SPF/1150)

Distinctive ceremonies were conducted for the burial of important individuals. Surveyor William Govett, observed an Aboriginal funeral near Goulburn in 1836. He wrote:

' ...I was struck with the peculiarity of the noise... I soon perceived before me three native black women, and rode up to them. They were sitting around a mound of earth, with their heads depressed and nearly touching one another... They were each of them striking their heads with a tomahawk, holding the instrument in the right hand, and wounding particularly the upper part of the back of the head... They weep this way, wailing and cutting their heads, until they become perfectly exhausted, and can shed tears no longer... The trees all

round the tomb were marked in various peculiar ways, some with zigzags and stripes, and pieces of bark otherwise cut…' (Briggs and Jackson 2011, 8.)

Plate 3 Example of mound burial (National Library of Australia: nla.pic-an8955101)

On the Central Tablelands, areas favoured by the local Wiradjuri also attracted the most interest from colonial settlers. This lead to several battles, and the building of defensive homesteads (Kass 2003). By the 1840s, there was widespread dislocation of the Aboriginal culture in the area. The holding of Corroborees in the hills around Mudgee until the 1850s were some of the last reported signs of a traditional Aboriginal presence in the Central Tablelands.

With the arrival of European people into the Parkes region, a dramatic disruption to the social and political structure of the Wiradjuri occurred. Aboriginal people were eventually moved by the government from their traditional lands, which culminated in the 1880's with the formation of the Aborigines Protection Board (Read 1988). With the development of government strategies for "management of the Aboriginal problem" came the development of managed mission stations and unmanaged stations or reserves, as well as a string of unmanaged Aboriginal fringe camps, which arose near European towns and settlements (AASC 2006).

3.2 Regional context

A limited number of archaeological surveys and studies have been carried out in the wider region surrounding the study area. Most sites have been recorded by amateurs over many years or during field training sessions (AASC 2006). Further afield, there have been a number of larger studies that give a good indication regarding site patterning (Pearson 1981; Koetting 1985) in the landscape.

Pearson's (1981) research focused primarily on the Upper Macquarie region with the western boundary of his study area being Wellington, approximately 100 kilometres north east of Goonumbla Quarry. Pearson excavated three rock shelters, which provided a regional record of Aboriginal occupation that dates to around 5,000 years ago. The pattern of occupation developed by Pearson involved an examination of site location characteristics in four sample areas. He found that sites could be divided into two main categories; occupation sites and non-occupation sites such as grinding grooves, modified trees, ceremonial sites, and burial sites. From his analysis, Pearson built a predictive model that included:

- Site distances from water varied from 10 to 500 metres, with larger sites being closer to water.
- Site location criteria included good soil drainage and views over watercourses.

- Most sites were located in contexts that once supported open woodlands.
- Burial sites and grinding grooves were situated as close to habitation areas as geographically possible.
- Ceremonial sites were located away from campsites.
- Stone arrangements were also located away from campsites in isolated places.
- Quarry sites were located where stone outcrops with desirable working stone was accessible.
- Ethnographic information indicated that Aboriginal camp sites were seldom used for longer than three nights and large archaeological sites represent the accumulation of material over a series of short visits.

However, Pearson's field coverage was directed by information obtained from informants, which was skewed towards larger or obtrusive sites identified by local residents. Also, the unsystematic nature of the recording of sites would have skewed both site type and location, while the small sample size is considered too small to yield significant results (Koettig 1985).

Koettig (1985) undertook a comprehensive study of Aboriginal occupation of the Dubbo area, which included a desktop assessment followed by a systematic survey to target all topographic landform units and different stream orders. The field survey was divided up into five sample survey areas covering three major physiographic zones in the broader Dubbo area. As a result of the study, Koettig concluded that:

- Aboriginal sites may be expected throughout all landscape units.
- The most frequently occurring sites types were open artefact scatters, scarred trees, and grinding grooves.
- The location of sites and their relative size were determined by a number of factors including environmental and social. Social factors could not be explained through archaeological research, however, environmental factors included:
  - The largest campsites were located close to permanent water and smaller sites were found all over the landscape including hills and ridges away from permanent water.
  - Certain sites required specific conditions. For example, burials tend to be found in sandy sediments, grinding grooves were suitable rock outcrops occur, and quarries tend to be found where stone resources as accessible.
  - The widest range of potential food resources were found along main watercourses due to the supply of permanent water, while some foods were seasonal and required foraging away from watercourses.

Koettig suggested that larger and more constantly occupied site are likely to occur along permanent water courses, while less intense and sporadic occupation evidence is seen along ridge tops and temporary water sources.

3.3 Local context

Closer to the study area, a small number of cultural heritage investigations have been conducted and are summarised here.

Stone (1986) was commissioned to carry out an archaeological survey of the Northparkes Mine approximately 10 kilometres north-west of the study area. Three location were targeted (E22, E26 and E27),

along with Goonumbla Creek, Tenandra Creek, and portions of the Bogan River. The survey located 16 new sites, which consisted of 14 artefact scatters, one isolated stone artefact, and one scarred tree associated with two artefacts. All of these sites were located along the Bogan River, and Goonumbla and Tenandra Creeks. The sites found were described as being small and in poor condition. The largest site covered an area of 50 metres by 50 metres and contained 28 artefacts. On average, the sites contained 7.5 artefacts and artefact density was low at all of the sites. All of the sites had been disturbed by erosion, ploughing, grazing and stock movement. Stone noted that small artefacts scatters are the most common type of archaeological site recorded in this area. Their locations adjacent to the Bogan River and associated watercourses is also typical of the site pattern identified in this region.

Witter (1987) conducted an archaeological assessment of the London-Victoria gold project, located 5 kilometres south west of Parkes. No Aboriginal sites were located and Witter noted that high levels of quartz contamination from the associated mining activities, made it difficult to located camp sites. Witter recommended that scarred trees in the area be subject to further investigation. Following from this survey, ten scarred trees were located within the London-Victoria gold project study area primary on bimble box and cypress pine trees; however, it is unusual that cypress pine trees were recorded as being culturally modified as this species is rarely used for such purposes.

Brayshaw (1993) undertook an archaeological survey for the proposed water supply pipe line to Northparkes Mine. The pipeline started 22 kilometres north west of Parks, along Bogan Road, and finished 27 kilometres south of Parkes. The survey identified two open camps sites and one isolated find. One campsite contained a quartz flaked piece with retouch and use wear that was located within a disturbed context adjacent to an unnamed ephemeral drainage line. The second camp site was located 700 metres south of the first camp site, and contained an isolated find of a mudstone flake, also within a disturbed context.

Kelton (1998) undertook an archaeological assessment of the Wellington to Forbes electricity transmission line, which transected the Goobang National Park. The Forbes component of the survey corridor was located 13.5 kilometres west of the Newell Highway and continued west until it crossed Bogan Road, 6 kilometres south of Goonumbla Hill. The survey identified 18 Aboriginal sites between Alectown and Forbes. Three of these were open camp sites located on alluvial sediments associated with Goobang Creek. Grinding stones, hammerstones, a ground edged hatchet, flakes, and flaked pieces were recorded. The raw materials consisted of mainly silcrete and quartz.

Australian Archaeological Survey Consultants Pty Ltd (2006) were commissioned by R.W. Corkery & Co. Pty Limited on behalf of North Mining Limited, to carry out the Indigenous cultural heritage assessment component at Northparkes Mines approximately 10 kilometres north west of the study area. During the archaeological survey, a total of three newly recorded Aboriginal archaeological sites were identified (Sites A1, A2 and A3). The sites consist of two isolated finds and one small artefact scatter. An attempt to relocate ten previously recorded sites within the study area resulted in 8 being identified. It was recommended that the artefacts be recovered as part of a salvage project to be undertaken with the Peak Hill Local Aboriginal Land Council.

OzArk (2012) was commissioned by Essential Energy to undertake an archaeological due diligence assessment of the proposed 8.6 kilometre 66kV power line at Parkes to determine if any impacts to Aboriginal heritage would occur during construction. No Aboriginal sites were located and the field assessment found that there was a high level of disturbance across the study area. The assessment concluded that the impacts from the proposed construction of the power line were unlikely to pose a threat to Aboriginal heritage.

Umwelt (2017) prepared an Aboriginal Cultural Heritage and Archaeological Assessment for the Parkes to Naromine inland rail on behalf of ARTC. During the preliminary archaeological inspection of the existing railway corridor and the proposed connection route, site P2N IA1 (43-3-0111) was identified. The site

consisted of a single silcrete flake located upon an access track on the northern bank of a tributary of Ridgey Creek, less than 10 meters from the rail line. Site predictions for the proposed area indicated that stone artefacts and scarred trees were the most likely site types. Stone artefacts sites were commonly associated with areas close to reliable sources of water. It was noted that there a number of reliable water sources were located nearby the proposed corridor, however the reliability of these water sources has been impacted by post-contact land use and artificial modifications. It was concluded that the Ridgey Creek Tributary where site P2N IA1 was located, possessed low archaeological potential within the corridor and moderate potential outside the rail corridor and level crossing. Various mitigation and management options were provided to ensure no harm would come to any identified site or areas of archaeological potential. It was recommended that prior to commencing construction, site P2N IA1 be collected and salvaged.

3.3.1 Identified Aboriginal archaeological sites

An extensive search of the AHIMS database was conducted on 11 January 2018 (Client service ID: 321593). The search identified 72 Aboriginal archaeological sites within a 10 kilometre search area, centred on the proposed study area (Table 2 and Table 3). None of these registered sites are located *within* the study area (Figure 7). The mapping coordinates recorded for these sites were checked for consistency with their descriptions and location on maps from Aboriginal heritage reports where available. These descriptions and maps were relied where notable discrepancies occurred.

It should be noted that the AHIMS database reflects Aboriginal sites that have been officially recorded and included on the list. Large areas of NSW have not been subject to systematic, archaeological survey; hence AHIMS listings may reflect previous survey patterns and should not be considered a complete list of Aboriginal sites within a given area.

Table 3 AHIMS sites within the study area

Site type	Occurrences	Frequency (%)
Artefact	50	69.44
Artefact, modified tree	1	1.39
Modified tree	19	26.39
Stone arrangement	1	1.39
Stone quarry	1	1.39
Total	**72**	**100%**

A simple analysis of the Aboriginal cultural heritage sites registered within 1km of the study area indicates that the dominant site type is artefacts representing 69.44% (n=50), followed by modified trees representing 26.39% (n=19). Artefacts with modified trees, stone arrangements, and stone quarries were represented by 1.39% each (n=1 each). All the sites were located within close proximity to the reliable sources of water, were either exposed by the land clearing works (artefact scatters) or in the areas with remnant native vegetation (scarred trees). An isolated find (P2N IA1 – 43-3-0111) recorded by Umwelt (2017) is located approximately 100 metres west from the proposed siding road. Site 43-3-0111 is located within approximately 20 metres west of the Ridgey Creek Tributary that would have originally run through a northern section of the proposed route, but has subsequently been dammed in two locations and the surrounding land ploughed, as can be seen in Figure 6.

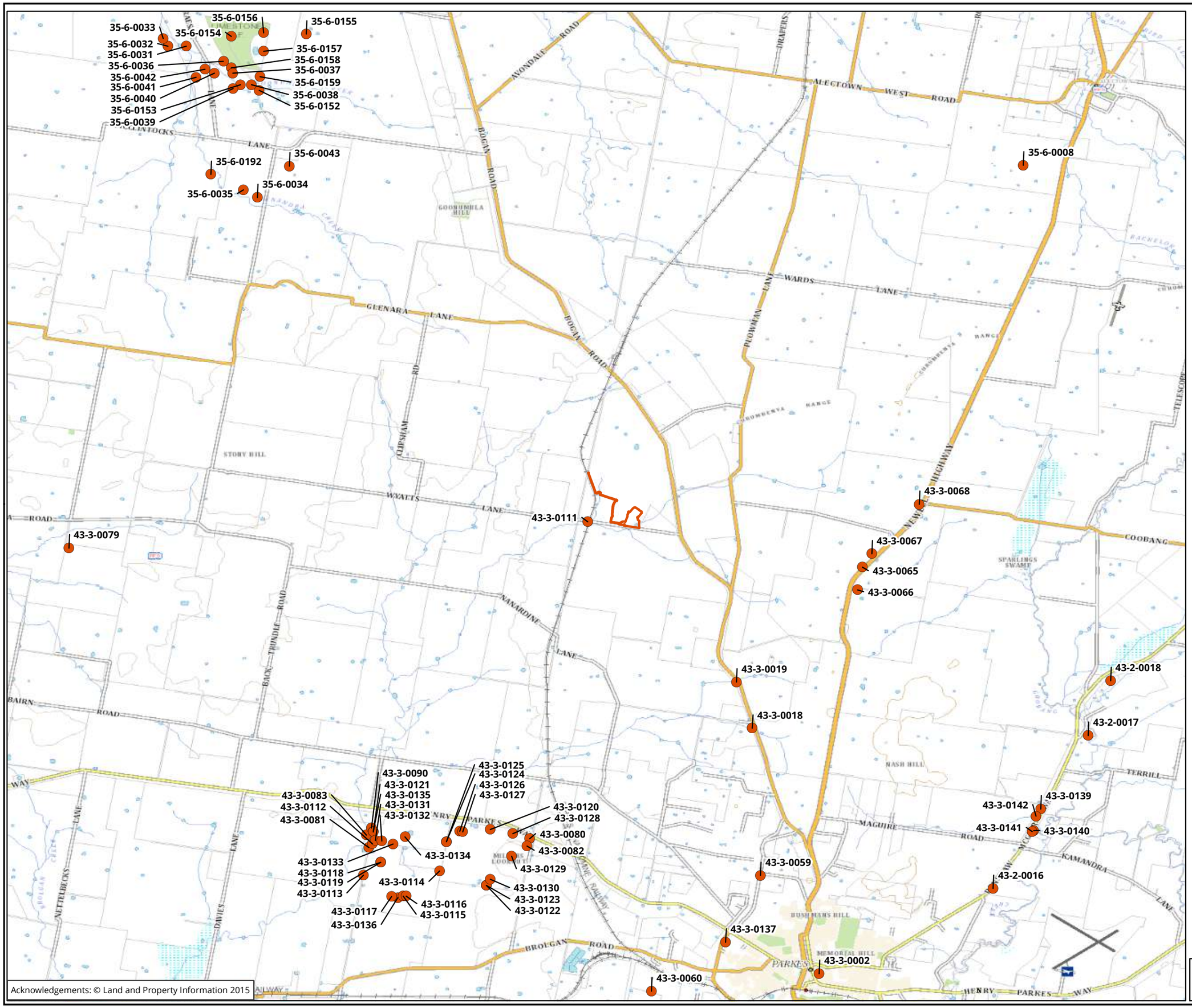


Figure 7: AHIMS records near the study area

NOT TO BE MADE PUBLIC

3.3.2 Predictive statements

A series of statements have been formulated to broadly predict the type and character of Aboriginal cultural heritage sites likely to exist throughout the study area and where they are more likely to be located.

This model is based on:

- Local and regional site distribution in relation to landform features identified within the study area.
- Consideration of site type, raw material types and site densities likely to be present within the study area.
- Findings of the ethnohistorical research on the potential for material traces to present within the study area;
- Potential Aboriginal use of natural resources present or once present within the study area; and
- Consideration of the temporal and spatial relationships of sites within the study area and surrounding region.

Based on this information, a predictive model has been developed, indicating the site types most likely to be encountered during the survey and subsequent sub-surface investigations across the present study area (Table 4). The definition of each site type is described firstly, followed by the predicted likelihood of this site type occurring within the study area.

Table 4 Aboriginal site prediction statements

Site Type	Site Description	Potential
Flaked stone artefact scatters and isolated artefacts	Artefact scatter sites can range from high-density concentrations of flaked stone and ground stone artefacts to sparse, low-density 'background' scatters and isolated finds.	Moderate: Stone artefact sites have been previously recorded in the region on level, well-drained topographies in close proximity to reliable sources of fresh water. Due to the distance from permanent fresh water resources, the potential for artefacts to be present within the study area is assessed as moderate.
Shell middens	Deposits of shells accumulated over either singular large resource gathering events or over longer periods of time.	Low: Shell midden sites have not been recorded within the vicinity of the study area. There is a very low potential for shell middens to be located in the study area due to the distance from a permanent water source.
Quarries	Raw stone material procurement sites.	Low: There are no record of any quarries being within or surrounding the study area.
Potential Archaeological Deposits (PADs)	Potential sub surface deposits of cultural material.	Moderate: PADs have not been previously recorded in the region; however, PADs are likely to be present within areas adjacent to water courses or on high points in undisturbed landforms.

Site Type	Site Description	Potential
Modified trees	Trees with cultural modifications	Moderate: Scarred trees are the second most common site type within the vicinity of the study area. Due to extensive vegetation clearance only a small number of mature native trees have survived within the study area.
Grinding grooves	Grooves created in stone platforms through ground stone tool manufacture.	Low: Suitable horizontal sandstone rock outcrops could occur along drainage lines; however, these are not present within the study area.
Burials	Aboriginal burial sites.	Low: Aboriginal burial sites are generally situated within deep, soft sediments, caves or hollow trees. Areas of deep sandy deposits will have the potential for Aboriginal burials. The soil profiles associated with the study area are not commonly associated with burials.
Rock shelters with art and / or deposit	Rock shelter sites include rock overhangs, shelters or caves, and generally occur on, or next to, moderate to steeply sloping ground characterised by cliff lines and escarpments. These naturally formed features may contain rock art, stone artefacts or midden deposits and may also be associated with grinding grooves.	Low: The sites will only occur where suitable sandstone exposures or overhangs possessing sufficient sheltered space exist, which are not present within the study area.
Aboriginal Ceremony and Dreaming Sites	Such sites are often intangible places and features and are identified through oral histories, ethnohistoric data, or Aboriginal informants.	Low: There are currently no recorded mythological stories for the study area.
Post-Contact Sites	These are sites relating to the shared history of Aboriginal and non-Aboriginal people of an area and may include places such as missions, massacre sites, post-contact camp sites and buildings associated with post-contact Aboriginal use.	Low: There are no post-contact sites previously recorded in the study area and historical sources do not identify one.

Site Type	Site Description	Potential
Aboriginal Places	Aboriginal places may not contain any "archaeological" indicators of a site, but are nonetheless important to Aboriginal people. They may be places of cultural, spiritual or historic significance. Often they are places tied to community history and may include natural features (such as swimming and fishing holes), places where Aboriginal political events commenced or particular buildings.	Low: There are currently no recorded Aboriginal historical associations for the study area.

4 European historical context

4.1 Introduction

Historical research has been undertaken to identify the land use history of the study area, to isolate key phases in its history and to identify the location of any archaeological resources within the study area. The historical research places the history of the study area into the broader context of the Parkes area.

4.2 Exploration and early settlement

The European settlement of the Central West reflects the broader movement of people throughout NSW. In 1813 Surveyor George Evans crossed the Blue Mountains and entered the Central Tablelands, which begun an era of official exploration. Two years later, Governor Macquarie proclaimed a Government Stock Establishment, staffed by soldiers and convicts, at the present site of Bathurst (Griffin 2004).

A number of commercial industries contributed to the increase in settlement of the region. The identification and mining of earth materials has been an important industry within the Central West since the 1840s. Settlers were attracted to the area by mining during both the nineteenth and early twentieth centuries. Copper was first mined in NSW and in 1845 a number of copper mines were in operation in the Central West. Copper was also discovered in Carcoar in the 1840s and in 1851 gold was discovered in Bathurst. Gold was discovered in 1851 in Orange at the junction of Lewis Ponds and Summer Hill Creek. By the end of the month there were several hundred people panning for gold at Ophir along Summer Hill Creek (Plate 4). This was the beginning of a gold rush and had the effect of tripling the population of Orange in a matter of months.

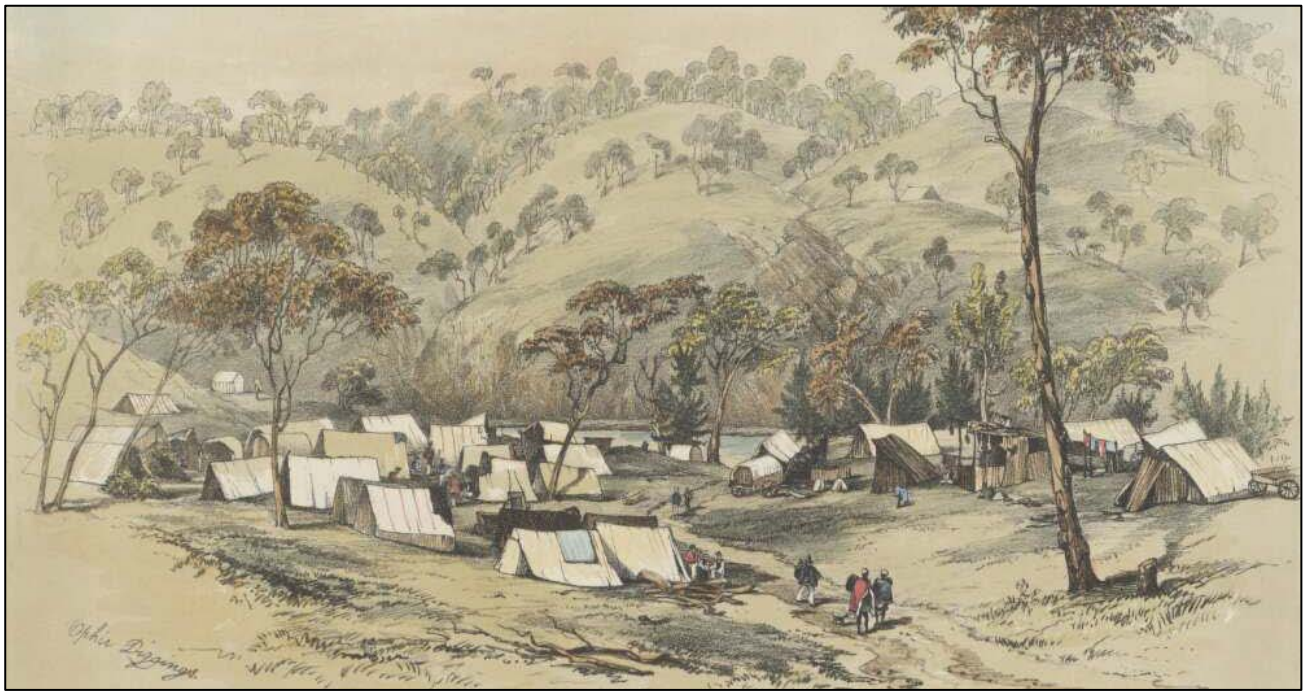


Plate 4 **c.1851 engraving by GF Angus of the Ophir Diggings showing the creation of a 'canvas' town (Source: National Library of Australia).**

Agriculture was also a large industry that increased settlement in the region, with farmers from eastern NSW, Victoria and South Australia moving into the area. This industry also brought in a seasonal migration with works associated with the yearly harvest, planting or searing. There are the number of heritage listed farming homesteads and planting throughout the region.

The earliest public enterprise in the Central West was the building of a road over the Blue Mountains, to assist in the movement of settlers. In many areas of NSW, the settlement of an area predates the building of major roadways. However, for the Central West the settlement could only occur once this infrastructure was built. The railway line reached Bathurst on the 4 April 1876 and altered settlement patterns.

4.3 Parkes historical development

The Parkes region remained relatively unsettled until 1862, when gold was discovered at Currajong. In 1862, the goldfields at Forbes were displaying evidence of being over worked, so James Pugh and two associates decided to try their luck further north. In October of the same year, they found a rich quartz reef in the hills near the town of Currarong and named the reef 'Pioneer'. On 8 November 1862, *The Sydney Morning Herald* announced 'a rush has taken place to Billabong, about 20 miles distant, where a rich quartz reef has been found'. James Pugh was awarded a government reward of £500 for finding a new field (Parkes Early History 2018). A 'canvas' town was erected at Currarong to accommodate the thousands of prospectors (Parkes Shire Council 2016). In 1871, a further discovery of gold at Bushman's Gold Mine helped the district to become one of the richest gold producing areas in the colony of NSW.

Plate 5 c.1890 Dayspring Mine, approximately 3 kilometres north of Parkes (Source: Parkes Early History 2018).

The Premier of NSW, Sir Henry Parkes, visited the district to inspect the gold fields in 1873 and, in the same year, the settlement's name was changed from Bushmans to Parkes in his honour. The boundaries of Parkes

were extended and the Municipality of Parkes was proclaimed on 1March 1883. Parkes was proclaimed a town on 20 March 1885 and the town continued to grow to encompass the village of Currajong.

As mining diminished in the Parkes area, the plough and harvester became the new symbols of progress. The wheat growing frontier had gradually expanded westwards as a consequence of the opening up of new land and the decided advantages of a drier climate for wheat growing. Coupled with new techniques and the development of new wheat varieties, the spread of wheat growing had a major impact on the landscape pf the Central West and the Parkes areas. Where wheat will grow, other grain crops will also flourish; therefore, oats, rye and barley were also planted (Kass 2003).

4.4 Study area

The study area is located within Portion 36, 46 and 60 of the original 1887 land grant to Charles J.E. Palmer and also part of the greater Billabong Gold Field proclaimed on 6 January 1894 (Plate 5). From the time of the original land grant to the present day, the study area has been owned by a succession of farmers and graziers whose primary use of the land was for agricultural purposes.

The Commercial Banking Company of Sydney Limited purchased Portion 36 in 1899, grazier John Woods purchased Portion 60 in 1930, and Portion 46 was purchased by the National Mutual Life Association of Australasia Limited in 1917. In 1961, grazier Edward Woods purchased the three Portions together, followed by Kevin Hennessy who purchased the now combined Portions in 1982. A 2013 newspaper article in the *Parkes Champion Post*, reported on the redevelopment of a dormant gravel quarry at Goonumbla that was situated on land owned by Mr TJ Unger. The study area is now part of the Goonumbla Quary.

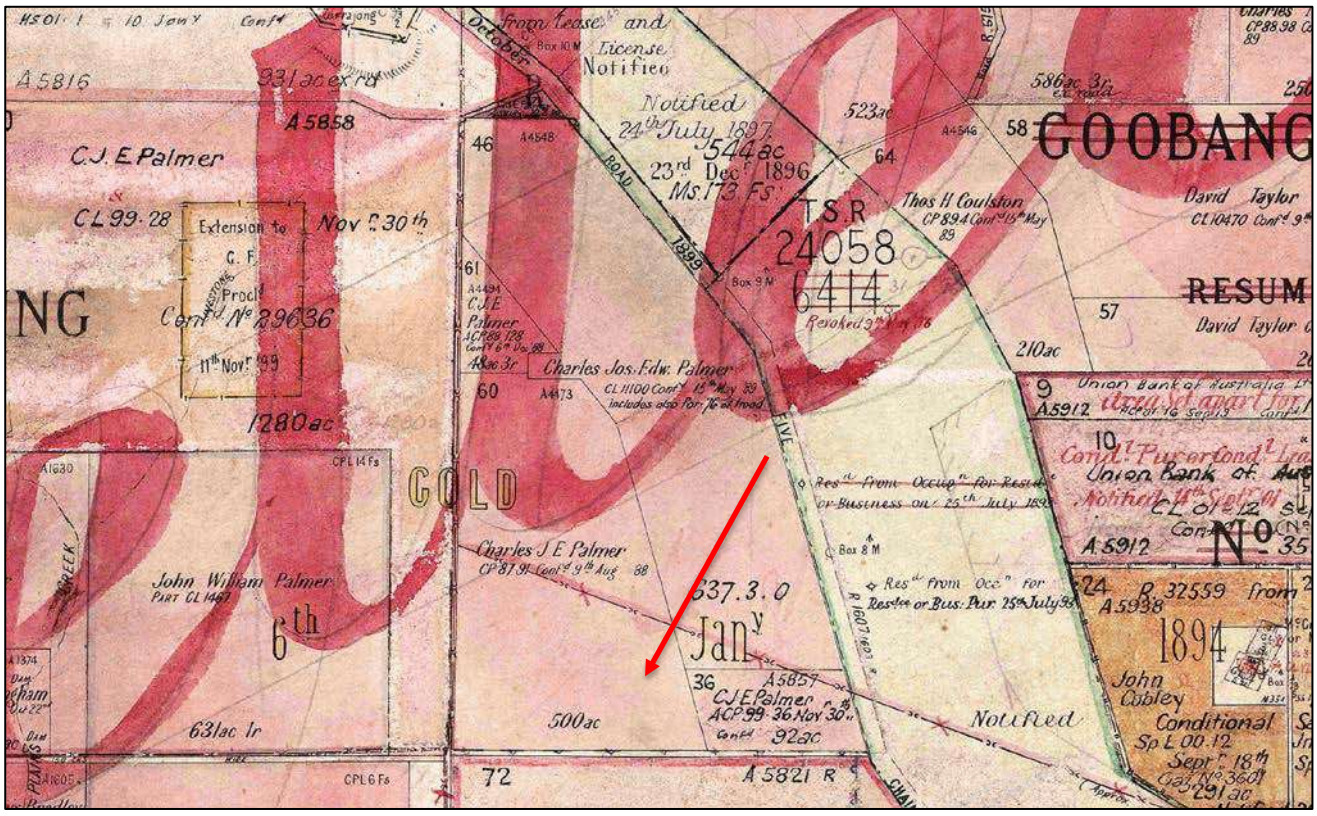


Plate 6 **c.1894 historic parish map showing Portions 36, 46, and 60. The approximate location of the study area is denoted by the arrow (Source: NSW Land and Property Information).**

5 Archaeological survey

An archaeological survey of the study area was undertaken on 22 January 2018, by Ashleigh Keevers-Eastman from Biosis Pty Ltd and Lynette Bell from Peak Hill Local Aboriginal Land Council, and was conducted in two stages. Stage 1 of the survey consisted of a single meandering transect north of the present quarry located within the study area where future mining activities have been proposed. Stage 2 of the survey effort consisted of five transects that targeted the proposed path of an access road running west to north of the present quarry. The survey sampling strategy, methodology and a discussion of results are provided below.

5.1 Archaeological survey aims

The principle aims of the survey were to:

- To undertake a systematic survey of the study area targeting areas with the potential for Aboriginal heritage.
- Identify and record Aboriginal archaeological sites visible on the ground surface.
- Identify and record areas of Aboriginal archaeological and cultural sensitivity.

5.2 Survey methods

The survey was conducted on foot. Recording during the survey followed the archaeological survey requirements of the Code and industry best practice methodology. Information that recorded during the survey included:

- Aboriginal objects or sites present in the study area during the survey.
- Survey coverage.
- Any resources that may have potentially have been exploited by Aboriginal people.
- Landform elements, distinguishable areas of land approximately 40m across or with a 20m radius (CSIRO 2009).
- Photographs of the site indicating landform.
- Ground surface visibility (GSV) and areas of exposure.
- Observable past or present disturbances to the landscape from human or animal activities; and,
- Aboriginal artefacts, culturally modified trees or any other Aboriginal sites.

Where possible, the identification of natural soil deposits within the study area was undertaken. Photographs and recording techniques were incorporated into the survey including representative photographs of survey units, landform, vegetation coverage, ground surface visibility and the recording of soil information for each survey unit were possible. Any potential Aboriginal objects observed during the survey were documented and photographed. The location of points marking the boundary of the landform elements were recorded using a hand-held Global Positioning System and the Map Grid of Australia (94) coordinate system.

5.3 Constraints to the survey

With any archaeological survey there are several factors that influence the effectiveness (the likelihood of finding sites) of the survey. Poor ground surface visibility (GSV) and high levels of disturbance by both human and natural agents affected the effectiveness of the survey effort undertaken by Biosis Pty Ltd to identify aboriginal objects or sites that may exist within the study area.

5.4 Visibility

In most archaeological reports and guidelines visibility refers to ground surface visibility, and is usually a percentage estimate of the ground surface that is visible and allowing for the detection of (usually stone) artefacts that may be present on the ground surface (DECCW 2010b).

The effectiveness of Stage 1 of the survey effort was affected by poor ground surface visibility, which ranged from 0-10% within the portion of the study area intended for mining works. This was due to the presence of tall grasses and dry thistle vegetation that populated the area surveyed during Stage 1 (Plate 7).

Ground surface visibility improved considerably along the intended route of the proposed access road leading from the existing quarry, inspected as a part of Stage 2 of the survey. GSV ranged from a minimum of 10% in areas heavily vegetated by tall grass in Transect 1, to 90% in areas where human activities including ploughing and vehicle access have disturbed the ground surface.

Plate 7 East facing view of section of the study area surveyed during Stage 1, showing presence of tall grasses, few remnant Kurrajong trees, and artificial dam located nearby.

5.5 Exposure

Exposure refers to the geomorphic conditions of the local landform being surveyed, and attempts to describe the relationship between those conditions and the likelihood the prevailing conditions provide for the exposure of (buried) archaeological materials. Whilst also usually expressed as a percentage estimate, exposure is different to visibility in that it is in part a summation of geomorphic processes, rather than a simple observation of the ground surface (Burke and Smith 2004: 79, DECCW 2010b).

Areas of exposure within Stage 1 were limited to areas of rocky outcropping and areas disturbed by vehicle access. Rocky outcropping within this section of the study area was heavily eroded and of poor quality. Visible areas of exposure identified during Stage 1 were limited to 0-5% due to presence of tall grasses and dry thistle vegetation upon the crest and slopes of the area surveyed.

Areas of exposure identified during Stage 2 of the archaeological survey were resultant of human activity within the area such as ploughing and disturbance of soil deposits via vehicle access or installation of fencing and ranged from 30-80%.

5.6 Disturbances

Disturbance in the study area is associated with natural and human agents. Natural agents generally affect small areas and include the burrowing and scratching in soil by animals, such as wombats, foxes, rabbits and wallabies, and sometimes exposure from slumping or scouring. Disturbances associated with recent human action are prevalent in the study area and cover large sections of the land surface. The agents include farming practices, such as initial vegetation clearance for creation of paddocks, clearing away of scattered raw materials, fencing and stock grazing; light industrial practices such as the creation of artificial dams are also present throughout the entire study area.

The area surveyed as part of Stage 1 has been heavily disturbed by human activity and natural agents. A man-made wall-like structure runs east to west through the study area and is made up of raw materials and soil that has been scraped up in an attempt to clear the area of rocky debris (see Plate 8). A dumping pit has also been constructed within this section of the study area, where natural soil deposits have been disturbed to create a deposit next to the pit as seen in Plate 9 and Plate 10. These activities would have disturbed any artefactual material that may have been present upon the surface of the crest and slope landform units within the study area.

Plate 8 North-facing view of sloping landscape of area surveyed during Stage 1, showing wall-like structure built up of natural soil and raw material from surrounding area.

Plate 9 North-facing view of dumping pit located within area surveyed during Stage 1 of the survey effort.

Plate 10 Soil heap located adjacent to dumping pit.

The proposed route for the access road assessed during Stage 2 of the survey has been disturbed by recent vehicle access to the area that has displaced natural soil deposits. An artificial dam also intersected Transect 4. Evidence of natural agents of disturbance are also present along Transect 5, where rabbit warrens were identified.

Plate 11 North facing view of intended route for proposed access road surveyed during Stage 2 of the survey effort.

Plate 12 North facing view of northern extent of the route surveyed during Stage 2, showing heavily disturbed soils.

Plate 13 White Cypress regrowth and tall dry thistle vegetation located adjacent to Transect 2.

5.7 Survey results and discussion

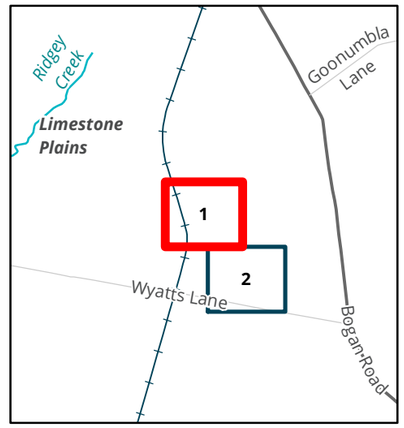
The archaeological survey was conducted in two stages in order to effectively assess the archaeological potential of the separate works to be undertaken within the study area (Figure 8). Stage 1 of the survey effort consisted of a meandering survey targeting the crests and slopes situated north of the present quarry, where the proposed mining and bunding activities will occur. No Aboriginal or historical objects or sites were identified during Stage 1 of the survey. The area surveyed was highly disturbed by recent human activity which included the clearing away of natural raw material that would have littered the landscape, and any accompanying sub-surface deposits.

Stage 2 of the survey effort assessed the proposed route for the access road that will run west to north from the present quarry. A total of five transects were walked in order to assess the archaeological potential of the proposed route. A summary of each transect has been provided in Table 5**.** A majority of the area has been heavily cleared of remnant vegetation or disturbed by agricultural practices such a ploughing, or vehicle access. No previously unrecorded Aboriginal or Historical sites or objects were recorded during Stage 2 of the survey effort.

Overall, the study area possesses low archaeological potential due to the absence of well drained undisturbed landforms in close proximity to permanent water sources that are associated with the identification of Aboriginal sites (see Figure 9). The level of disturbance within the study area, as a result of human agents, also affects the archaeological potential of the area to contain intact deposits. Vehicle disturbance and ploughing within the lower plains, and clearing methods employed for farming purposes on the crest and slopes of the study area have potentially displaced any surface deposits that might have been present.

Table 5 Stage 2 transect summary

Transect No.	Landform Unit	Visibility %	Exposure %	Description
1	Plains	40	50	Access track heading west from existing quarry located adjacent to Wyatts Lane. Some remnant vegetation present.
2	Plains	10	30	Heavily vegetated continuation of access track heading west from existing quarry located adjacent to Wyatts Lane, with White Cypress saplings, tall grasses and thistle vegetation area to the north.
3	Plains	60	60	Heavily disturbed long tract of land used as an access track located adjacent to a ploughed field to the west.
4	Plains	70	60	Tract of land following fence line west, bypassing artificial dam within a ploughed field.
5	Plains	90	80	Tract of land used as an access track within a ploughed field, following fence line vegetated by iron bark regrowth, heading north. Train track located to the west, adjacent to the fence line.



Legend

- Study area
- Transect
- Siding access road

Stage

- 2

Figure 8: Survey effort

0 25 50 75 100 125

Metres

Scale: 1:2,600 @ A3

Coordinate System: GDA 1994 MGA Zone 55

N

biosis

Biosis Pty Ltd

Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Matter: 25564
Date: 22 February 2018,
Checked by: CLA, Drawn by: LW, Last edited by: lwilson
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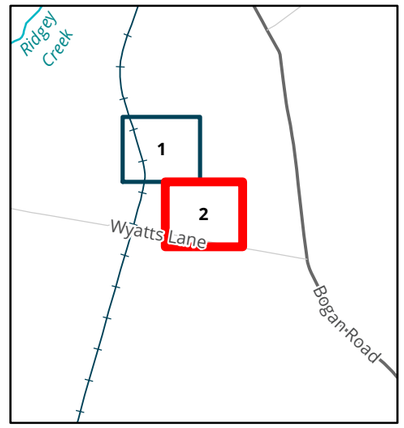

Legend

- Study area
- Transect
- Access road
- Siding access road

Stage

- 1
- 2

Figure 8: Survey effort

0 25 50 75 100 125

Metres

Scale: 1:2,600 @ A3

Coordinate System: GDA 1994 MGA Zone 55

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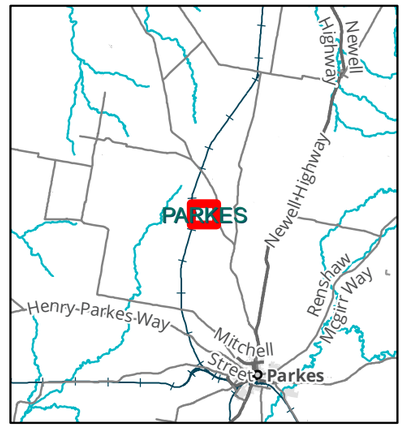

Legend

Study area

Areas of archaeological potential

Low potential

Figure 9: Survey results

0 50 100 150 200 250

Metres

Scale: 1:5,753 @ A3

Coordinate System: GDA 1994 NSW Lambert

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Albury, Ballarat, Melbourne,
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6 Conclusions and recommendations

6.1 Conclusions

This assessment has determined that the study area possesses low archaeological potential. A desktop assessment of the study area concluded that no previously recorded Aboriginal or historical sites or objects exist within the vicinity of the study area, exempting them from harm. A review of local and regional patterns between site distribution and landforms also suggests that the study area possesses low archaeological potential, as it is not located within close proximity to permanent sources of water, and is highly disturbed by human activity within the area.

No previously unidentified Aboriginal or historical sites or areas of cultural sensitivity were identified during survey efforts carried out on the 22 January 2018. Biosis Pty Ltd has therefore made the following recommendations as per the guidelines outlined within the Due Diligence Flow Chart (see Figure 10).

6.2 Recommendations

The following management recommendations have been developed relevant to the study area and influenced by:

- Predicted impacts to Aboriginal cultural heritage.
- The planning approvals framework.
- Current best conservation practise, widely considered to include:
  - Ethos of the Australia ICOMOS Burra Charter (2013)
  - The code

Prior to any impacts occurring within the study area, the following is recommended:

Recommendation 1: No further archaeological assessment is required in areas of low archaeological potential

No further archaeological work is required in the study area due to the entire study area assessed as having low archaeological potential.

Recommendation 2: Discovery of unanticipated Aboriginal objects

All Aboriginal objects and Places are protected under the*National Parks and Wildlife Act 1974*. It is an offence to knowingly disturb an Aboriginal site without a consent permit issued by the Office of Environment and Heritage (OEH). Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations. These may include notifying the OEH and Aboriginal stakeholders.

Recommendation 3: Discovery of Aboriginal Ancestral Remains

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity you must:

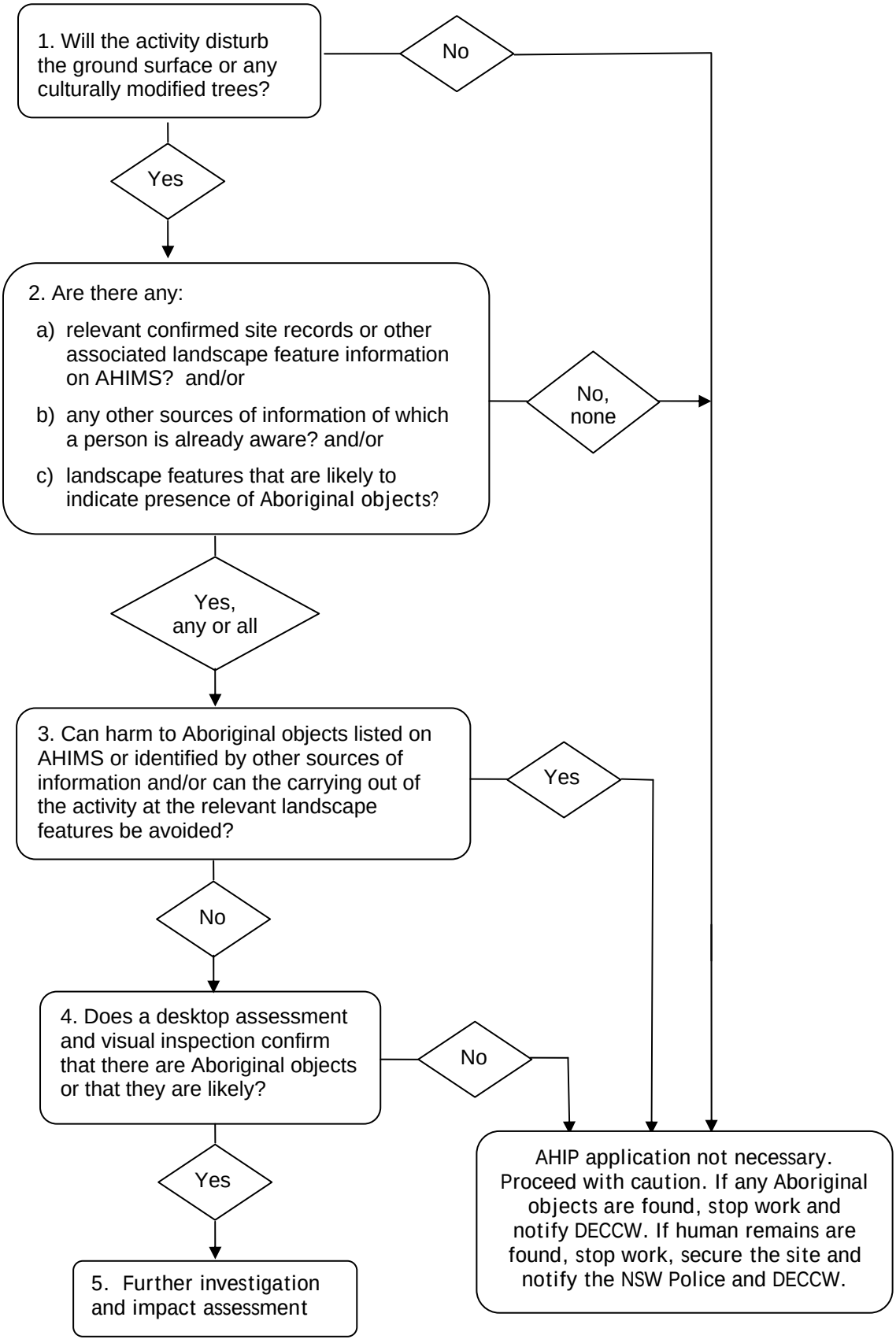
1. Immediately cease all work at that location and not further move or disturb the remains.

2. Notify the NSW Police and OEH's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location.
3. Not recommence work at that location unless authorised in writing by OEH.

Recommendation 4: Unexpected finds protocol

In the event that unanticipated non-Aboriginal heritage items are encountered, the archaeological remains should be assessed by an archaeologist to determine whether the suspected find constitutes a relic under the *NSW Heritage Act 1977* and whether NSW Heritage Council should be notified.

Figure 10: Due Diligence Flowchart



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Appendices

Appendix 1 AHIMS search results

This Appendix is not to be made public.

Appendix E

NOISE & VIBRATION IMPACT ASSESSMENT

amg

Assured Monitoring Group

GOONUMBLA QUARRY: NOISE & VIBRATION IMPACT ASSESSMENT

AUSROCK QUARRIES PTY LTD

Project ID. 11104

R_3

DATE OF RELEASE: 12/03/2018

Unit 7, 142Tennyson Memorial Avenue – Tennyson – Queensland - 4105

ABN: 87 604 851 078

Table 1: Document Approval

	Name	Position Title	Signature	Date
Author	Michelle Clifton	Senior Consultant	[redacted]	12/03/2018
Reviewer	Craig Beyers	Consulting Services Manager		12/03/2018
Approver	Craig Beyers	Consulting Services Manager		12/03/2018

Table 2: Revision Register

Revision	Date	Name	Issued to	Comment
R_0	6/02/2018	C. Beyers	C. Bigg	Formal report release
R_1	12/02/2018	C. Beyers	C. Bigg	Client Comments
R_2	19/02/2018	C. Beyers	C. Bigg	Client Comments
R_3	19/03/2018	C. Beyers	C. Bigg	Revised modelling

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1 INTRODUCTION

1.1 Scope of Assessment

The Assured Monitoring Group was appointed by Ausrock Quarries Pty Ltd to undertake a noise and vibration impact assessment for the proposed Goonumbla Quarry Expansion project (the Project). The project involves the operation of an extension to the existing open-cut pit on a single land parcel (Lot 32 on DP816454).

The noise study has been undertaken to assess the potential operational impacts of the proposed extension on nearby sensitive receptors in accordance with the following NSW policies and guidelines:

- NSW Environmental Protection Authority NSW Noise Policy for Industry (NPfI) (EPA, 2017);
- NSW Assessing Vibration: a technical guideline (DEC, 2006);
- NSW Road Noise Policy (DECCW, 2011); and
- Interim Construction Noise Guideline (DECCW, 2009).

In accordance with the requirements of the above guidelines, computational modelling and first principle calculations have been undertaken to support the assessment of the potential for adverse amenity impacts as a result of the development.

1.2 This Report

This report summarises the methodology, results and conclusions of the noise and vibration impact assessment. A glossary of terms is presented in Appendix A to assist the reader.

2 PROPOSED DEVELOPMENT

2.1 Development Site

The proposed development site is located approximately 10 km north of Parkes in New South Wales. Specifically, the Project is to be constructed within the boundary of Lot 32 on DP816454.

The area surrounding the proposed development includes a range of agricultural and rural uses. Figure 1 presents the layout of the site and Figure 2 provides the site location in the context of the surrounding uses.

2.2 Nearby Sensitive Receptors

The nearest off-site residential receptors to the proposed extension of the quarry include six (6) existing dwellings located within two (2) km of the Project.

Figure 1 and Table 3 below provide a summary of the nearest sensitive uses to the proposed development.

Table 3: Nearby Sensitive Receptors

Receptor ID	Description	Distance to Proposed Development Site
R1	Existing Dwelling	520 m
R2	Existing Dwelling (unoccupied)	865 m
R3	Existing Dwelling	960 m
R4	Existing Dwelling	1,160 m
R5	Existing Dwelling	1,910 m
R6	Existing Dwelling	1,710 m

2.3 Description of Development

2.3.1 Production Rate

The extension of the existing quarry is expected to provide for extraction and processing of up to 300,000 tonnes per year with a maximum of 150,000 tonnes expected to be transported by truck from the site via road and the remainder would be transported by truck to a nearby rail link, accessible via internal access roads; the future use of this access road does not form part of the scope of this assessment.

Rock extraction will be undertaken in two stages (see Figure 1):

- Stage 1 involves hard rock excavation of 545,000 m^3; and
- Stage 2 involves hard rock excavation of 179,700 m^3.

2.3.2 Operational Hours

The operation of the proposed quarry following the expansion will see rock extraction activities (including excavation, crushing, stockpiling) and loadout activities will occur

between the hours of 7 am to 6 pm Monday to Friday and 7 am to 3 pm Saturdays. Blasting at the quarry would be undertaken between the hours of 9 am and 5 pm Monday to Friday only.

No activities are proposed to be undertaken on Sundays or public holidays.

2.3.3 Site Clearance

Clearing and stripping will only be undertaken within the proposed development footprint. For the purpose of the assessment, it has been assumed that stripped material will be formed into earth mounds of a minimum 3 m in height around the pit expansion boundary of the extraction footprint as identified on Figure 1.

An access road from the processing and loading area (southern extent of the site) will be established around the quarry extension to allow site (and bund) maintenance to occur.

2.3.4 Material Extraction

Recovery of hard rock material from the quarry will be undertaken primarily through drill and blast techniques. Specifically, this process involves drilling and blasting by a qualified contractor to generate fragment rock suitable for processing.

Given the capacity and expected production of the quarry, it is anticipated that approximately 6 blasts per year would be required. Each of these blast events would be undertaken following approximately one week of drilling activity to produce the necessary hole depth and pattern required to win the desired 30,000 – 50,000 tonnes of fragment rock material.

Fragment rock material created by the blast would be loaded by excavator into CAT D350D haul trucks for transport to the mobile crushing plant located within the pit for processing.

2.3.5 Processing

Hard rock processing will occur in two phases:

- Primary crushing and screening (in pit); and
- Aggregate plant processing (in quarry).

Blasted material will be loaded directly into the primary mobile jaw crusher by an excavator. Crushed material would then be conveyed into a mobile cone crusher and screen. Product from the primary crushing includes ballast (20-65 mm) and fines (<20 mm). The plant (which is currently operational at the site) has a capacity of 300 tph.

The aggregate plant will be used to further process the 'fines' from the primary crusher. Following loading into the aggregate plant feed hopper, the material passes through a cone crusher and onto two screens to separate the different aggregates (20/14 mm, 10 mm, 7 mm, 5 mm, manufacturer sand, dust and road base). The plant has a capacity of 180 tph.

2.4 Assessment Phases

Typically, site clearing activities are included as part of the construction phase of a new quarry. However, as the Project is an existing quarry, site clearance is undertaken when the quarry progresses onto a new bench. As such for the purposes of this assessment, clearing activities will be considered part of the operational activities.

Three operational phases will be assessed;

- Surface stripping activities;
- Initial quarrying phase near the surface of the expanded pit; and
- Subsurface quarrying 20 m below the natural surface of the expanded pit.

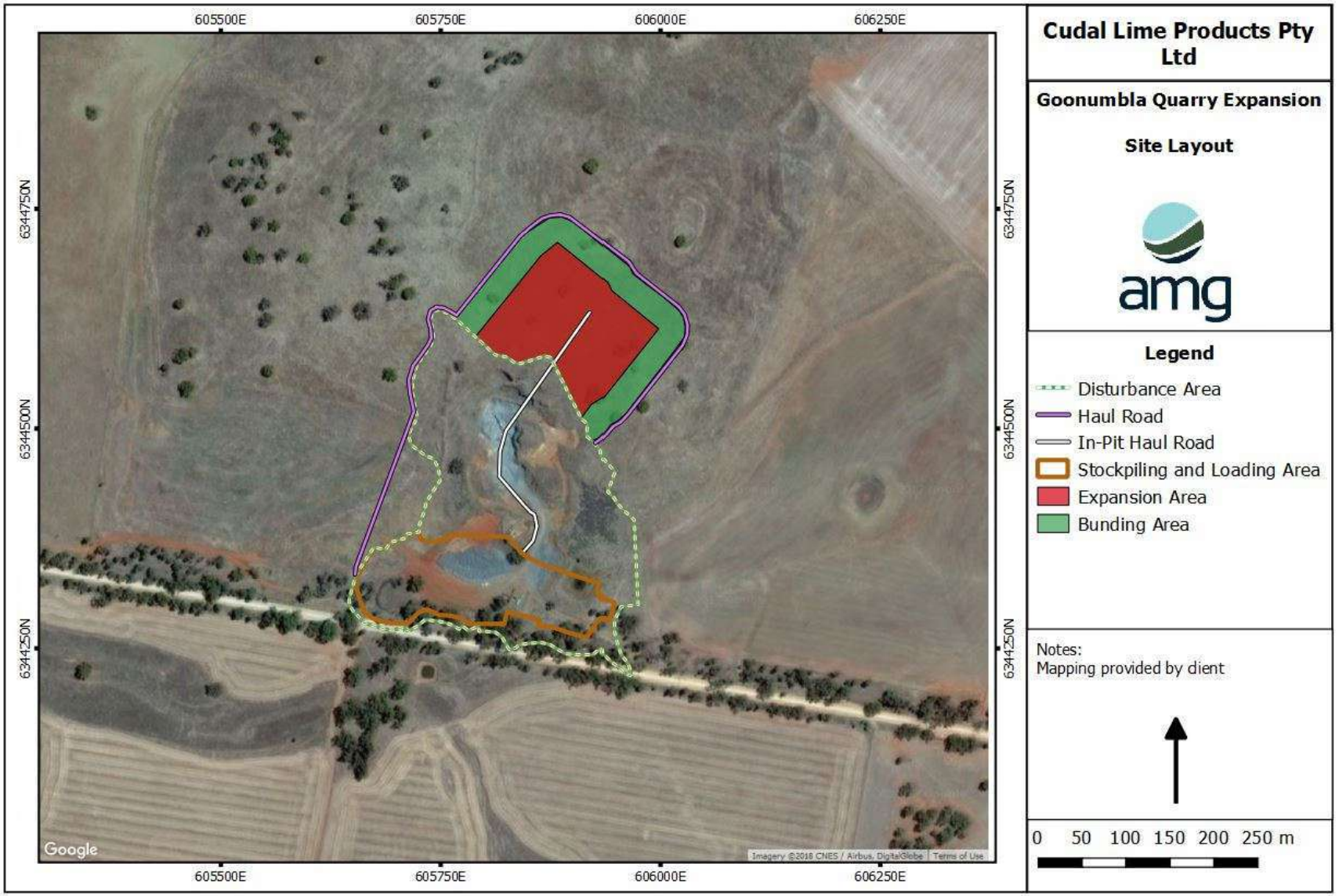


Figure 1: Site Layout

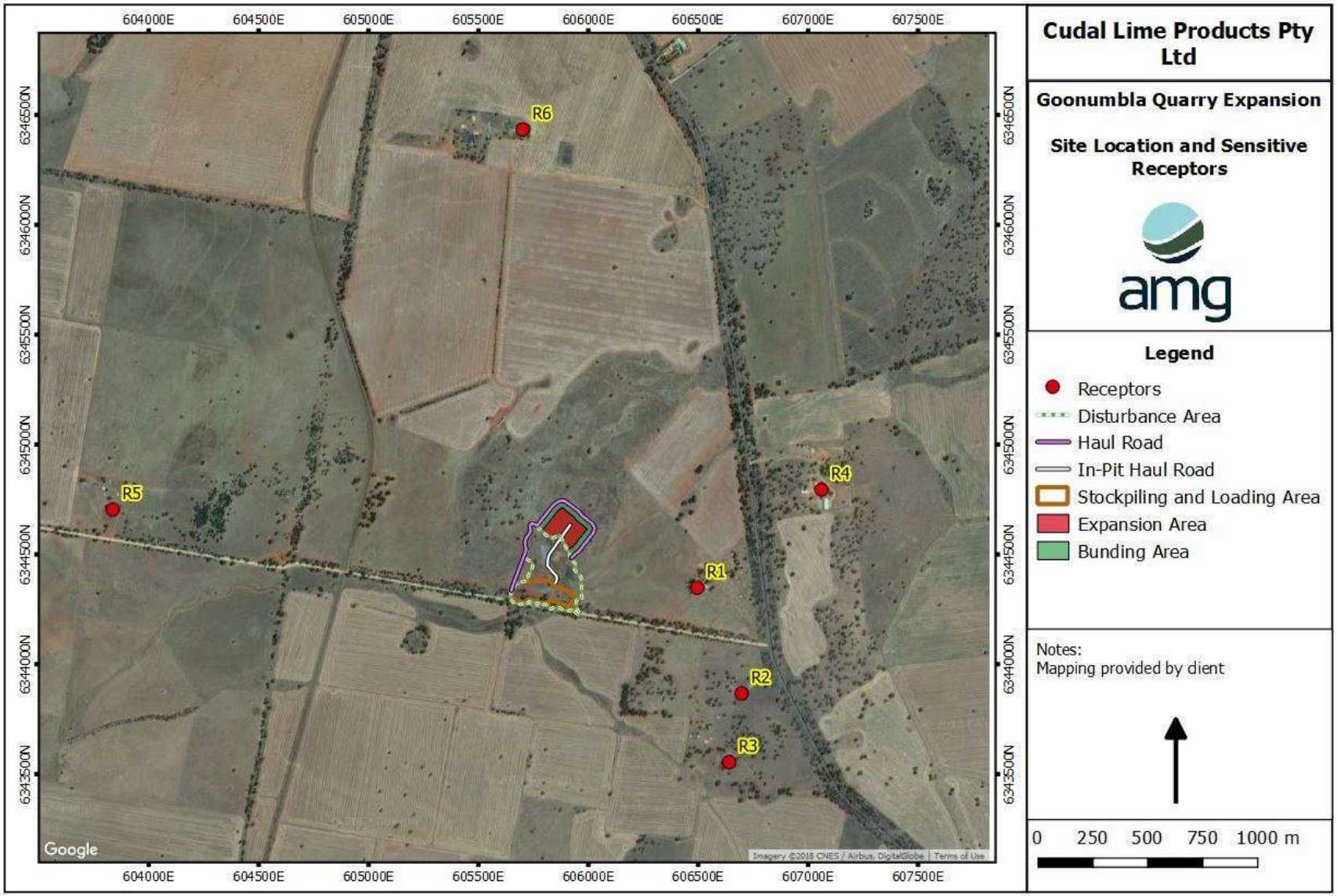


Figure 2: Site Location and Sensitive Receptors

3 OPERATIONAL PHASE NOISE ASSESSMENT

3.1 Operational Noise Criteria

3.1.1 Overview

The acoustic assessment has been completed in accordance with the procedure identified in the NSW NPfI. The NPfI establishes two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. These two criteria are then used to determine project triggers levels against which the proposed development will be assessed. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response.

The derivation of the two sets of criteria are presented below. For residential dwellings, the noise criteria are assessed at the most-affected point (i.e. highest noise level) on or within the property boundary. Where the property boundary is more than 30 m from the house, then the criteria applies at the most-affected point within 30 m of the house. For industrial receptors, compliance with the noise criteria is assessed at the reasonably most-affected point on or within the property boundary.

3.1.2 Intrusiveness Noise Criteria

The project intrusiveness noise level is intended to protect against significant changes in noise levels as a result of industrial development. To achieve this, the NPfI describes intrusive noise as noise that exceeds background noise levels (as defined by the Rating Background Level or RBL) by more than 5 dB.

For the purposes of the assessment, baseline noise levels have been assumed to be equivalent to the minimum background noise levels provided in the NPfI. At some receptors, where there is likely to be an influence during day periods from existing industrial activity in the area, this is considered to represent a conservative assumption. Table 8 presents the derivation of the intrusiveness criteria based on the minimum background noise level established by the NPfI.

Table 4: Derived Intrusiveness Noise Criteria

Receptor	Intrusiveness $L_{Aeq,15\text{-minute}}$ Criteria		
	Day	Evening	Night
All nearby residential receptors [a)]	40 [b)]	35 [b)]	35 [b)]

a) Receptor noise limit applied at a location 30 m from the dwelling façade.

b) Minimum background noise level established by the NPfI 2017

3.1.3 Amenity Criteria

The project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Review of the surrounding area has identified that the proposed quarry represents an isolated activity in an otherwise rural environment. Given this, further industrial activity in the area is considered unlikely.

Therefore, in accordance with the NPfI, the project amenity noise criteria are derived in Table 5 below for the residential uses in the area.

Table 5: NPfI Acceptable Noise Levels for Residential Receivers

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, (dB(A))	
			Total Industrial Noise	Project Specific[a)]
Residence	Rural	Day	50	50
		Evening	45	45
		Night	40	40

a) Taken to be equivalent to the recommended amenity noise levels given the absence of existing or future industrial development in the area.

3.1.4 Project Trigger Levels

The project trigger level is the lower value of the project intrusiveness noise level and the project amenity level, after the conversion to $L_{Aeq,15min}$ dB(A) equivalent level. Table 6 presents the standardised intrusiveness noise level and the project amenity level as derived by adding 3 dB to each period of the day.

Table 6: Determining Project Trigger Levels

Type of Receiver	Time of Day	Standardised $L_{Aeq,\ 15\ min}$ Noise Level (dB)		
		Intrusiveness Criteria	Project Specific ANL	Project Trigger Level
Residential	Day	40	50 + 3 = 53	40
	Evening	35	45 + 3 = 48	35
	Night	35	40 + 3 = 43	35

a) Intrusive levels are only applied to residential receivers. For all other types ANL are used.

It is noted that the existing licence under which the facility operates (EPL 20288) has daytime noise limit of 35 dB(A). As described above however, derivation of the day-time noise limits in accordance with the recently published NPfI has resulted in a higher day-time noise limit of 40 dB(A).

Were the proponent to make an application for a quarry development at the site in the absence of the existing facility, this higher (40 dB(A)) noise limit would apply. Given this, adopting a lower noise limit consistent with the existing EPL for this assessment (and the regulation of noise emissions from the expanded quarry) would fail to deliver natural justice for the applicant. Therefore, for the purposes of this assessment, the noise limits derived in accordance with the NPfI have been adopted. Further, it is recommended that where the application is approved, the noise limits established for the expanded operation are consistent with the adopted noise limits.

3.1.5 Sleep Disturbance

NSW EPA have identified a screening assessment for sleep disturbance based on the night-time noise levels at a residential location. Where noise levels at a residential location exceed:

- $L_{Aeq,\ 15\ min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 whichever is the greater,

a detailed maximum noise level event assessment should be undertaken.

The proposed quarry does not operate at night time, therefore sleep disturbance as a result of this project is not an issue.

3.2 Noise Sources

Table 7 and Table 8 presents a summary of the source noise levels considered in the assessment. The sound power levels for the plant and equipment presented in the table below are as provided by the manufacturer or taken from information held in our library.

Table 7: Source Noise Levels (Existing Equipment)

Source	Qty	Location	Sound Power Level (dB(A))
Drilling	1	Pit	116
Dozer with heavy ripper	1	Overburden stripping	115
Excavator	2	Pit	103
Front End Loader	2	Quarry	107
Mobile jaw crusher	2	Pit	118 a)
Cone /Screen mobile plant	2	Pit	115 a)
Haulage Trucks	1	Quarry	108
Conveyors (per metre)	9	Pit	89
Conveyor motors	1	Pit	100
Semi-trailer (32 tonne)	60/day	Loading area	110
Light vehicle	14/day	Access road	92

a) Based on previous experience with similar sources there is potential for tonal influences associated with this source. Therefore, in accordance with the NPFI, a +5 dB penalty has been applied to this source.

Table 8: Source Noise Levels (New Equipment)

Source	Qty	Location	Sound Power Level (dB(A))
Cone crusher	1	Aggregate plant	115 a)
Feeder (1) and screens (2)	3	Aggregate plant	118 a)
Conveyors (per metre)	9	Aggregate plant	89
Conveyor motors	1	Aggregate plant	100

a) Based on previous experience with similar sources there is potential for tonal influences associated with this source. Therefore, in accordance with the NPFI, a +5 dB penalty has been applied to this source.

3.3 Noise Modelling Methodology

For the purposes of predicting impacts associated with noise emissions from the development site on nearby sensitive receptors, noise modelling of the sources was completed using the proprietary software CadnaA (version 2018 build 161.4800) developed by DataKustik. CadnaA incorporates the influence of meteorology, terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions have been undertaken in accordance with ISO Standard 9613 (1996) Acoustics - Attenuation of sound during propagation outdoors.

The model is utilised to assess the potential noise emissions from the site under a range of operating scenarios and meteorological conditions. The noise modelling also allows investigation of possible noise management solutions, in the event that non-compliance with the assessment criterion is predicted.

3.4 Meteorology

The NPfI presents guidelines for the consideration of meteorological effects on noise propagation. Specifically, temperature inversions and/or gradient winds should be modelled if each factor is a feature of the local environment. The following conditions for modelling temperature inversions or gradients winds are provided:

- Temperature inversions:
  - Use default parameters for temperature inversions and drainage-flow wind speed where inversions are present for at least 30 percent of the total night time during winter as specified; or
  - Use parameters determined by direct measurement. Wind data should be collected at a 10 m height.
- Gradient winds:
  - Where there is 30 percent or more occurrence of wind speeds below 3 m/s (source-to-receiver component), then the highest wind speed (below 3 m/s) is used instead of the default.
  - Where there is less than 30 percent occurrence of wind speeds of up to 3 m/s (source-to-receiver component), wind is not included in the noise prediction calculation.

Given the location of the site, the presence of temperature inversions is considered possible for night-periods. Therefore, in accordance with the requirements of the NPfI, the following scenarios have been considered:

- Day Periods - Source to receptor wind at 3 m/s representing a worst-case assessment of potential impacts for day-periods; and
- Night Periods - Moderate temperature inversion with light source to receptor winds representing a worst-case assessment of potential impacts for night periods.

3.5 Predicted Noise Levels

3.5.1 Expanded Quarry Operations

There are two phases to the expansion of the quarry; the initial phase of overburden stripping and quarrying relatively near the surface and subsurface quarrying as the project progresses.

The initial phase of the quarrying has been considered as a worst-case scenario during the expansion of the quarry as the operations are closest to the surface and therefore are not benefiting from the noise mitigation provided by the pit walls. Table 9 below presents predicted receptor noise levels during the initial phase of the expanded operational phase of the quarry.

The modelling results have identified exceedences at sensitive receptors R1 and R2 are possible as a result of noise emissions from stripping activities, the new aggregate plant and drilling activities. It is noted that the results of the modelling indicate that the highest noise levels will occur at R1, with an exceedence of up to 2 dB(A) during the stripping phase. However, these activities are short-term in nature. As the depth of the pit increases, the predicted noise levels at the receptors will also decrease. Subsequently, when rock extraction is occurring at a depth of 20 m, there is no predicted exceedence of the project trigger level at R1. The predicted noise contours are presented in Appendix B.

Table 9: Predicted Daytime Receptor Noise Levels – Expanded Operational Phase, dB(A)

Receptor	Predicted Operational Noise Levels, $L_{Aeq, 15min}$			Day Trigger Level Criteria	Comply (Y/N)
	Stripping Phase	Initial Phase	Subsurface Phase		
R1	42	40	36	40	N/Y/Y
R2	36	41	39	40	Y/N/Y
R3	31	38	35	40	Y/Y/Y
R4	31	29	24	40	Y/Y/Y
R5	<20	<20	<20	40	Y/Y/Y
R6	<20	<20	<20	40	Y/Y/Y

3.5.2 Mitigation of Potential Impacts

In order to mitigate potential noise impacts at sensitive receptor R1 the assessment considered a range of mitigation options for the long-term operation of the quarry. Specifically, the modelling has considered implementation of the following mitigation measures:

- Initial phase:
  - Using a silenced rock drill as part of all drill and blast activities;
- Both phases:
  - Installation of a 5 m high, 12 m long noise barrier to the east of the aggregate plant; and

- Lining the aggregate plant hopper feed bin with material to minimise the impact noise.

Table 10 presents the mitigated predicted L_{Aeq} noise levels for the initial and subsurface phases. The predicted noise contours are presented in Appendix B.

Table 10: Predicted Daytime Receptor Noise Levels – Expanded Operational Phase with Mitigation, dB(A)

Receptor	Predicted Operational Noise Levels, $L_{Aeq, 15min}$		Day Trigger Level Criteria	Comply (Y/N)
	Initial Phase	Subsurface Phase		
R1	36	34	40	Y/Y
R2	38	37	40	Y/Y
R3	35	34	40	Y/Y
R4	25	23	40	Y/Y
R5	<20	<20	40	Y/Y
R6	<20	<20	40	Y/Y

Review of the predicted noise levels with mitigation confirms that compliance with the noise limits could be achieved with the recommended mitigation.

4 ROAD TRAFFIC NOISE ASSESSMENT

4.1 Introduction

Noise impacts associated with vehicle movements during the operational phase of the Project are not expected to increase compared to the existing operations. Heavy vehicle movements are based on a maximum annual tonnage of product transported off-site to customers of 150,000 tonnes, transported on 5.5 days of each week.

Throughout the Project, it is anticipated that up to seven (7) employee (light) vehicles will travel to and from the site daily. The staff vehicles will arrive prior to 7 am hours and leave the site after 6 pm hours).

The number of heavy vehicles accessing the site would not exceed 30 (i.e. generating a total of 60 heavy vehicle movements in a day).

Given this, the assessment has considered the potential impacts associated with noise emissions from the maximum expected 14 light and 60 heavy vehicle movements from the site entry along the local access road (Wyatts Lane) via Bogans Road as summarised in Table 11 below.

Table 11: Summary of Road Traffic Data

Road Segment	Vehicle Type	Vehicle Speed	Number of Movements	
			Day (7 am to 10 pm)	Night (Peak 1-hour)
Wyatts Lane	Light	60 km/hr	7	7
	Heavy	40 km/hr	60	0
Bogans Road	Light	100 km/hr	7	7
	Heavy	80 km/hr	60	0

4.2 Assessment Criteria

Noise criteria provided in the NSW Road Noise Policy (RNP) is based on the type of roadway. Table 12 below presents the applicable road traffic noise criteria for existing residences affected by traffic on existing roadways generated by land use developments.

Table 12: Applicable Road Traffic Noise Criteria

Road Category	Type of Project & Land Use	Assessment Criteria
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	Day: $L_{Aeq,1\ hour}$ 55 dB(A) Night: $L_{Aeq,1\ hour}$ 50 dB(A) (external)

4.3 Noise Modelling Methodology

For the purposes of predicting impacts associated with road traffic noise emissions was completed using the proprietary software CadnaA (version 2018 build 161.4800) developed by DataKustik. The model incorporates the influence of terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor

locations. All predictions have been undertaken in accordance with Calculation of Road Traffic Noise (CRTN) methodology developed by the UK Department of Transport. In accordance with the requirements of the RNP, the predictive noise modelling incorporated the following assumptions:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the CRTN methodology using the approximation $L_{Aeq,1\ hour} = L_{A10,1\ hour} - 3$.
- Noise source heights were set at 0.5 m above road level for cars, 1.5 m for heavy vehicle engines and 3.6 m for heavy vehicle exhausts.
- Noise from heavy vehicle exhausts is 8 dB lower than the steady continuous engine noise; and
- Corrections established for Australian conditions applied through a negative correction to the CRTN predations of -1.7 dB for façade-corrected levels (Samuels and Sauders, 1982).

Table 13 below presents predicted noise levels for the nearest residential receptor to Bogan Road which is setback at a distance of 160 m from the Bogan Road. This is considered to be representative of all dwellings in the area.

Review of the predicted noise level presented in Table 13 below confirms that compliance with the RNP is predicted and adverse amenity impacts due to peak traffic levels generated by the proposed construction works is considered unlikely.

Table 13: Predicted $L_{Aeq,15\ hour}$ Noise Levels - Road Traffic Noise

Receptor	Setback from Roadway	Period	Parameter	Criteria	Predicted Noise Level	Comply (Y/N)
Closest dwelling to Bogan Road	160 m	Day	$L_{Aeq,\ 1hour}$	55 dB(A)	41	Y
		Night	$L_{Aeq,\ 1hour}$	50 dB(A)	31	

5 VIBRATION ASSESSMENT

5.1 Introduction

A review of the proposal indicates there is potential for impacts as a result of vibration generated by plant and equipment during the operational phases. Given this, an assessment of the potential for vibration impacts has been undertaken. In particular, the assessment has considered the potential for impacts on both human comfort and structural damage for the nearest residence to the quarry expansion.

5.2 Assessment Criteria

The vibration criteria presented in the Environmental Noise Management – Assessing Vibration: A Technical Guide (2006) published by the NSW Department of Environment Climate Change and Water (DECCW) have been adopted for the assessment. The technical guide provides vibration criteria associated with amenity impacts (human annoyance) for the three categories of vibration:

- Continuous vibration (e.g. road traffic, continuous construction activity);
- Impulsive vibration includes less than 3 distinct vibration events in an assessment period (e.g. occasional dropping of heavy equipment); and
- Intermittent vibration includes interrupted periods of continuous vibration (e.g. drilling), repeated periods of impulsive vibration (e.g. crushers) or continuous vibration that varies significantly in amplitude.

Table 14 and Table 15 present the criteria for continuous and impulsive vibration and intermittent vibration, respectively.

Table 14: Continuous & Impulsive Vibration Criteria for Residences – Peak Velocity

Location	Vibration Type	Preferred Limit (mm/s)	Maximum Limit (mm/s)
Residences	Continuous	0.28	0.56
Residences	Impulsive	8.6	17

Table 15: Intermittent Vibration Criteria for Residences

Location	Assessment Period	Preferred Value ($m/s^{1.75}$)	Maximum Value ($m/s^{1.75}$)
Residences	Day-time	0.20	0.40

The above criteria are suitable for assessing human annoyance in response to vibration levels. In order to assess potential damage to buildings, reference has been made to British Standard BS 7385-2: 1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration. Table 16 presents vibration criteria for assessing the potential for building damage.

Table 16: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak Particle Velocity (mm/s)	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures – residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

For blasting, in addition to the criteria provided in the DEC technical guideline, reference has also been made to the Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZECC 1990). Table 17 provides a summary of the criteria applied in the assessment of potential blasting vibration and airblast overpressure levels.

Table 17: Blasting Vibration Criteria

Criteria	Values
Airblast Overpressure	The recommended maximum level for airblast overpressure is 115 dB(Lin Peak). The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the level should not exceed 120 dB (Lin Peak) at any time.
Peak Particle Velocity	The recommended maximum level for ground vibration is 5 mm/sec (peak particle velocity (ppv)). The ppv level of 5 mm/sec may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/sec at any time. However, it is recommended that a level of 2 mm/sec (ppv) be considered as the long term regulatory goal for the control of ground vibration.

5.3 Assessment of Impacts – Operations (excluding Blasting)

5.3.1 Potential Vibration Sources

Table 18 identifies the vibration source levels for the equipment and likely to be used for the expansion of the quarry. It should be noted there are no vibration source levels for processing plant.

Table 18: Vibration Source levels – Peak Particle Velocity

Equipment Item	PPV at 10 metres (mm/s)	Source
Loaded trucks (rough surface)	5	USA DT [a)]
Loaded trucks (smooth surface)	1 – 2	USA DT [a)]
Excavator	2.5 – 4	DECCW

b) Transit Noise and Vibration Impact Assessment, US Department of Transportation, May 2006.

c) Rockhill, D.J., Bolton, M.D. & White, D.J. (2003) 'Ground-borne vibrations due to press-in piling operations'

5.3.2 Assessment of Potential Impacts

Based on the vibration source levels at 10 metres (presented in Table 18), peak particle velocities have been predicted at various separation distances. The NSW DECCW indicates that in predicting vibration levels, it can be assumed that the vibration level is inversely proportional to distance (with the relationship varying between $d^{-0.8}$ to $d^{-1.6}$ based on field data).

The US Department of Transportation's Transit Noise and Vibration Impact Assessment (May 2006) presents the following construction vibration propagation formula assuming an inverse relationship:

$$PPV@d_2 = PPV@d_1 \times (d_1/d_2)^{1.5}$$

where: d_1 = distance 1 (reference distance for source data) (m)
d_2 = distance 2 (separation distance for predicted PPV) (m)
PPV = peak particle velocity (mm/s)

The above formula has been considered for predicted PPVs at various distances from construction equipment. Based on the above information, Table 19 presents PPV predictions for the various construction equipment.

Table 19: Predicted Peak Particle Velocity at Sensitive Receptors (mm/s)

Distance from Source (m)	Predicted Peak Particle Velocity (mm/s)		
	Excavator	Loaded trucks (rough surfaces)	Loaded trucks (smooth surfaces)
10	4.00	5.00	1 – 2
20	1.41	1.77	0.35 – 0.71
30	0.77	0.96	0.19 – 0.38
40	0.50	0.63	0.13 – 0.25
50	0.36	0.45	0.09 – 0.18
60	0.27	0.34	0.07 – 0.14
70	0.22	0.27	0.06 – 0.11
80	0.18	0.22	0.05 – 0.09
90	0.15	0.19	0.04 – 0.07
100	0.13	0.16	0.03 – 0.06
150	0.07	0.09	0.02 – 0.03
Type	Continuous	Intermittent	Intermittent
Nuisance Criteria	Residential 0.28 (preferred) / 0.56 (max) School 0.56 (preferred) / 1.1 (max)	Residential 8.6 (preferred) / 17 (max)	
Building Criteria	Residential 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above		

The predicted vibration levels presented in Table 19 indicate compliance with the continuous preferred vibration nuisance criteria for locations at a separation distance of 50-60 metres. Compliance with the building damage criteria is predicted at 10 metres from operations for each source.

For intermittent vibration associated with haul vehicles, it is difficult to provide an appropriate comparison with the relevant criteria (which is presented as a Vibration Dose Value (VDV) in $m/s^{1.75}$). The calculation of a VDV requires both the overall weighted RMS (root mean square) acceleration (m/s^2) typically obtained from on-site measurements and the estimated time period for vibration events.

It is noted, however, that haul truck movements (on rough surfaces) at distances of >80 m is predicted to be within the maximum continuous criteria of 0.56 mm/s. This comparison with the continuous criteria (as a conservative approach) indicates that vibration levels associated with operation of the quarry are not considered to be significant (which is expected given the significant separation distances).

5.4 Assessment of Impacts - Blasting

5.4.1 Airblast Overpressure

Airblast levels have been estimated using the following equation from AS 2187.2-2006 "Explosives - Storage and use - Use of explosives":

$$P = K_a \left(\frac{R}{Q^{1/3}}\right)^a$$

Where:

P = pressure (kPa)
Q = explosives mass charge (kg)
R = distance from charge (m)
K_a = site constant (10 – 100)
A = site exponent (-1.45)

Applying a site constant (K_a) of 10 for receptor R1, a maximum instantaneous charge (MIC) of 100 kg results in predicted compliance with the criteria of 115 dB(Lin Peak) at all nearby receptors.

5.4.2 Ground Vibration

Ground vibration levels have been estimated using the following equation from AS 2187.2-2006 "Explosives - Storage and use - Use of explosives":

$$V = K_g \left(\frac{R}{Q^{1/2}}\right)^{-B}$$

Where:

V = ground vibration as PPV (mm/s)
Q = explosives mass charge (kg)

R = distance from charge (m)
K_g = site constant (1140)
B = site constant (1.6)

Applying the maximum instantaneous charge as determined from the air blast overpressure calculation of 100 kg, the ground vibration level predicted to occur at receptor R1 is 2 mm/s, which complies with the criteria of 5 mm/sec and the long term regulatory goal of 2 mm/s.

It should be noted however that the impacts of blasting are dependent on site specific factors including the blast management techniques, ground conditions and geological strata types and locations. Given this, it is recommended that the maximum instantaneous charge be determined by the blast contractor using site specific data as part of the blast management plan for the quarry expansion.

6 CONCLUSIONS AND RECOMMENDATIONS

Cudal Lime Products propose to expand the open pit of the Goonumbla Quarry. To confirm the suitability of acoustic amenity at the site for residential uses, a noise impact assessment has been undertaken. Specifically, the assessment has considered the potential for adverse impacts upon existing residential uses as a result of the operation of the expanded quarry.

The impact assessment has considered the potential for adverse impacts resulting from noise (road traffic and operational) and vibration emissions on nearby uses.

Predictive noise modelling has been undertaken for the expanded quarry to assess the potential impacts of noise emissions including overburden stripping, drilling, haulage trucks and the new aggregate plant. Review of the predicted noise levels with mitigation confirms that compliance with the noise limits could be achieved with the following mitigation measures:

- Initial phase:
  - Using a rock drill with a shroud to minimise noise;
- Both phases:
  - Installation of a 5 m high, 12 m long noise barrier to the east of the aggregate plant; and
  - Lining the aggregate plant hopper feed bin with material to minimise the impact noise.
  - Clearing and stripping will be undertaken such that only the minimum area necessary is cleared/stripped to conduct operations. All stripped soils are to be separated (topsoil and subsoils) and stockpiled in the proposed bunding area for future rehabilitation works. To assist in the mitigation of potential off-site noise impacts, stockpiled material is to be formed into earth bunds along with edges of the disturbance area.
  - The maximum instantaneous charge is to be determined by the blast contractor using site specific data as part of the blast management plan for the quarry expansion such that the peak particle velocity and airblast overpressure criteria can be achieved.

To achieve the acoustic objectives, all acoustic barriers should be constructed in a manner that meets the following requirements:

- Reflective type noise fence panels must have a minimum surface density at air dry moisture content (excluding structural components) of 12 kg/m²;
- The barrier must be complete and free from gaps along its length and at ground level; and
- Acoustic sealing is required between posts.

The acoustic barrier could also comprise either two stacked shipping containers, or an earth berm (or a combination of earth berm and noise barrier) providing the final height of 5 m is achieved.

Additionally, best practice noise control methods should be adopted, including:

- Using broad-band reversing alarms on all mobile plant and equipment;

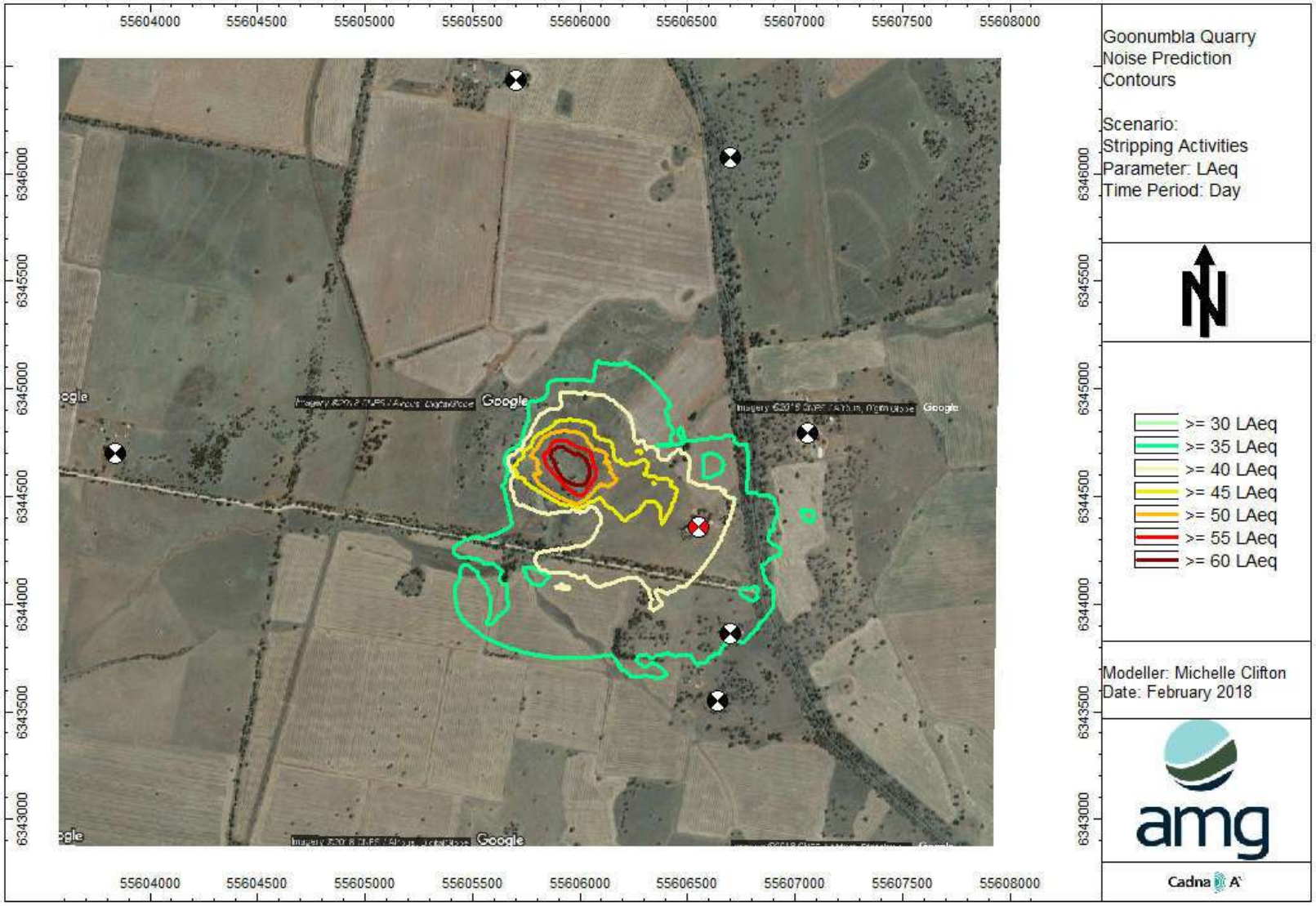
- Select quieter items of plant and equipment where feasible and reasonable.;
- Operating plant in a quiet and efficient manner;
- Reduce throttle setting and turn off equipment when not being used; and
- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.

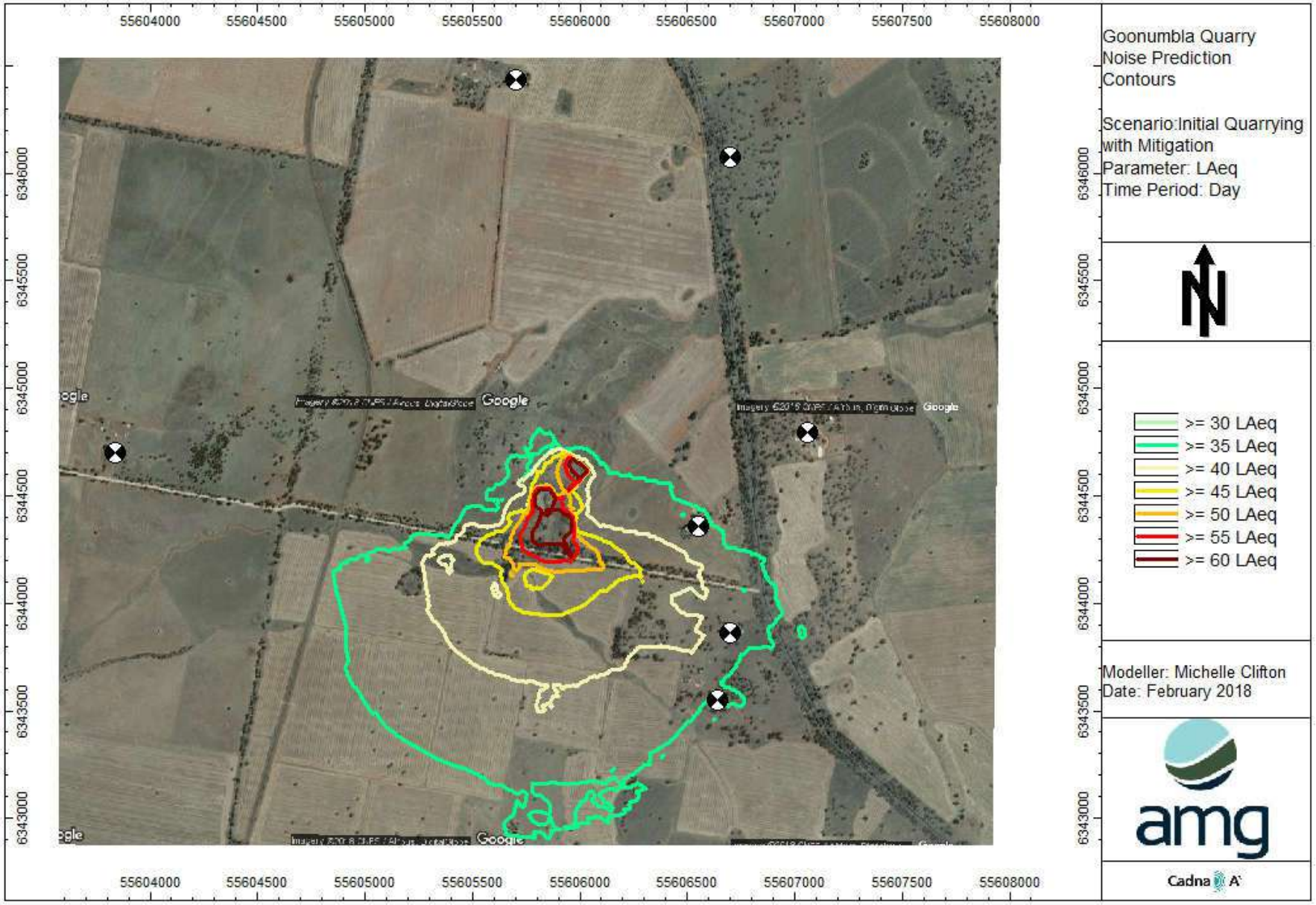
Overall, based on the results of the assessment, the risk of adverse impacts as a result of the Project, including blasting is considered to be low and complies with all applicable criteria.

APPENDIX A: GLOSSARY OF TERMS

A-Weighting	A response provided by an electronic circuit which modifies sound in such a way that the resulting level is similar to that perceived by the human ear.
dB (decibel)	This is the scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and the reference pressure (0.00002 N/m^2).
dB(A) or dBA	This is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Free-field	Refers to a sound pressure level determined at a point away from reflective surfaces other than the ground with no significant contribution due to sound from other reflective surfaces; generally, as measured outside and away from buildings.
L_{Aeq}	This is the equivalent steady sound level in dB(A) containing the same acoustic energy as the actual fluctuating sound level over the given period. Noise levels often fluctuate over a wide range with time. Therefore, when a noise varies over time, the L_{Aeq} is the equivalent continuous sound which would contain the same sound energy as the time varying sound. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

APPENDIX B: PREDICTED NOISE CONTOURS

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Modeller: Michelle Clifton
Date: February 2018
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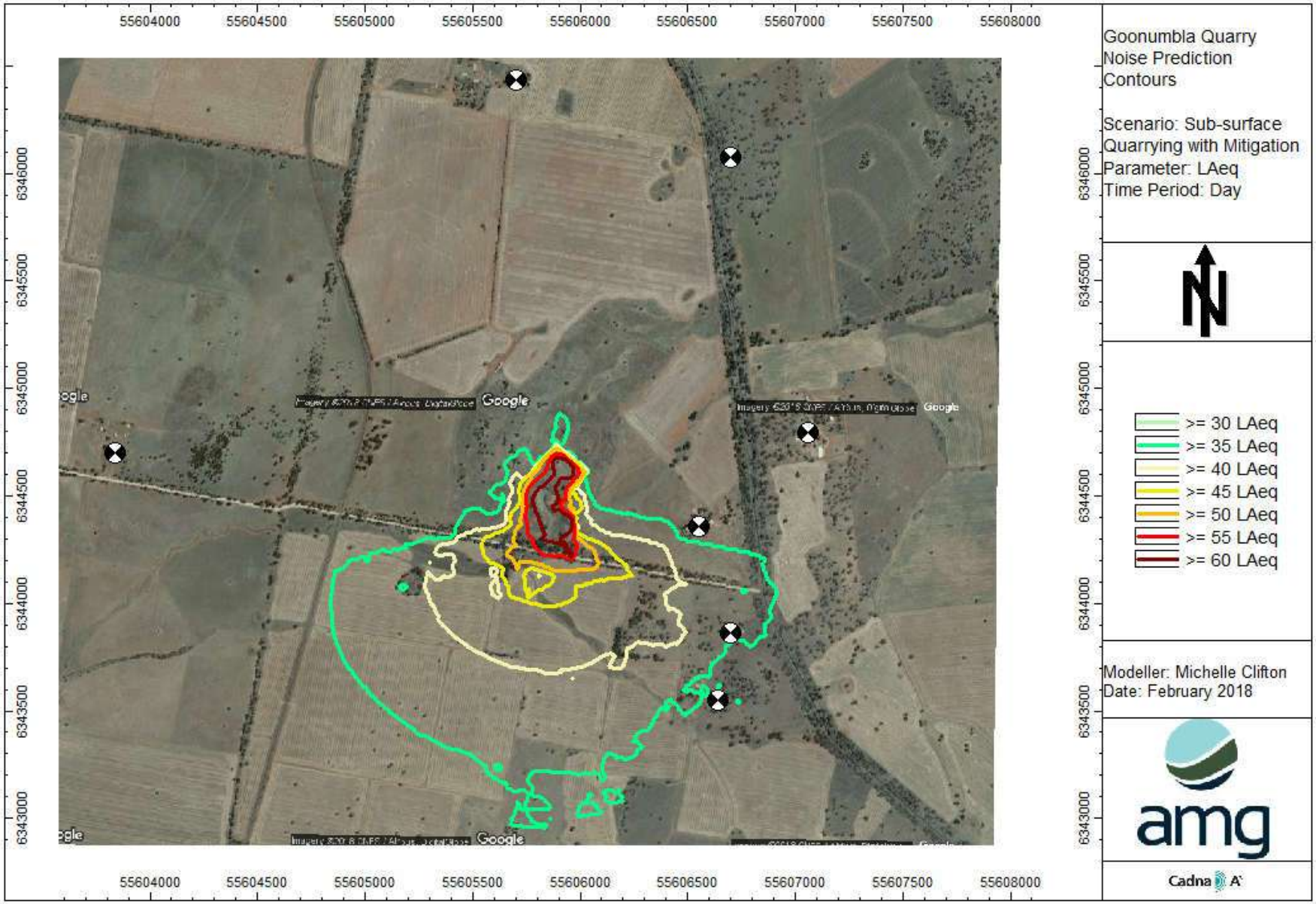
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Google
Goonumbla Quarry
Noise Prediction
Contours
Scenario: Sub-surface
Quarrying with Mitigation
Parameter: LAeq
Time Period: Day
N
>= 30 LAeq
>= 35 LAeq
>= 40 LAeq
>= 45 LAeq
>= 50 LAeq
>= 55 LAeq
>= 60 LAeq
Modeller: Michelle Clifton
Date: February 2018
amg
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Appendix F

AIR QUALITY ASSESSMENT

GOONUMBLA QUARRY: AIR QUALITY ASSESSMENT

AUSROCK QUARRIES PTY LTD

Project ID. 11104

R_4

DATE OF RELEASE: 13/03/2018

Assured Monitoring Group

ABN: 87 604 851 078

Unit 7, 142Tennyson Memorial Avenue – Tennyson – Queensland - 4105

Table 1: Document Approval

	Name	Position Title	Signature	Date
Author	Michelle Clifton	Senior Consultant	[redacted]	13.03.2018
Reviewer	Craig Beyers	Manager Consulting Services		13.03.2018
Approver	Craig Beyers	Manager Consulting Services		13.03.2018

Table 2: Revision Register

Revision	Date	Name	Issued to	Comment
R_0	06.02.2018	C. Beyers	C. Bigg	Formal report release
R_1	12.02.2018	C. Beyers	C. Bigg	Comments
R_2	19.02.2018	C. Beyers	C. Bigg	Comments
R_3	08.03.2018	C. Beyers	C. Bigg	Comments
R_4	13.03.2018	C. Beyers	C. Bigg	Revised traffic data

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1 INTRODUCTION

1.1 Scope of Assessment

The Assured Monitoring Group was appointed by Ausrock Quarries Pty Ltd to undertake an air quality assessment for the expansion of the Goonumbla Quarry (the Project) involving the extension of the existing open-cut pit on within a single land parcel (Lot 32 on DP816454).

The air quality study has been undertaken to assess the potential operational impacts of the proposed extension on nearby sensitive receptors in accordance with Approved Methods for Modelling and Assessment of Air Pollutants in NSW (EPA, 2016).

In accordance with the requirements of the above guidelines, Level 2 computational modelling has been undertaken to assess the potential for adverse air quality impacts as a result of the operation of the expanded quarry.

1.2 This Report

This report summarises the methodology, results and conclusions of the air quality impact assessment. A glossary of terms is presented in Appendix A to assist the reader.

2 PROPOSED DEVELOPMENT

2.1 Development Site

The proposed Development Site is located approximately 10 km north of Parkes in New South Wales. Specifically, the Project is to be constructed within the boundary of Lot 32 on DP816454.

The area surrounding the proposed development includes a range of agricultural and rural uses. Figure 1 presents the layout of the site and Figure 2 provides the site location in the context of the surrounding uses.

2.2 Nearby Sensitive Receptors

The nearest off-site residential receptors to the proposed extension of the quarry include six (6) single existing dwellings located within two (2) km of the Project.

Figure 1 and Table 3 below provide a summary of the nearest sensitive uses to the proposed development.

Table 3: Nearby Sensitive Receptors

Receptor ID	Description	Distance to Proposed Development Site
R1	Existing Dwelling	520 m
R2	Existing Dwelling (unoccupied)	865 m
R3	Existing Dwelling	960 m
R4	Existing Dwelling	1,160 m
R5	Existing Dwelling	1,910 m
R6	Existing Dwelling	1,710 m

2.3 Description of Development

2.3.1 Production Rate

The extension of the existing quarry is expected to provide for extraction and processing of up to 300,000 tonnes per year with a maximum of 150,000 tonnes expected to be transported by truck from the site via road and the remainder would be transported by truck to a nearby rail link, accessible via internal access roads; the future use of this access road does not form part of the scope of this assessment.

Rock extraction will be undertaken in two stages (see Figure 1):

- Stage 1 involves hard rock excavation of 545,000 m^3; and
- Stage 2 involves hard rock excavation of 179,700 m^3.

2.3.2 Operational Hours

The operation of the proposed quarry following the expansion will see rock extraction activities (including excavation, crushing, stockpiling) and loadout activities will occur between the hours of 7 am to 6 pm Monday to Friday and 7 am to 3 pm Saturdays. Blasting

at the quarry would be undertaken between the hours of 9 am and 5 pm Monday to Friday only. No activities are proposed to be undertaken on Sundays or public holidays.

2.3.3 Site Clearance

Clearing and stripping will only be undertaken within the proposed development footprint.

For the purpose of the assessment, it has been assumed that stripped material will be formed into earth mounds of a minimum 3 m in height around the pit expansion boundary of the extraction footprint as identified on Figure 1. An access road from the processing and loading area (southern extent of the site) will be established around the quarry extension to allow site (and bund) maintenance to occur.

2.3.4 Material Extraction

Recovery of hard rock material from the quarry will be undertaken primarily through drill and blast techniques. Specifically, this process involves drilling and blasting by a qualified contractor to generate fragment rock suitable for processing.

Given the capacity and expected production of the quarry, it is anticipated that approximately 6 blasts per year would be required. Each of these blast events would be undertaken following approximately one week of drilling activity to produce the necessary hole depth and pattern required to win the desired 30,000 – 50,000 tonnes of fragment rock material. Fragment rock material created by the blast would be loaded by excavator into CAT D350D haul trucks for transport to the mobile crushing plant located within the pit for processing.

2.3.5 Processing

Hard rock processing will occur in two phases:

- Primary crushing and screening (in pit); and
- Aggregate plant processing (in quarry).

Blasted material will be loaded directly into the primary mobile jaw crusher by an excavator. Crushed material would then be conveyed into a mobile cone crusher and screen. Product from the primary crushing includes ballast (20-65 mm) and fines (<20 mm). The plant (which is currently operational at the site) has a capacity of 300 tph.

The aggregate plant will be used to further process the 'fines' from the primary crusher. Following loading into the aggregate plant feed hopper, the material passes through a cone crusher and onto two screens to separate the different aggregates (20/14 mm, 10 mm, 7 mm, 5 mm, manufacturer sand, dust and road base). The plant has a capacity of 180 tph.

2.4 Assessment Phases

Typically, site clearing activities are included as part of the construction phase of a new quarry. However, as the Project is an existing quarry, site clearance is undertaken when the quarry progresses onto a new bench. As such for the purposes of this assessment, clearing activities will be considered part of the operational activities.

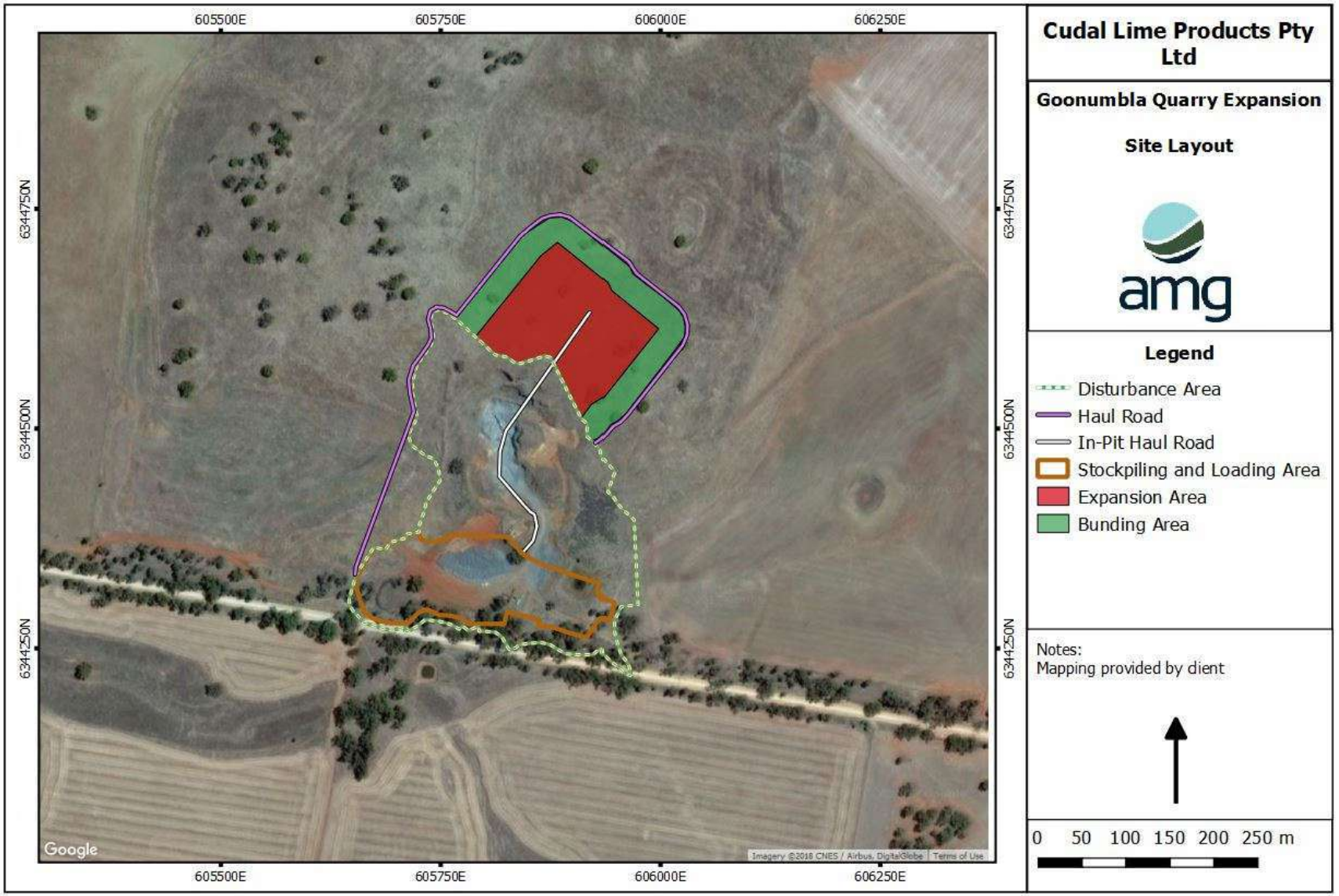


Figure 1: Site Layout

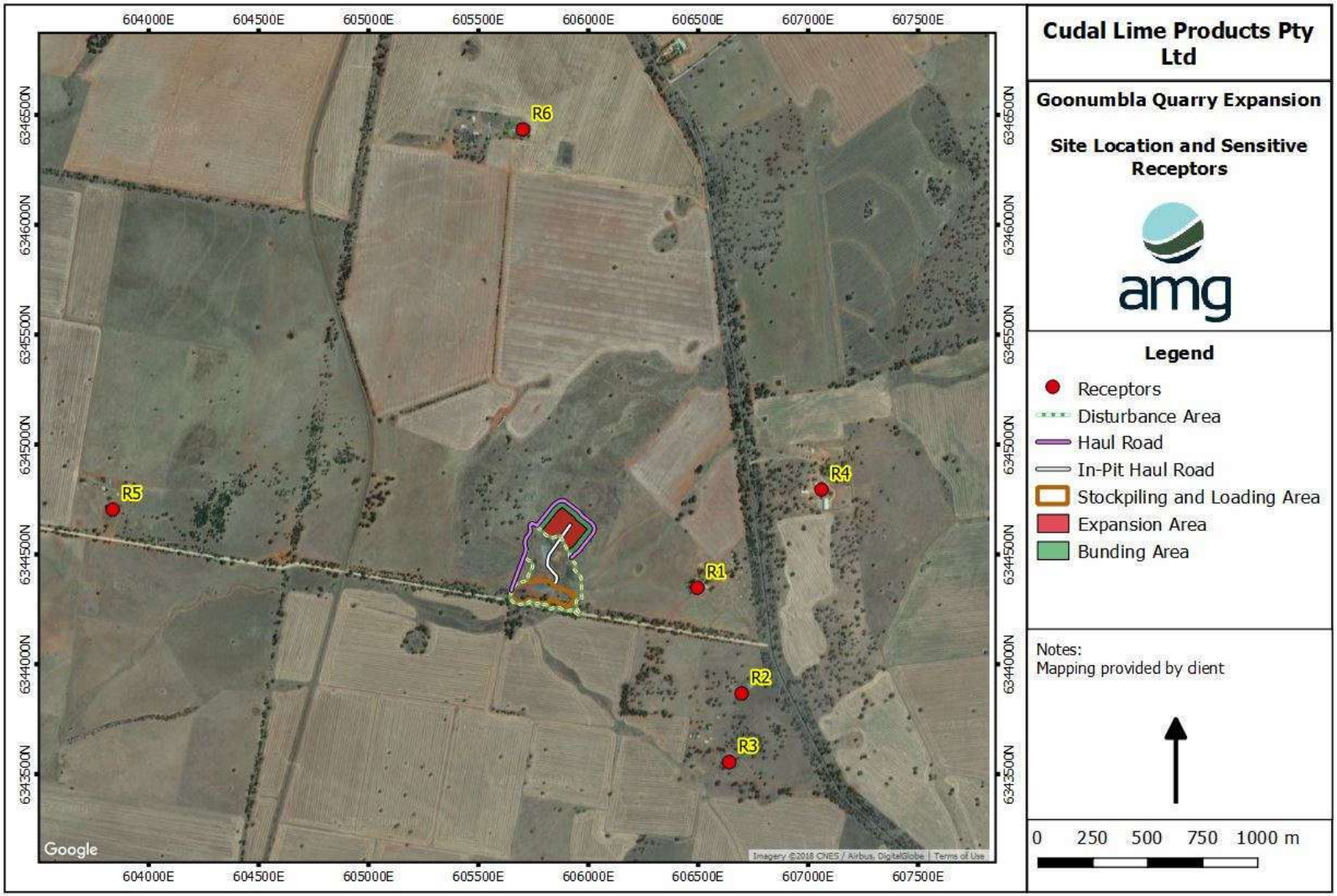


Figure 2: Site Location and Sensitive Receptors

3 ASSESSMENT CRITERIA

Assessment criteria relevant to this assessment are presented in the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2016), published by the NSW EPA. For the purposes of the assessment, Table 4 provides a summary of the criteria provided in the approved methods for those relevant to the operation of the expanded quarry.

Table 4: Approved Methods Emission Standards

Pollutant	Averaging Period	Concentration	
		pphm	µg/m^3
PM_{10}	24-hours	-	50
	Annual	-	25
$PM_{2.5}$	24-hours	-	25
	Annual	-	8
TSP	Annual	-	90
Deposited Dust	Month	-	2 g/m^2/month maximum increase
		-	4 g/m^2/month total dust level

4 MODELLING METHODOLOGY

4.1 Overview

Atmospheric dispersion modelling involves the mathematical simulation of the dispersion of air contaminants in the environment. The modelling utilises a range of information to estimate the dispersion of pollutants released from a source including:

- Meteorological data for surface and upper air winds, temperature and pressure profiles, as well as humidity, rainfall, cloud cover and ceiling height information;
- Emissions parameters including source location and height, source dimensions and physical parameters (e.g. Exit velocity and temperature) along with pollutant mass emission rates;
- Terrain elevations and land use both at the source and throughout the surrounding region; and
- The location, height and width of any obstructions (such as buildings or other structures) that could significantly impact on the dispersion of the plume.

For the purpose of the assessment, meteorological modelling has been undertaken using TAPM (The Air Pollution Model) and CALMET to predict localised meteorological conditions. The meteorological data derived from these models have been used as an input for the CALPUFF dispersion modelling.

4.2 TAPM Predictions

In accordance with the Approved Methods, a site specific meteorological dataset has been determined using the prognostic model TAPM (The Air Pollution Model). Prognostic models, such as TAPM, permit the development of localised meteorological datasets, based on synoptic weather conditions. The model predicts the regional flows important to dispersion, such as sea breezes and terrain induced flows, against a background of larger-scale meteorology provided by synoptic analyses. The output of this model, when used with a diagnostic meteorological model, such as CALMET, provides a meteorological dataset suitable for introduction into the diagnostic wind field results. This methodology is the recommended approach for the modelling of contaminant concentrations using CALMET.

Predictions of meteorological parameters for the year 2016 for the region in the surroundings of the Development Site were undertaken using TAPM (Version 4). The model was configured with a series of nested grids chosen to provide an appropriate communication and transfer of information from the broad synoptic to the local scale.

The model was configured to use a domain consisting of 25 x 25 x 25 grid points with nesting spacing of 30 km, 10 km, 3 km and 1 km.

4.3 Meteorological Modelling

4.3.1 Overview

A three-dimensional prognostic dataset derived from the TAPM model was input to CALMET to predict meteorological conditions near the Development Site. TAPM 2016 data has been used to allow for validation against historical meteorological data collected by the

Bureau of Meteorology at Forbes Airport. The following sections provide an overview of the data utilised in the CALMET modelling, along with details of some of the key parameters selected to establish calculation limits within CALMET.

4.3.2 Vertical Stations

For the purposes of the modelling, CALMET was initialised with a total of 12 vertical layers with layer boundaries at 20 m, 50 m, 75 m, 150 m, 200 m, 500 m, 750 m, 1,000 m, 1,500 m, 2,000 m, 3,000 m and 4,000 m respectively. The vertical levels used in the modelling were selected to provide the model with the ability to predict a generic range of atmospheric conditions near to the site.

4.3.3 Terrain and Land Use Data

Terrain height data was based on data from the Shuttle Radar Imaging Mission (SRTM), and obtained from the United States Geological Survey (USGS) web site. This produced terrain height data on a 3 arc-second longitude/latitude grid (approximately 0.03 km) for a grid domain of 16 km x 16 km encompassing the site region. Figure 3 below presents the modelling domain considered for both CALMET and CALPUFF along with the terrain variation observed across the domain. Land use data was also obtained from the USGS and incorporated into the CALMET model.

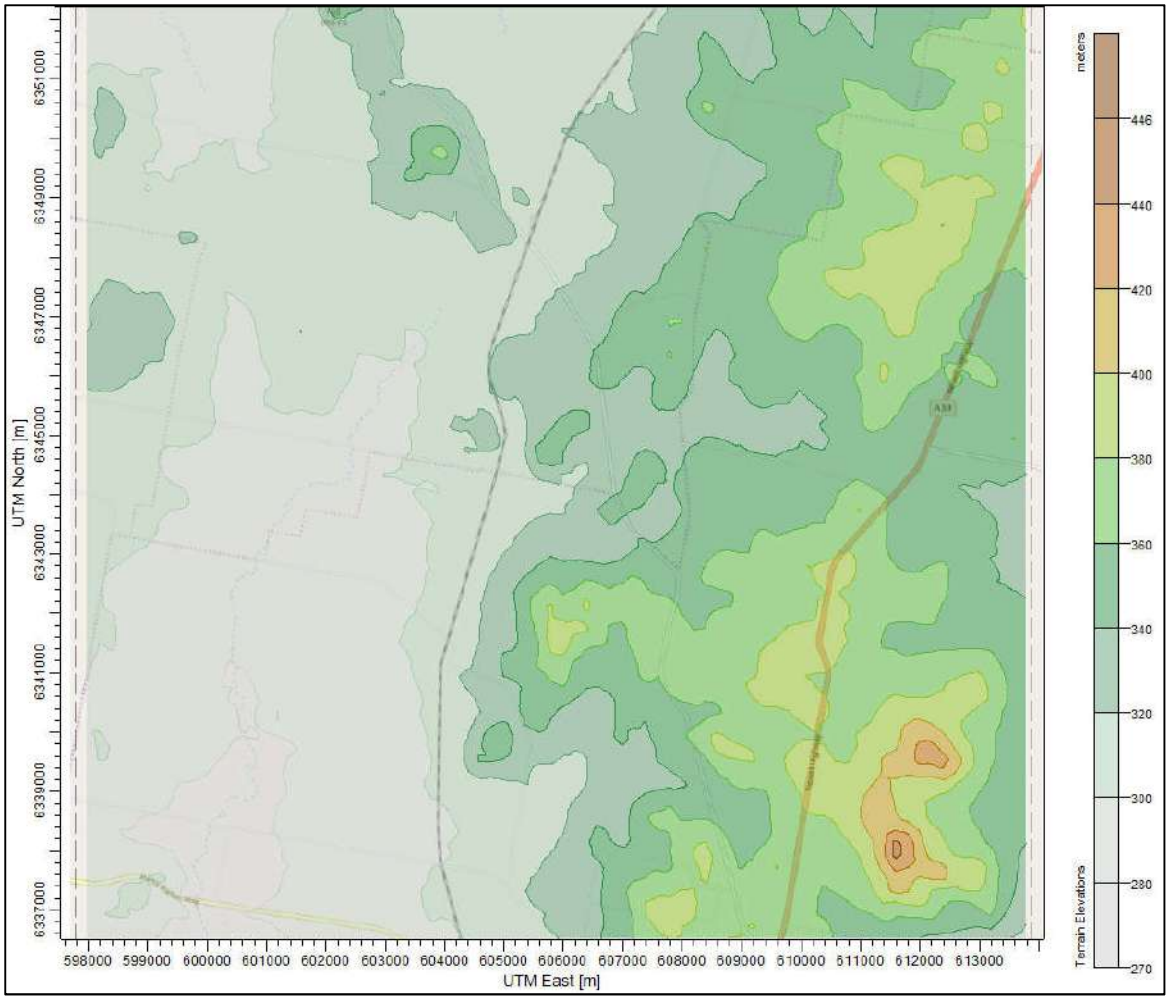


Figure 3: Terrain Across the Modelling Domain

4.4 Meteorology

4.4.1 Wind Predictions

Figure 4 presents the predicted 9 am and 3 pm wind roses respectively for the Development Site. Figure 5 presents historical wind roses for the BOM Parkes Airport station (number 65068) which is located approximately 14 km to the south east of the proposed Development Site. Historical data from Parkes Airport is used to assess the viability of the predicted data.

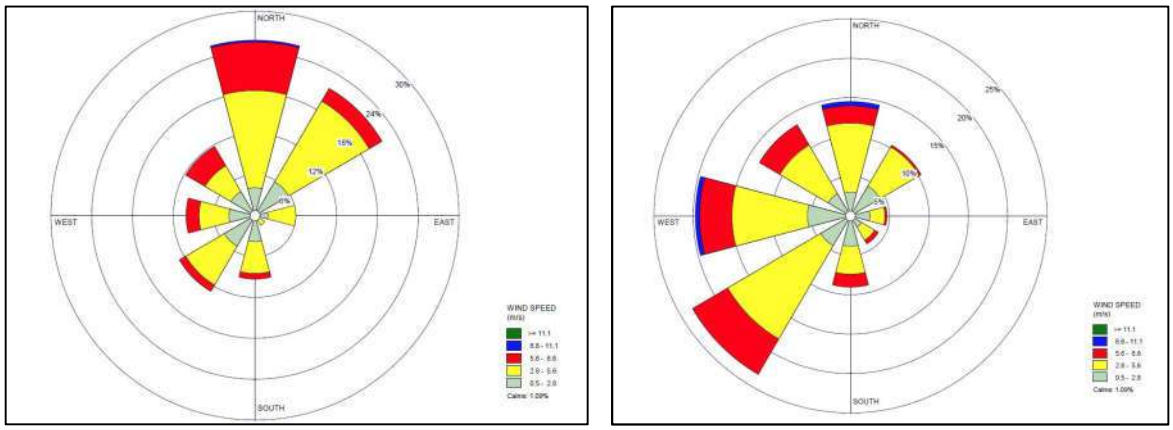
Comparison of the wind roses predicted for the Development Site (Figure 4) and observed data from Parkes Airport (Figure 5) predict the following wind conditions for the Development Site.

- North to North easterly winds are dominant in the morning (0900 hours);
- West to South Westerly winds are dominant in the afternoon (1500 hours);
- Predicted wind fields have a slightly lower proportion of easterly winds than the long term historical data from Parkes Airport at 9 am; and

- The occurrence of calm conditions is under-predicted by the model at 9 am.

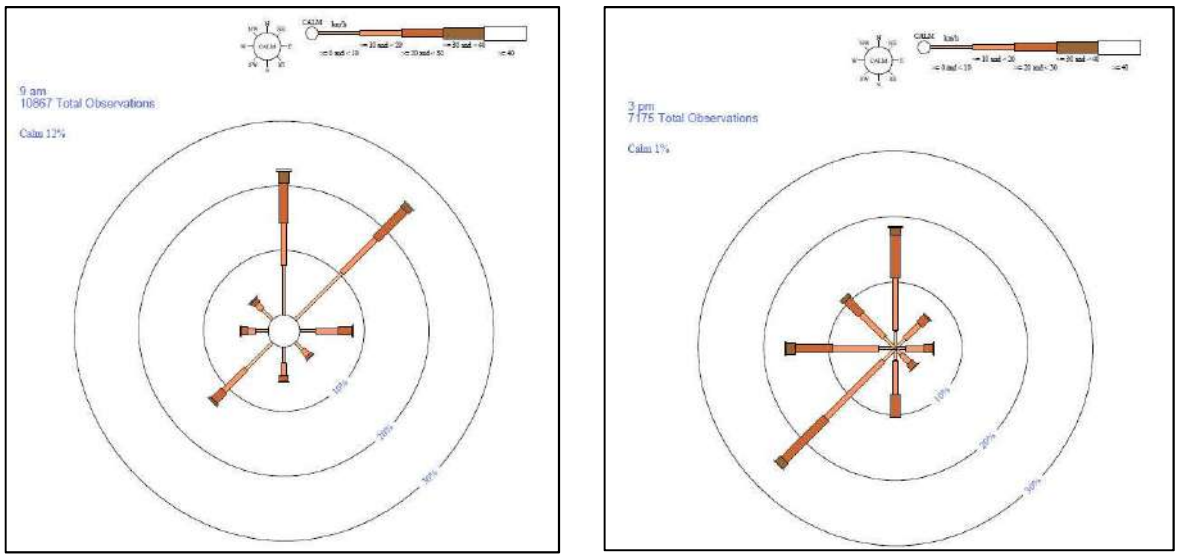
Overall, the observed variations between predicted and observed meteorology in the area is not expected to significantly impact on dispersion of emissions.

In the absence of site specific monitoring data, the predicted meteorology is considered suitable for the purposes of the assessment.



09:00 hours 15:00 hours

Figure 4: Predicted wind rose for Development Site (2016)



09:00 hours 15:00 hours

Figure 5: Historical 9 am and 3 pm wind roses for Parkes Airport (Bureau of Meteorology)

4.4.2 Predicted Atmospheric Stability

The amount of turbulence in the ambient air has a major effect upon the rise and dispersion of emissions. In particular, the amount of turbulence in the atmosphere plays a key role in

diffusion of an emitted plume in the air with stronger turbulence (increased instability) increasing the rate of diffusion. Where the atmosphere exhibits weak turbulence (increased stability), downwind contaminant concentrations can be expected to increase due to the limited diffusion.

Figure 6 presents the diurnal variability in atmospheric stability identified in the predicted meteorological dataset. As can be seen, atmospheric instability increased during the day where the influence of the solar energy drives convection in the atmosphere. Conversely, increased stability can be seen during night periods where stable conditions are predicted for more than 80 % of the time.

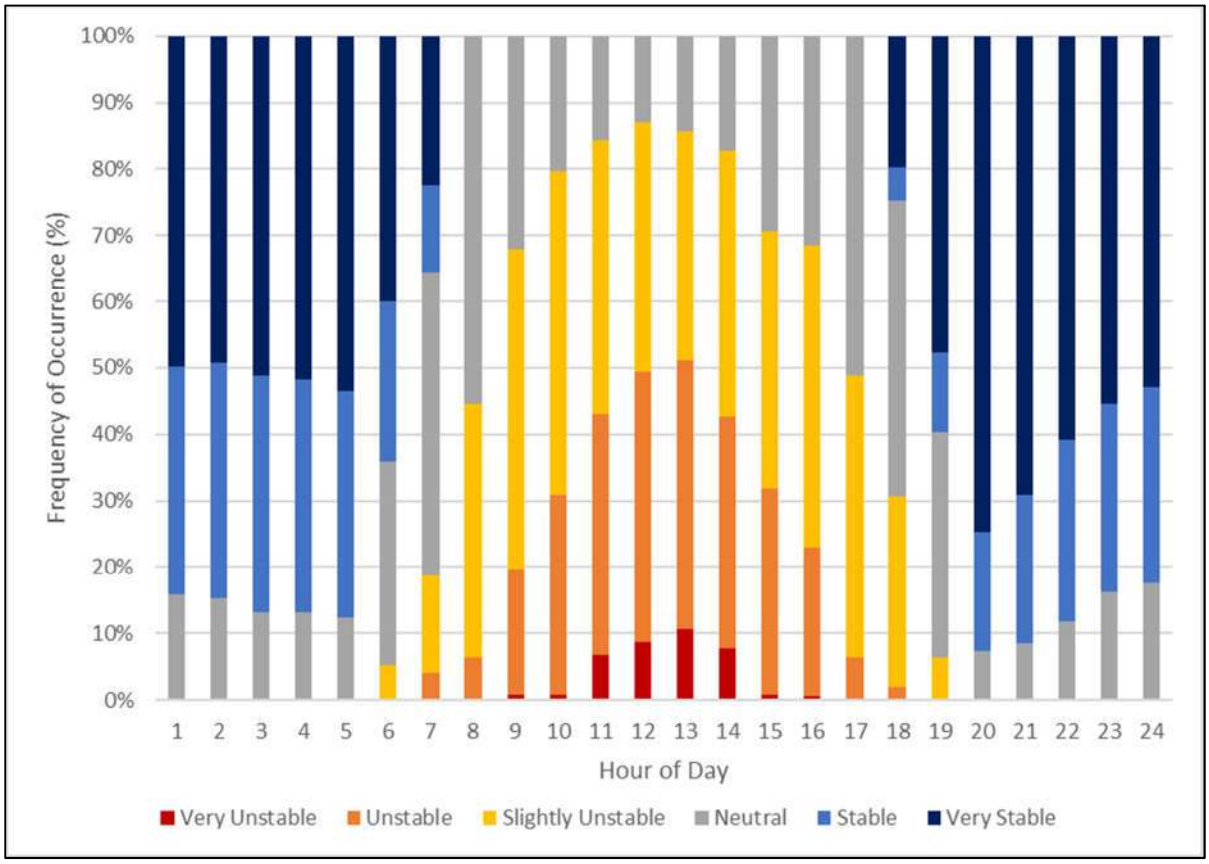


Figure 6: Annual Distribution of Diurnal Atmospheric Stability Variability

4.4.3 Monin-Obukhov Length

The Monin-Obukhov Length represents a parameter (with dimension of length) which provides a relationship between parameters characterising dynamic, thermal, and buoyant processes. The parameter, first described by Obukhov in 1946, is the characteristic height scale of the dynamic sub-layer of the atmosphere and is positive for stable stratifications and negative for unstable stratifications.

Figure 7 below presents a graphical representation of the reciprocal of the Monin-Obukhov length (1/L) for the 2016 prognostic (CALMET) dataset. In this figure, neutral stability conditions have the 1/L value of zero (0), stable conditions have positive values of 1/L and unstable conditions have negative values of 1/L. The more positive 1/L value, the more stable

the atmosphere is assumed to be by the model. Similarly, the more negative 1/L becomes, the more unstable the atmosphere is assumed to be by the model.

4.4.4 Predicted Atmospheric Mixing Height

Figure 8 presents an illustration of diurnal variations in maximum and average mixing heights predicted by CALMET at the Development Site across the 2016 prognostic meteorological dataset. As expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and growth of the convective mixing layer.

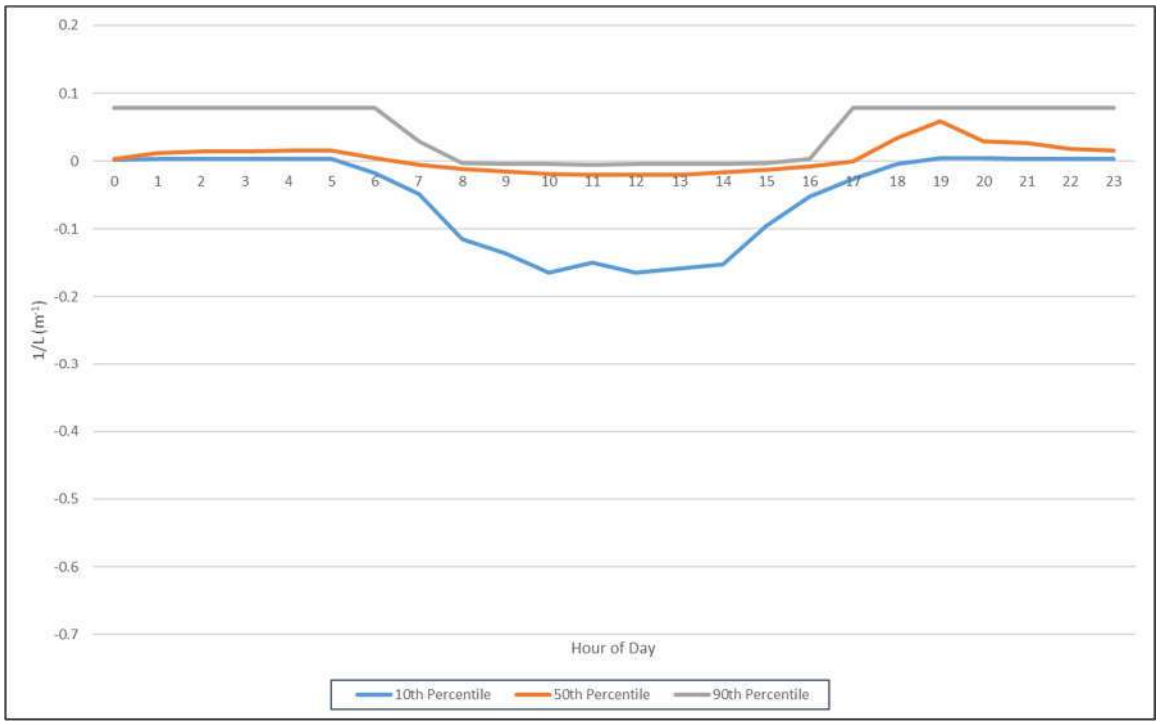


Figure 7: Annual Variability of Monin-Obukhov Length by Hour

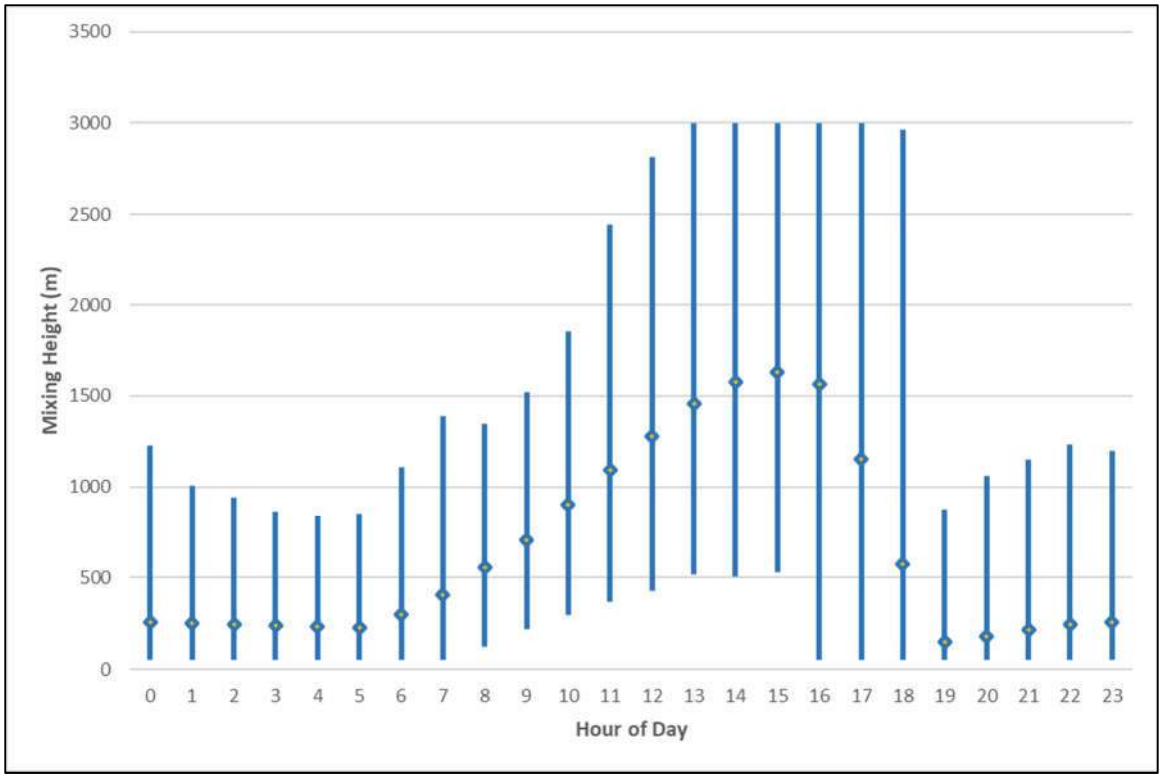


Figure 8: Atmospheric Mixing Height by Hour

5 AIR DISPERSION MODELLING

5.1 Introduction

5.1.1 CALPUFF Dispersion Modelling

The CALPUFF modelling system treats emissions as a series of puffs. These puffs are then dispersed throughout the modelling area and allowed to grow and bend with spatial variations in meteorology. In doing so, the model is able to retain a memory of the plume's movement throughout a single hour and from one hour to the next while continuing to better approximate the effects of complex air flows.

CALPUFF utilises the meteorological processing and prediction model CALMET to provide three-dimensional wind field predictions for the area of interest. The final wind field developed by the model (for consideration by CALPUFF) includes an approximation of the effects of local topography, the effects of varying surface temperatures (as is observed in land and sea bodies) and surface roughness (resulting from varied land uses and vegetation cover in an area). The CALPUFF model is able to resolve complex terrain influences on local wind fields including consideration of katabatic flows and terrain blocking.

5.1.2 CALPOST

Post processing of modelled emissions is undertaken using the CALPOST package. This allows the rigorous analysis of pollutant predictions generated by the CALPUFF system. In particular, CALPOST is able to provide an analysis of predicted pollutant concentrations for a range of averaging periods from 1 hour to 1 year. For the purposes of this assessment, predicted pollutant concentrations have been analysed to provide 24-hour, monthly and annual average concentrations at every gridded receptor across the modelling domain.

5.2 Background Concentrations

To assess cumulative impacts, daily background air quality data has been obtained from the Office of Environment & Heritage (OEH) website for 2016.

The nearest and most representative monitoring stations have been used for this assessment. Due to the remote location of the Development Site, the nearest monitoring station is located in Bathurst, however this station only records PM_{10} and $PM_{2.5}$.

Table 5 details the background monitoring data used in the contemporaneous modelling. It should be noted that where data gaps were identified, the 70th percentile of the daily data was applied. It is noted that no exceedences of PM_{10} or $PM_{2.5}$ were recorded at Bathurst for the year of assessment[a].

Review of the hourly monitoring data determines that the existing air quality concentrations comply with the criteria listed in Table 4.

[a] According to information provided in the Annual Air Quality Statement 2016 (OEH, 2017)

Ambient monitoring of TSP is undertaken at Parkes as part of the Regional Air Monitoring Network, however data is not readily available. In lieu of this, research indicates that in rural areas, PM_{10} typically represents 49% of total TSP, therefore, TSP concentrations have been estimated based on the application of this ratio[b].

Dust deposition is not measured in NSW; therefore, a background concentration has not been considered in this assessment. It is noted that the dust deposition criteria provided in the approved methods is based on an increment of 2 g/m^2/month and as such, the inclusion of existing background deposition rates is considered unnecessary.

Table 5: Background Concentrations

Compound	Missing Data (%)	24-Hour Concentration (µg/m^3)				OEH Station
		Maximum	90th Percentile	70th Percentile	Average	
PM_{10}[a]	7%	34.1	23.5	15.9	13.4	Bathurst
$PM_{2.5}$[a]	37%	15.0	9.4	7.7	6.6	

5.3 Sources of Emissions

Emissions to atmosphere from the Project can be categorised into the following activities:

- Drilling and blasting;
- Bulldozing;
- Material Transfers;
- Screening and crushing;
- Vehicle Movements;
- Wind Erosion (stockpiles and exposed areas).

Table 6 presents a summary of the equipment for each modelling scenario and their location within the quarry.

Table 6: Equipment Details

Source	Qty	Location	Scenario	
			Existing	Future
Dozer with heavy ripper	1	Overburden stripping	✓	✓
Excavator	2	Pit	✓	✓
Front End Loader	2	Quarry	✓	✓
Mobile jaw crusher	2	Pit	✓	✓
Haulage Trucks	1	Quarry	✓	✓
Cone /Screen mobile plant	1	Pit	✓	✓
Conveyors	9	Pit	✓	✓
Conveyor motors	1	Pit	✓	✓
Semi-trailer (32 tonne)		Loading area	30/day	60/day

[b] Air Noise Environment Pty Ltd (1999) 'Fine dust and the implications for the coal industry', ACARP Project C7009.

Source	Qty	Location	Scenario	
			Existing	Future
Light vehicle		Access road	6/day	14/day
Cone crusher	1	Aggregate plant		✓
Feeder (1) and screens (2)	3	Aggregate plant		✓
Conveyors	9	Aggregate plant		✓
Conveyor motors	1	Aggregate plant		✓

Emissions estimates for the above activities have been derived based on the following methodologies:

- National Pollution Inventory (NPI) Manual for Mining (Commonwealth of Australia, 2012); and
- USEPA AP-42: Compilation of Air Emission Factors (US Environmental Protection Agency, Various Dates).

Emission factors within these documents are used to estimate emissions of TSP, PM_{10} and $PM_{2.5}$ to the air from various sources. Emission factors relate the quantity of a substance emitted from a source to some measure of activity associated with the source.

Emission factors are used to estimate a facility's emissions by the general equation:

$$E_{i\,(kg/yr)} = \left[A_{(t/h)} \times OP_{(h/yr)} \right] \times EF_{i\,l(kg/t)} \times \left[1 - \frac{CE_i}{100} \right]$$

Where:

- E_i (kg/yr) = Emission rate of pollutant
- A (t/h) = Activity rate
- OP (h/yr) = operating hours
- EF_i l(kg/t) = uncontrolled emission factor of pollutant
- CE_i = overall control efficiency for pollutant

The equations, activity rates and control measures are presented in Appendix B. A summary of annual emission rates based on the maximum hourly plant throughout (for the existing and future operations) modelled for all operational hours are presented in Table 7.

Table 7: Summary of Emission Rates

Activity	Units	Existing Operations			Future Operations		
		TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Drilling	t/yr	8.0	4.2	0.2	8.0	4.2	0.2
Blasting	t/yr	1.1	0.6	<0.1	1.1	0.6	<0.1
Bulldozing	t/yr	7.9	5.9	0.8	7.9	5.9	0.8
Material Transfers	t/yr	31.9	15.1	2.3	44.0	20.8	3.2
Screening	t/yr	32.9	11.3	0.8	59.1	20.3	1.4
Crushing	t/yr	14.2	6.3	0.1	17.7	7.9	0.1
Vehicle Movements	t/yr	62.7	19.1	1.8	98.0	29.8	2.9
Wind Erosion	t/yr	0.017	0.009	0.001	0.017	0.009	0.001
	Total	**158.6**	**62.4**	**6.1**	**235.9**	**89.5**	**8.6**

6 PREDICTED GROUND LEVEL CONCENTRATIONS

6.1 Overview

In accordance with the Approved Methods, the individual dispersion model predictions for each receptor is added to the corresponding measured background concentration. In doing so, the tables presented in this Section show the highest predicted cumulative (source contribution plus existing background) receptor concentrations along with the highest predicted source contribution concentrations (for the Project) and the corresponding predicted date of occurrence.

The boundary between the Project and sensitive receptor R1 is not defined. Therefore, to determine the maximum concentrations from the facility, the disturbance area boundary has been used. The disturbance boundary is presented in the maximum ground level cumulative concentration contours (isopleths) presented in Appendix C.

6.2 Existing Operations – Maximum Hourly Throughput

6.2.1 Particulate Matter PM_{10}

Table 8 presents the maximum predicted 24-hour average cumulative (source plus background) PM_{10} receptor concentrations at each of the identified sensitive receptors and the maximum beyond the boundary of the disturbance area (shown in Figure 1). Appendix C presents the maximum ground level cumulative concentration contours (isopleths). Review of the maximum predicted concentration contours confirms that compliance with the 50 µg/m^3 criterion is predicted to be achieved for the all sensitive receptors, with the exception of the maximum at disturbance boundary.

Table 9 presents the predicted annual average cumulative PM_{10} concentrations across the modelling domain. The results of the modelling presented confirm that the predicted concentrations are significantly below the 25 µg/m^3 criteria, with the exception of the maximum at disturbance boundary.

It is noted that as there are no sensitive receptors at the boundary of the disturbance area (and therefore no risk of exposure), exceedences is considered immaterial.

Table 8: Existing Operations - Maximum Predicted 24-Hour Average Cumulative PM_{10} Concentrations (µg/m^3)

Receptor	Maximum Predicted Cumulative (Source plus Background) Receptor Concentrations			
	Date	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	16/04/2016	1.92	34.1	36.0
R2	16/04/2016	0.51	34.1	34.6
R3	16/04/2016	0.04	34.1	34.1
R4	16/04/2016	0.04	34.1	34.1
R5	16/04/2016	0.04	34.1	34.1

Receptor	Maximum Predicted Cumulative (Source plus Background) Receptor Concentrations			
	Date	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R6	16/04/2016	0.04	34.1	34.1
Maximum [a)]	16/04/2016	144.3	34.1	178.4
Air Quality Objective				50

a) Maximum at the disturbance area boundary of the existing quarry

Table 9: Existing Operations - Predicted Annual Average Cumulative PM_{10} Concentrations ($\mu g/m^3$)

ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	1.3	13.4	14.7
R2	0.6	13.4	14.1
R3	0.6	13.4	14.0
R4	0.7	13.4	14.1
R5	0.4	13.4	13.8
R6	0.7	13.4	14.1
Maximum [a)]	22.0	13.4	35.5
Air Quality Objective			25

a) Maximum at the disturbance area boundary of the existing quarry

Table 10 presents maximum predicted source contribution PM_{10} receptor concentrations at each of the identified sensitive receptors and the maximum at the quarry disturbance boundary. Also presented in this table is the coincident background concentration and predicted cumulative receptor concentration for the same period.

The results of the modelling confirm that emissions from the existing activities are predicted to result in maximum off-site PM_{10} concentrations of 50% of the relative criterion specified in the Approved Methods.

Table 10: Existing Operations - Maximum Predicted 24-Hour Average Source Contribution PM_{10} Concentrations ($\mu g/m^3$)

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	16.5	5.4	21.9
R2	8.0	12.1	20.1
R3	4.9	12.1	17.0
R4	7.6	4.2	11.7
R5	1.9	11.1	13.0
R6	4.8	13.3	18.1
Maximum [a)]	172.2	6.0	178.2
Air Quality Objective			50

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)

a) Maximum at the disturbance area boundary of the existing quarry

6.2.2 Particulate Matter $PM_{2.5}$

Table 11 presents the maximum predicted 24-hour average cumulative (source plus background) $PM_{2.5}$ receptor concentrations at each of the identified sensitive receptors and the maximum at the boundary of the disturbance area as shown in Figure 1. Appendix C presents the maximum ground level cumulative concentration contours (isopleths). Review of the maximum predicted concentration contours confirms that compliance with the 25 µg/m^3 criterion is predicted to be achieved for the all receptors.

Table 12 presents the predicted annual average cumulative $PM_{2.5}$ concentrations across the modelling domain. The results of the modelling presented confirm that the predicted concentrations are below the 8 µg/m^3 criteria for the off-site sensitive receptors.

Table 11: Existing Operations - Maximum Predicted 24-Hour Average Cumulative $PM_{2.5}$ Concentrations (µg/m^3)

Receptor	Maximum Predicted Cumulative (Source plus Background) Receptor Concentrations			
	Date	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	21/5/16	0.8	15.0	15.8
R2	21/5/16	0.8	15.0	15.8
R3	21/5/16	0.8	15.0	15.8
R4	21/5/16	0.8	15.0	15.8
R5	21/5/16	0.8	15.0	15.8
R6	21/5/16	0.8	15.0	15.8
Maximum [a)]	21/5/16	6.4	15.0	21.4
Air Quality Objective				25

a) Maximum at the disturbance area boundary of the existing quarry

Table 12: Existing Operations - Predicted Cumulative Annual Average $PM_{2.5}$ Concentrations (µg/m^3)

ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	0.6	6.5	7.2
R2	0.5	6.5	7.1
R3	0.5	6.5	7.1
R4	0.6	6.5	7.1
R5	0.5	6.5	7.1
R6	0.5	6.5	7.1
Maximum [a)]	2.5	6.5	9.1

Air Quality Objective	8

a) Maximum at the disturbance area boundary of the existing quarry

Table 13 presents maximum predicted source contribution $PM_{2.5}$ receptor concentrations at each of the identified sensitive receptors and the maximum at the quarry disturbance boundary. Also presented in this table is the coincident background concentration and predicted cumulative receptor concentration for the same period.

The results of the modelling confirm that emissions from the existing operations are predicted to result in maximum concentrations of $PM_{2.5}$ concentrations at sensitive receptors of less than 40% of the relative criterion specified in the Approved Methods.

Table 13: Existing Operations - Maximum Predicted 24-Hour Average Source Contribution $PM_{2.5}$ Concentrations (µg/m^3)

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	1.5	2.3	3.8
R2	0.7	7.5	8.3
R3	0.4	7.5	8.0
R4	0.7	4.6	5.3
R5	0.2	7.7	7.8
R6	0.4	7.7	8.1
Maximum [a)]	15.9	4.5	20.4
Air Quality Objective			25

a) Maximum at the disturbance area boundary of the existing quarry

6.2.3 Total Suspended Particles

Table 14 presents maximum predicted source contribution TSP concentrations at each of the identified sensitive receptors and the maximum at the quarry disturbance boundary. Also presented in this table is the coincident background concentration and predicted cumulative receptor concentration for the same period.

The results of the modelling confirm that emissions from the existing operations are predicted to result in maximum concentrations of TSP concentrations at sensitive receptors of less than 35% of the relative criterion specified in the Approved Methods.

Table 14: Existing Operations - Predicted Cumulative Annual Average TSP Concentrations (µg/m^3)

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	0.9	27.4	28.3
R2	0.3	27.4	27.7
R3	0.2	27.4	27.6
R4	0.3	27.4	27.7

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R5	<0.1	27.4	27.4
R6	0.1	27.4	27.5
Maximum [a)]	37.6	27.4	65.0
Air Quality Objective			90

a) Maximum at the disturbance area boundary of the existing quarry

6.2.4 Dust Deposition

Table 15 presents maximum predicted source contribution dust deposition concentrations at each of the identified sensitive receptors and the maximum at the quarry disturbance boundary. No background values for dust deposition have been applied as discussed in Section 5.2.

The results of the modelling confirm that emissions from the existing operations are predicted to result in maximum dust deposition at sensitive receptors of <2% of the relative criterion specified in the Approved Methods.

Table 15: Existing Operations - Predicted Cumulative Annual Average Dust Deposition ($g/m^2/month$)

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	0.04	-	0.04
R2	0.02	-	0.02
R3	0.01	-	0.01
R4	0.01	-	0.01
R5	<0.01	-	<0.01
R6	<0.01	-	<0.01
Maximum [a)]	1.79	-	1.79
Air Quality Objective			2

a) Maximum at the disturbance area boundary of the existing quarry

6.3 Future Operations – Maximum Hourly Throughput

6.3.1 Particulate Matter PM_{10}

Table 16 presents the maximum predicted 24-hour average cumulative (source plus background) PM_{10} receptor concentrations at each of the identified sensitive receptors and the maximum at the boundary of the disturbance area as shown in Figure 1. Appendix C presents the maximum ground level cumulative concentration contours (isopleths).

Review of the maximum predicted concentration contours confirms that compliance with the 50 $\mu g/m^3$ criterion is predicted to be achieved for the all sensitive receptors, with the exception of the maximum at disturbance boundary.

Table 17 presents the predicted annual average cumulative PM_{10} concentrations across the modelling domain. The results of the modelling presented confirm that the predicted concentrations are significantly below the 25 µg/m^3 criteria, with the exception of the maximum at disturbance boundary.

Table 16: Future Operations - Maximum Predicted 24-Hour Average Cumulative PM_{10} Concentrations (µg/m^3)

Receptor	Maximum Predicted Cumulative (Source plus Background) Receptor Concentrations			
	Date	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	16/04/2016	3.9	34.1	38.0
R2	16/04/2016	1.3	34.1	35.3
R3	16/04/2016	0.6	34.1	34.6
R4	16/04/2016	0.6	34.1	34.6
R5	16/04/2016	0.6	34.1	34.6
R6	16/04/2016	0.6	34.1	34.6
Maximum [a)]	16/04/2016	144.4	34.1	178.4
Air Quality Objective				50

a) Maximum at the disturbance area boundary of the future quarry

Table 17: Future Operations - Predicted Annual Average Cumulative PM_{10} Concentrations (µg/m^3)

ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	2.0	13.4	15.4
R2	0.9	13.4	14.3
R3	0.7	13.4	14.2
R4	1.0	13.4	14.4
R5	0.4	13.4	13.8
R6	0.5	13.4	13.9
Maximum [a)]	22.0	13.4	35.5
Air Quality Objective			25

a) Maximum at the disturbance area boundary of the future quarry

Table 18 presents maximum predicted source contribution PM_{10} receptor concentrations at each of the identified sensitive receptors and the maximum at the quarry disturbance boundary. Also presented in this table is the coincident background concentration and predicted cumulative receptor concentration for the same period.

The results of the modelling confirm that emissions from the expanded quarry operation are predicted to result in maximum off-site PM_{10} concentrations of less than 70% of the relative criterion specified in the Approved Methods.

Table 18: Future Operations - Maximum Predicted 24-Hour Average Source Contribution PM_{10} Concentrations (µg/m^3)

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	28.2	5.4	33.5
R2	12.5	12.1	24.6
R3	7.5	7.1	14.6
R4	12.8	4.2	17.0
R5	2.7	11.1	13.8
R6	8.2	13.3	21.5
Maximum [a)]	350.1	5.4	355.5
Air Quality Objective			50

a) Maximum at the disturbance area boundary of the future quarry

6.3.2 Particulate Matter $PM_{2.5}$

Table 19 presents the maximum predicted 24-hour average cumulative (source plus background) $PM_{2.5}$ receptor concentrations at each of the identified sensitive receptors and the maximum at the boundary of the disturbance area as shown in Figure 1. Appendix C presents the maximum ground level cumulative concentration contours (isopleths). Review of the maximum predicted concentration contours confirms that compliance with the 25 µg/m^3 criterion is predicted to be achieved for the all receptors.

Table 20 presents the predicted annual average cumulative $PM_{2.5}$ concentrations across the modelling domain. The results of the modelling presented confirm that the predicted concentrations are below the 8 µg/m^3 criteria for the off-site sensitive receptors.

Table 19: Future Operations - Maximum Predicted 24-Hour Average Cumulative $PM_{2.5}$ Concentrations (µg/m^3)

Receptor	Maximum Predicted Cumulative (Source plus Background) Receptor Concentrations			
	Date	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	21/5/16	0.8	15.0	15.8
R2	21/5/16	0.8	15.0	15.8
R3	21/5/16	0.8	15.0	15.8
R4	21/5/16	0.8	15.0	15.8
R5	21/5/16	0.8	15.0	15.8
R6	21/5/16	0.8	15.0	15.8
Maximum [a)]	21/5/16	6.4	15.0	21.4
Air Quality Objective				25

a) Maximum at the disturbance area boundary of the future quarry

Table 20: Future Operations - Predicted Cumulative Annual Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)

ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	0.6	6.5	7.2
R2	0.5	6.5	7.1
R3	0.5	6.5	7.1
R4	0.6	6.5	7.1
R5	0.5	6.5	7.1
R6	0.5	6.5	7.1
Maximum [a)]	2.5	6.5	9.1
Air Quality Objective			8

a) Maximum at the disturbance area boundary of the future quarry

Table 21 presents maximum predicted source contribution $PM_{2.5}$ receptor concentrations at each of the identified sensitive receptors and the maximum at the quarry disturbance boundary. Also presented in this table is the coincident background concentration and predicted cumulative receptor concentration for the same period.

The results of the modelling confirm that emissions from the expanded quarry are predicted to result in maximum concentrations of $PM_{2.5}$ concentrations at sensitive receptors of less than 40% of the relative criterion specified in the Approved Methods.

Table 21: Future Operations - Maximum Predicted 24-Hour Average Source Contribution $PM_{2.5}$ Concentrations ($\mu g/m^3$)

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	2.6	2.3	4.9
R2	1.1	7.5	8.7
R3	0.7	3.6	4.3
R4	1.2	4.6	5.8
R5	0.2	8.6	8.8
R6	0.7	7.7	8.4
Maximum [a)]	15.9	2.3	18.2
Air Quality Objective			25

a) Maximum at the disturbance area boundary of the future quarry

6.3.3 Total Suspended Particles

Table 22 presents maximum predicted source contribution TSP concentrations at each of the identified sensitive receptors and the maximum at the quarry disturbance boundary.

Also presented in this table is the coincident background concentration and predicted cumulative receptor concentration for the same period.

The results of the modelling confirm that emissions from the expanded quarry operations are predicted to result in maximum concentrations of TSP concentrations at sensitive receptors of less than 35% of the relative criterion specified in the Approved Methods.

Table 22: Future Operations - Predicted Cumulative Annual Average TSP Concentrations (µg/m^3)

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	1.3	27.4	28.7
R2	0.4	27.4	27.8
R3	0.3	27.4	27.7
R4	0.4	27.4	27.8
R5	<0.1	27.4	27.4
R6	0.1	27.4	27.5
Maximum [a)]	104.4	27.4	131.8
Air Quality Objective			90

a) Maximum at the disturbance area boundary of the future quarry

6.3.4 Dust Deposition

Table 23 presents maximum predicted source contribution dust deposition concentrations at each of the identified sensitive receptors and the maximum at the quarry disturbance boundary. No background values for dust deposition have been applied as discussed in Section 5.2.

The results of the modelling confirm that emissions from the expanded facility are predicted to result in maximum dust deposition at sensitive receptors of <2% of the relative criterion specified in the Approved Methods.

Table 23: Future Operations - Predicted Cumulative Annual Average Dust Deposition (g/m^2/month)

Receptor ID	Source Contribution (A)	Existing Background (B)	Cumulative (A + B)
R1	0.04	-	0.04
R2	0.01	-	0.01
R3	0.01	-	0.01
R4	0.01	-	0.01
R5	<0.01	-	<0.01
R6	<0.01	-	<0.01
Maximum [a)]	5.6	-	5.6
Air Quality Objective			2

a) Maximum at the disturbance area boundary of the future quarry

6.4 Comparison of Results

Comparison of the individual results from the existing and future expansion scenarios confirms that:

- Due to the expansion of the quarry, the day on which the maximum source contributions from the expanded operations occur for sensitive receptor R3 changes, which results in lower corresponding background concentrations for PM_{10} and $PM_{2.5}$ on the day of the maximum source contribution. This does not lower the maximum 24-hour concentrations of PM_{10} and $PM_{2.5}$ which are driven by background concentrations.
- The differences between the maximum predicted 24-hour average concentrations of PM_{10} between the existing and future operations are minimal with the greatest observed increase of 2 $\mu g/m^3$ at R1 (from 36 $\mu g/m^3$ to 38 $\mu g/m^3$).
- There is not predicted to be any change in the maximum 24-hour concentrations of $PM_{2.5}$ concentrations at any off-site sensitive receptor with the expansion of the quarry.
- The expanded quarry is predicted to result in an increase in the annual average TSP concentration of 1.3 $\mu g/m^3$ at R5 and R6; and
- Off-site impacts from dust deposition are not predicted to change significantly with the expansion of the quarry.

7 CONCLUSIONS AND RECOMMENDATIONS

Ausrock Quarries propose to expand the open pit of the Goonumbla Quarry. In order to confirm the suitability of air quality at the closest residential receptors, an air quality impact assessment has been undertaken.

Air dispersion modelling (which includes contemporaneous background concentrations) has been undertaken using the CALMET/CALPUFF modelling system for the proposed expansion of the quarry to assess the potential impacts of particulate emissions upon nearby receptors.

The results of the air modelling indicate compliance with the all air quality objectives is predicted to be achieved for all relevant averaging periods at the nearest sensitive receptors to the quarry expansion. Review of the results indicate that the predicted concentrations are driven by the background concentrations with only minor changes (above those resulting from existing quarry operations) expected.

Overall, based on the results of the predictive dispersion modelling, the risk of adverse impacts of the proposed expansion of the quarry is considered to be low.

8 REFERENCES

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APPENDIX A: GLOSSARY OF TERMS

Conversion of ppm to mg/m^3	Where R is the ideal gas constant; T, the temperature in kelvin (273.16 + T°C); and P, the pressure in mm Hg, the conversion is as follows: $\mu g\ m^{-3}$ = (P/RT) x Molecular weight x (concentration in ppm) $= \frac{P \times \text{Molecular weight} \times (\text{concentration in ppm})}{62.4 \times (273.2 + T°C)}$
g/s	Grams per second
mg/m^3	Milligrams (10^{-3}) per cubic metre. Conversions from mg/m^3 to parts per volume concentrations (i.e., ppm) are calculated at 0 °C as required by the SEPP(AQM).
µg/m^3	Micrograms (10^{-6}) per cubic metre. Conversions from □g/m^3 to parts per volume concentrations (i.e., ppb) are calculated at 0 °C.
ppb	Parts per billion.
ppm	Parts per million.
PM_{10}, $PM_{2.5}$, PM_1	Fine particulate matter with an equivalent aerodynamic diameter of less than 10, 2.5 or 1 micrometres respectively. Fine particulates are predominantly sourced from combustion processes. Vehicle emissions are a key source in urban environments.
50th percentile	The value exceeded for 50 % of the time.
NOx	Oxides of nitrogen – a suite of gaseous contaminants that are emitted from road vehicles and other sources. Some of the compounds can react in the atmosphere and, in the presence of other contaminants, convert to different compounds (e.g., NO to NO_2).
VOC	Volatile Organic Compounds. These compounds can be both toxic and odorous.

APPENDIX B: EMISSION ESTIMATION EQUATIONS

The major air emission from surface mining is fugitive dust. Emission factors can be used to estimate emissions of TSP, PM_{10} and $PM_{2.5}$ to the air from various sources.

Drilling and blasting emissions:

Emission factors for overburden/raw material detailed in AP-42 Chapter 11.9 "Western Surface Coal Mining" have been used. The calculation is based on 90 holes drilled per blast covering an area 1008 m^2, with one blast per day.

Bulldozers:

Emission factors for overburden/raw material detailed in AP-42 Chapter 11.9 "Western Surface Coal Mining" have been used.

TSP Emission Factor equation for overburden is: $\frac{2.6\ (s)^{1.2}}{(M)^{1.3}}$

Scaling factors of 0.75 and 0.105 has been used to derived PM_{10} and $PM_{2.5}$ emission rates from TSP. The calculation is based on one bulldozer operating 10 hours per day. The silt (s) and moisture (M) contents of 6.9% and 7.9% have been assumed. A control efficiency of 50% has been applied based on the NSW Coal Mining Benchmarking Study (Katestone, 2011).

Wind Erosion:

Emission factors for TSP from active stockpile wind erosion is detailed in AP-42 Chapter 11.9 "Western Surface Coal Mining". The wind erosion (kg/ha/hr) is determined by multiplying the average wind speed by 1.8. The wind speed has been determined form the CALMET analysis. PM_{10} and $PM_{2.5}$ scaling factors from NPI Manual for Mining were applied. A 30% control efficiency factor for wind breaks was applied.

Emission factors for TSP from exposed areas wind erosion is detailed in AP-42 Chapter 11.9 "Western Surface Coal Mining". The wind erosion (Mg/ha/hr) is determined by multiplying the average wind speed by 0.85. The wind speed has been determined form the CALMET analysis. PM_{10} and $PM_{2.5}$ scaling factors from NPI Manual for Mining were applied.

Screening:

Emission factors for TSP from active stockpile wind erosion is detailed in AP-42 Chapter 11.9.2 "Crushed Stone Processing and Pulverised Mineral Processing".

TSP: 0.0125 kg/t;

PM_{10}: 0.0043 kg/t; and

$PM_{2.5}$: Derived from $\frac{EF_{PM10}\ x\ 0.000025}{0.00037}$

Crushing:

Emission factors for TSP from active stockpile wind erosion is detailed in AP-42 Chapter 11.9.2 "Crushed Stone Processing and Pulverised Mineral Processing". Emission factors are based on raw quarry material and no control efficiency factors were applied.

TSP: 0.0027 kg/t;

PM_{10}: 0.0012 kg/t; and

$PM_{2.5}$: Derived from $\frac{EF_{PM10}\ x\ 0.00005}{0.0027}$

Material Transfers:

Emission factors for TSP from active stockpile wind erosion is detailed in AP-42 Chapter 13.2.4 "Aggregate Handling and Storage Piles". Emission factors are based on mean wind speed (U) and moisture (M) content of material and no control efficiency factors were applied. The mean wind speed was 3.5 m/s as derived from CALMET and the moisture content for overburden is 7.9% and 2.1% for raw and product material.

Emission factors:

TSP: $EF_{TSP} = 0.74\ x\ 0.0016\ x\ \frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}$

PM_{10}: $EF_{PM10} = 0.35\ x\ 0.0016\ x\ \frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}$

$PM_{2.5}$: $EF_{PM2.5} = 0.53\ x\ 0.0016\ x\ \frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}$

Vehicle Movements:

Light and heavy vehicle movements have been derived from the NPI "Manual for Mining" for wheel generated dust from unpaved roads. The calculations take into account the gross vehicle weight (W), silt and moisture content (s and M), speed (S).

Table 24: Vehicle Movement Emission Factors

	TSP	PM_{10}
Light vehicles	$EF_{TSP} = 1.69 \times \frac{(s/12) \times (S/48)^{0.3}}{(M/0.5)^{0.3}} - 0.0013$	$EF_{PM_{10}} = 0.51 \times \frac{\left(s/12\right) \times \left(S/48\right)^{0.5}}{\left(M/0.5\right)^{0.2}} - 0.0013$
Heavy vehicles	$EF_{TSP} = \frac{0.4536}{1.6093} \times 4.9 \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$EF_{PM_0} = \frac{0.4536}{1.6093} \times 1.5 \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$

A control efficiency of 50% for level 1 watering has been applied.

Control Efficiencies Applied:

Table 25: Summary of Control Efficiencies Applied to Emission Rates

Activity	Control Efficiency	Source
Bulldozers	50% for moist materials	NSW Coal Mining Benchmark Study
Wind Erosion	30% for wind breaks	NPI for Mining
Vehicle Movements	50% for level 1 watering	NPI for Mining

APPENDIX C: POLLUTION PREDICTION CONTOURS

Contour plots illustrate the spatial distribution of ground-level concentrations across the modelling domain for each time period of interest. However, this process of interpolation causes a smoothing of the base data that can lead to minor differences between the contours and receptor model predictions.

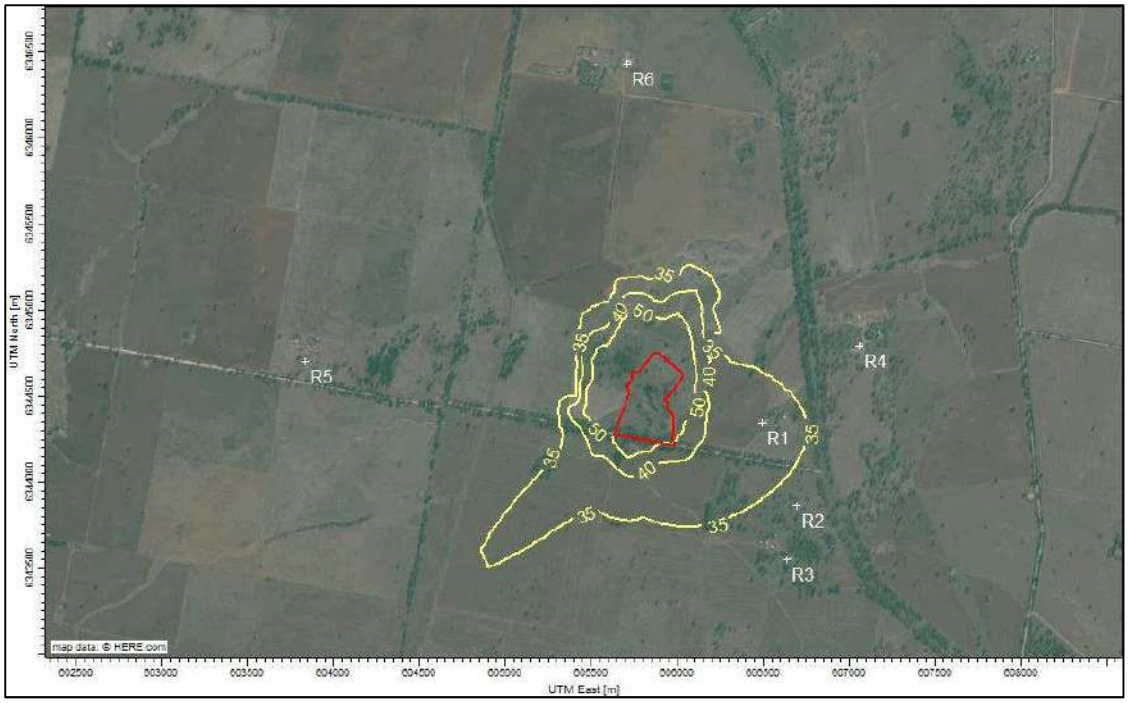

Figure 9: Existing Operations: Max Predicted 24-hour Average PM_{10} Concentrations ($\mu g/m^3$)

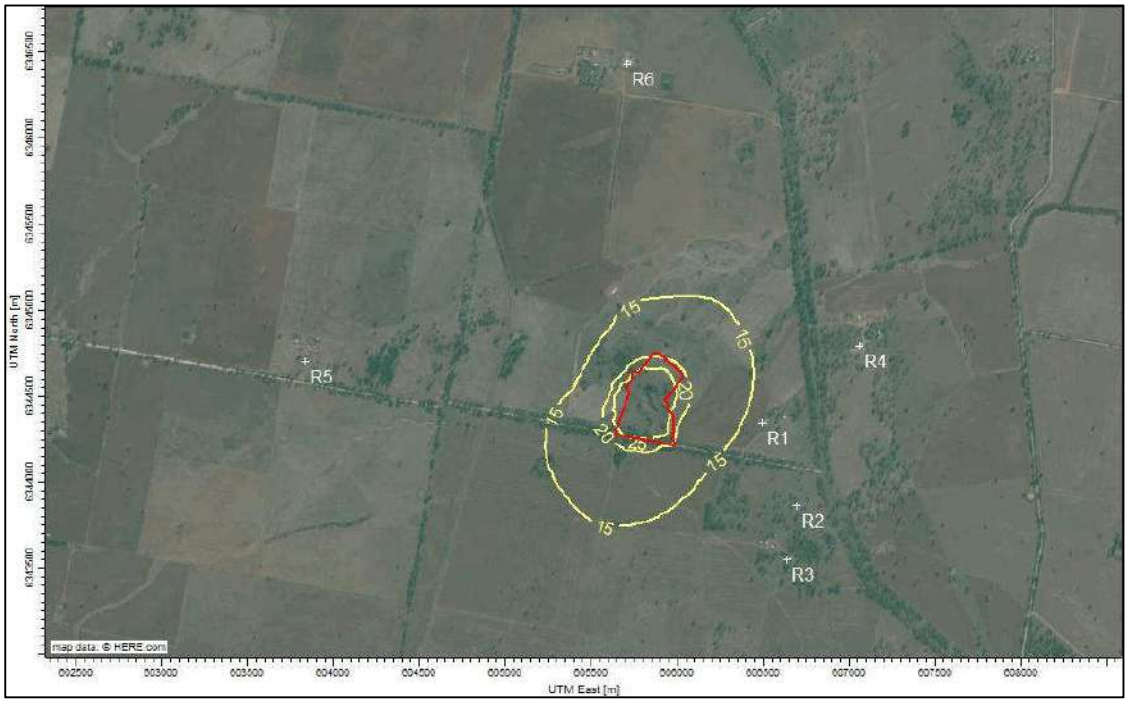

Figure 10: Existing Operations: Predicted Annual Average PM_{10} Concentrations ($\mu g/m^3$)

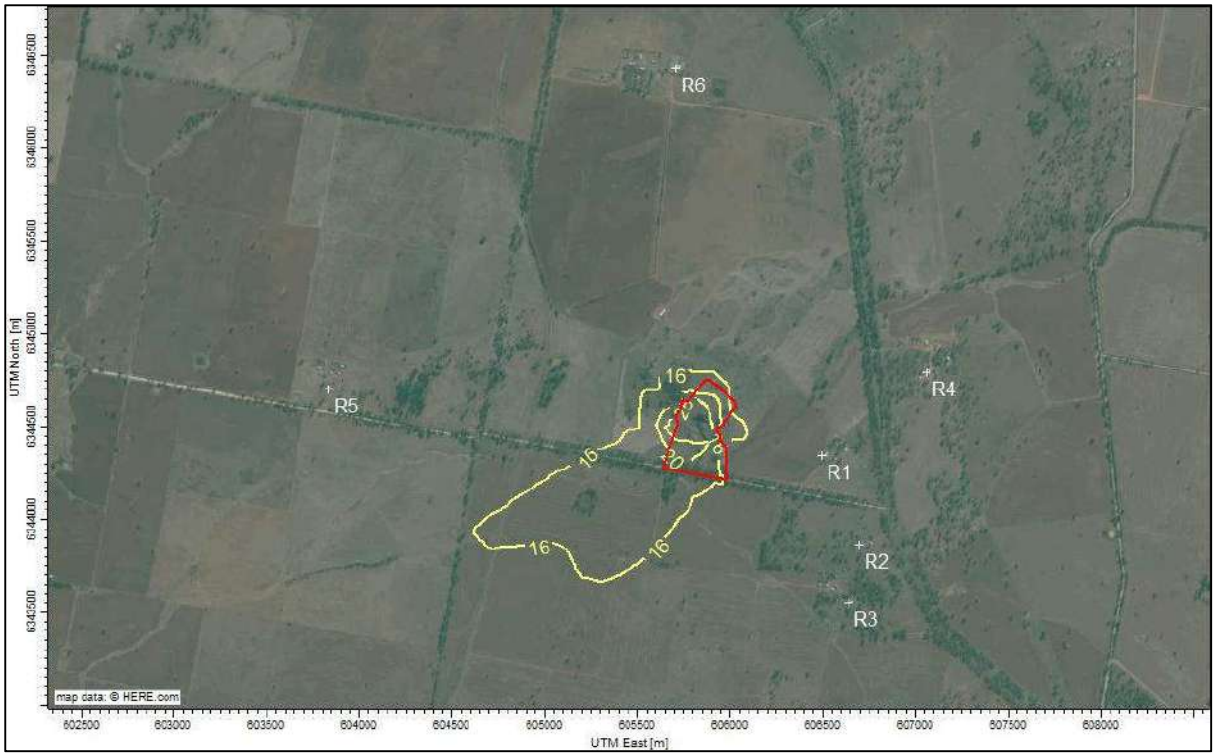

Figure 11: Existing Operations: Max Predicted 24-hour Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)

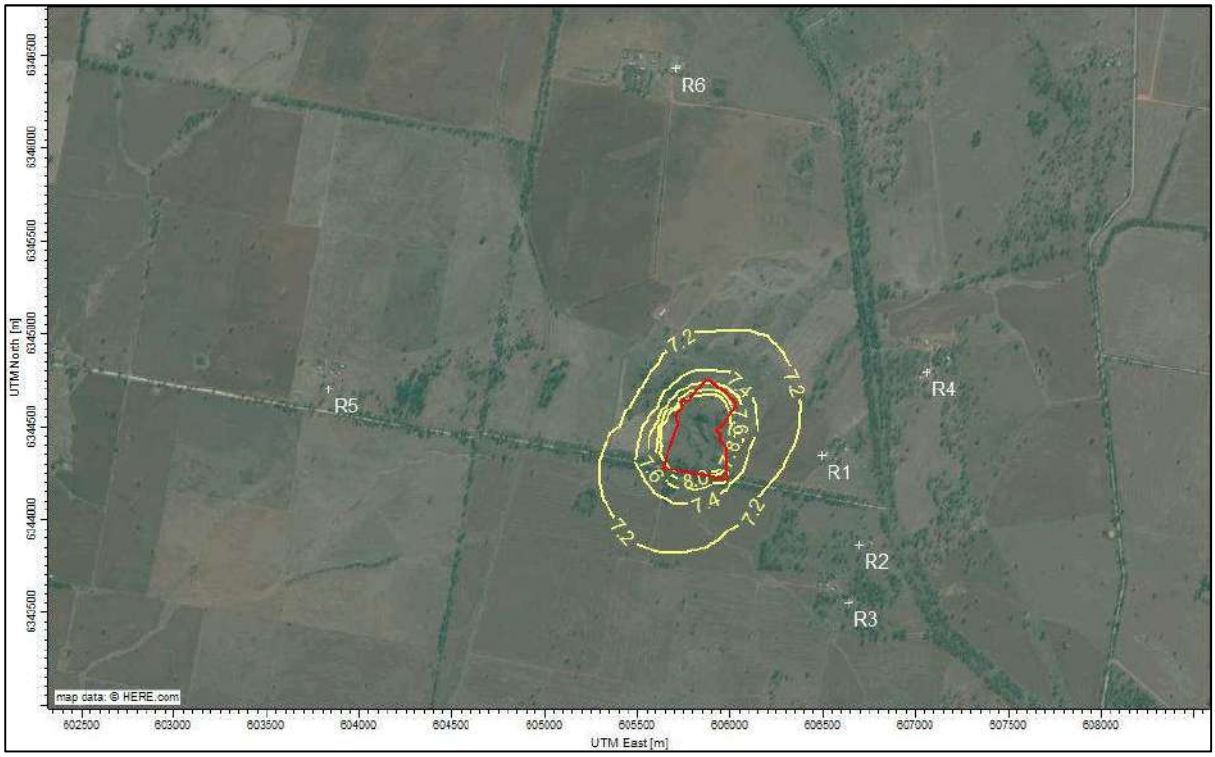

Figure 12: Existing Operations: Predicted Annual Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)

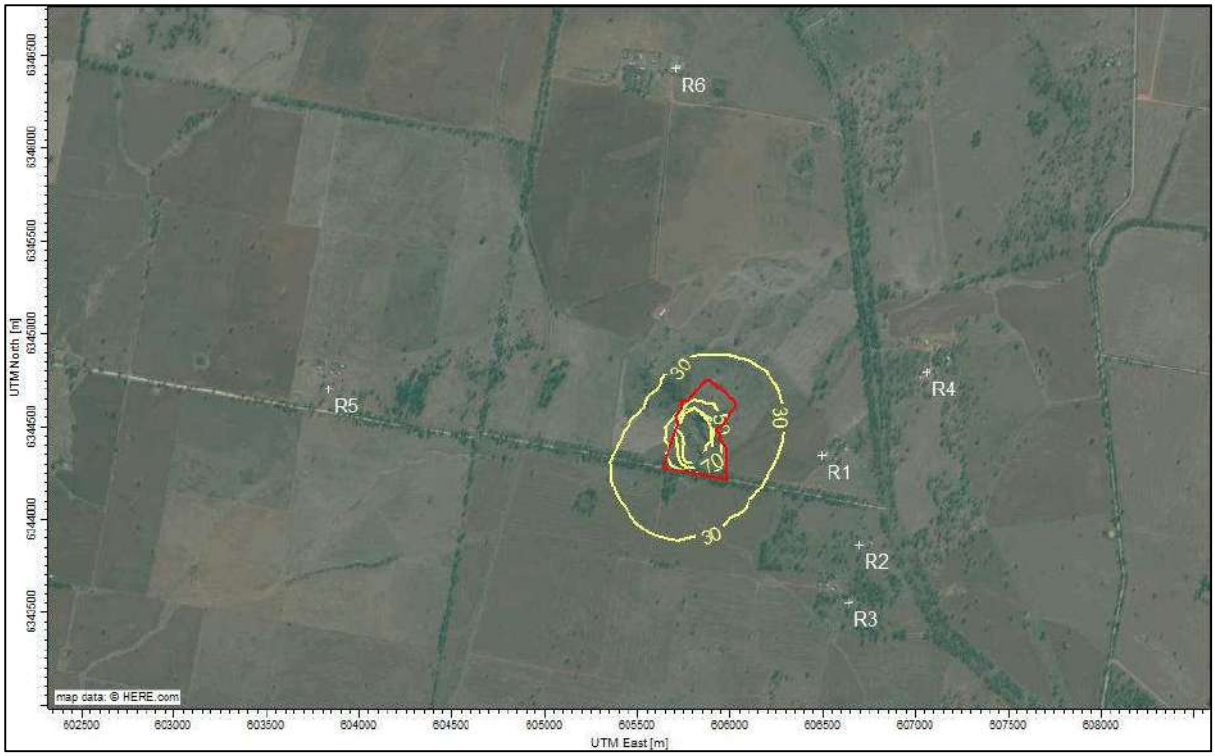

Figure 13: Existing Operations: Annual Average TSP Concentrations (µg/m^3)

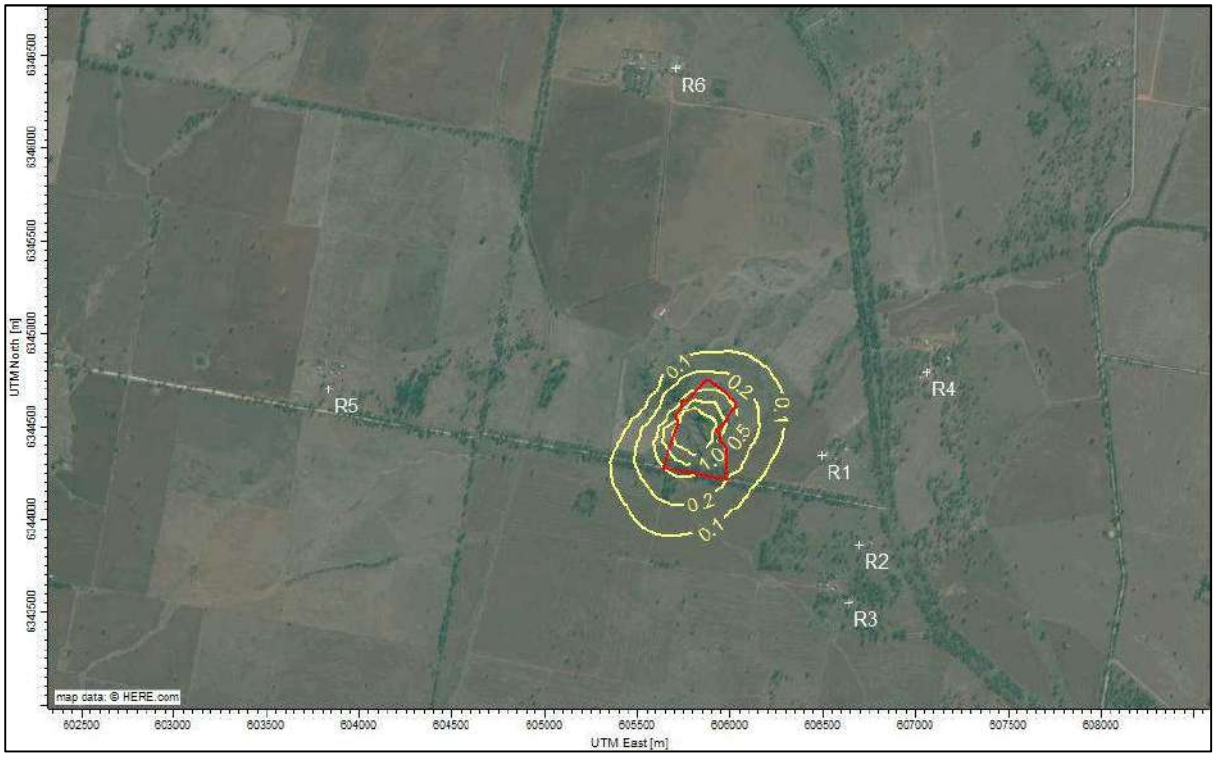

Figure 14: Existing Operations: Predicted Dust Deposition (g/m^2/month)

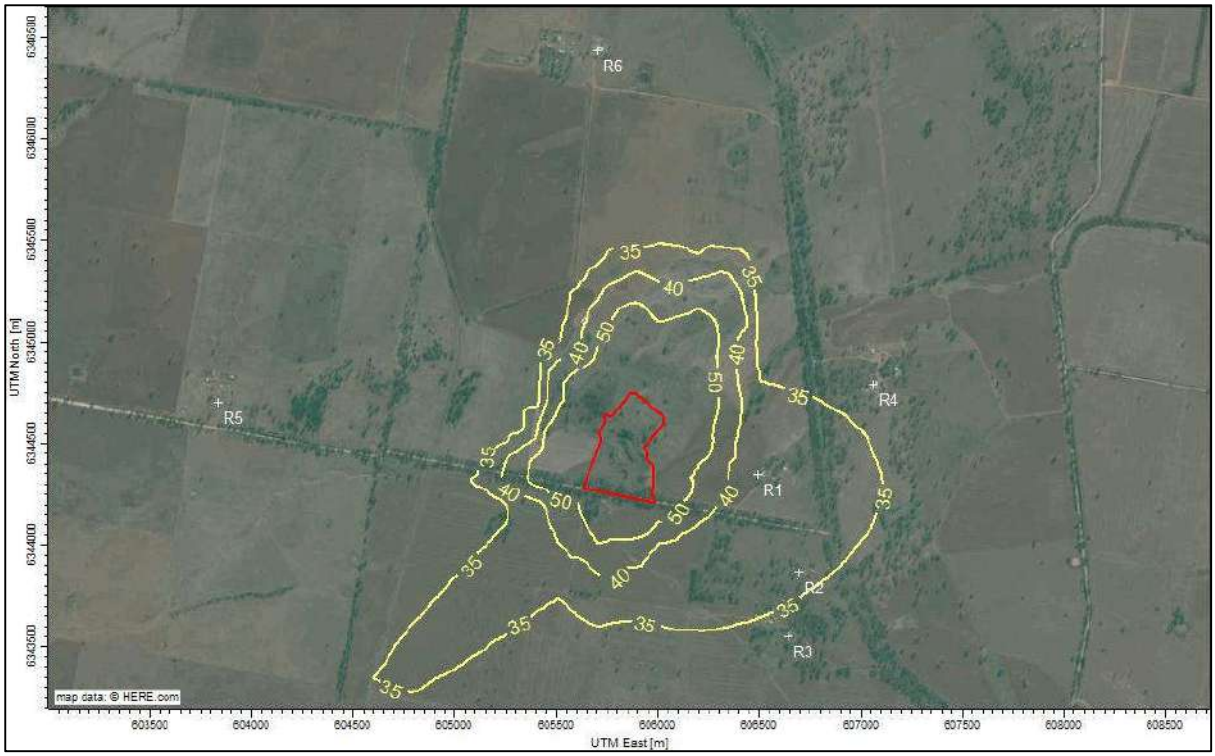

Figure 15: Future Operations: Max Predicted 24-hour Average PM_{10} Concentrations ($\mu g/m^3$)

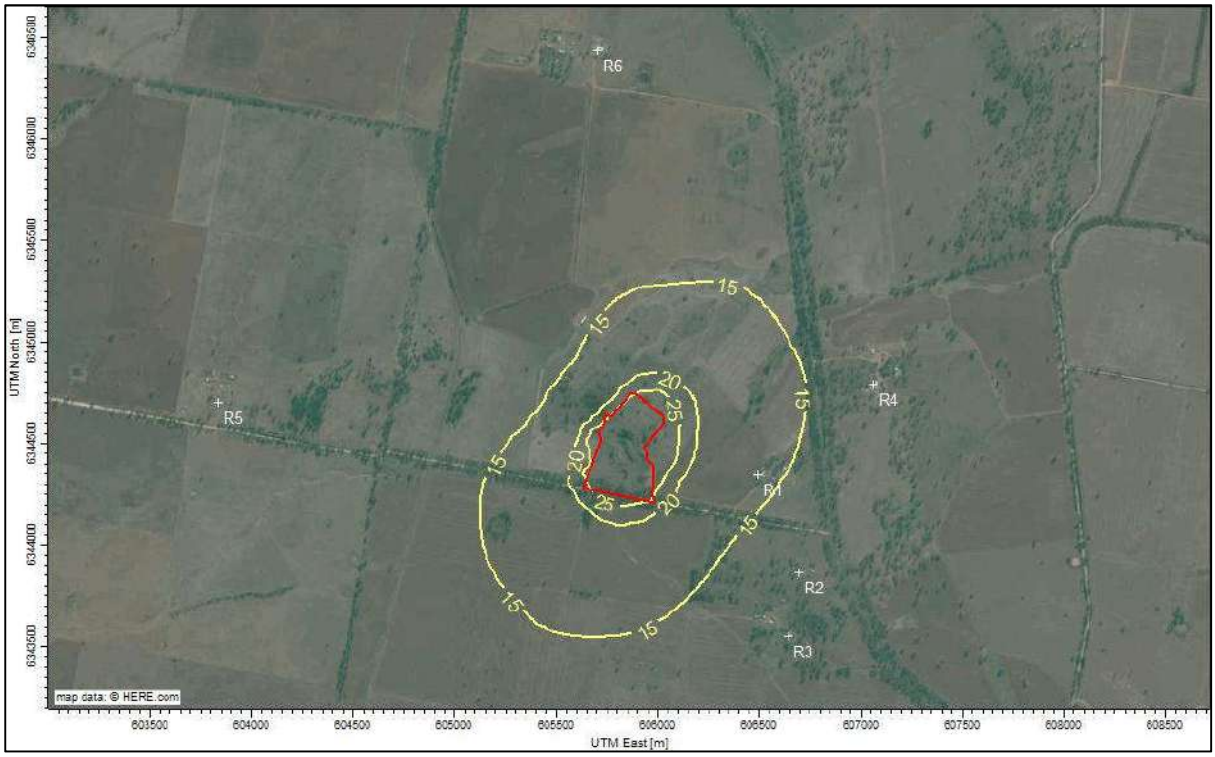

Figure 16: Future Operations: Predicted Annual Average PM_{10} Concentrations ($\mu g/m^3$)

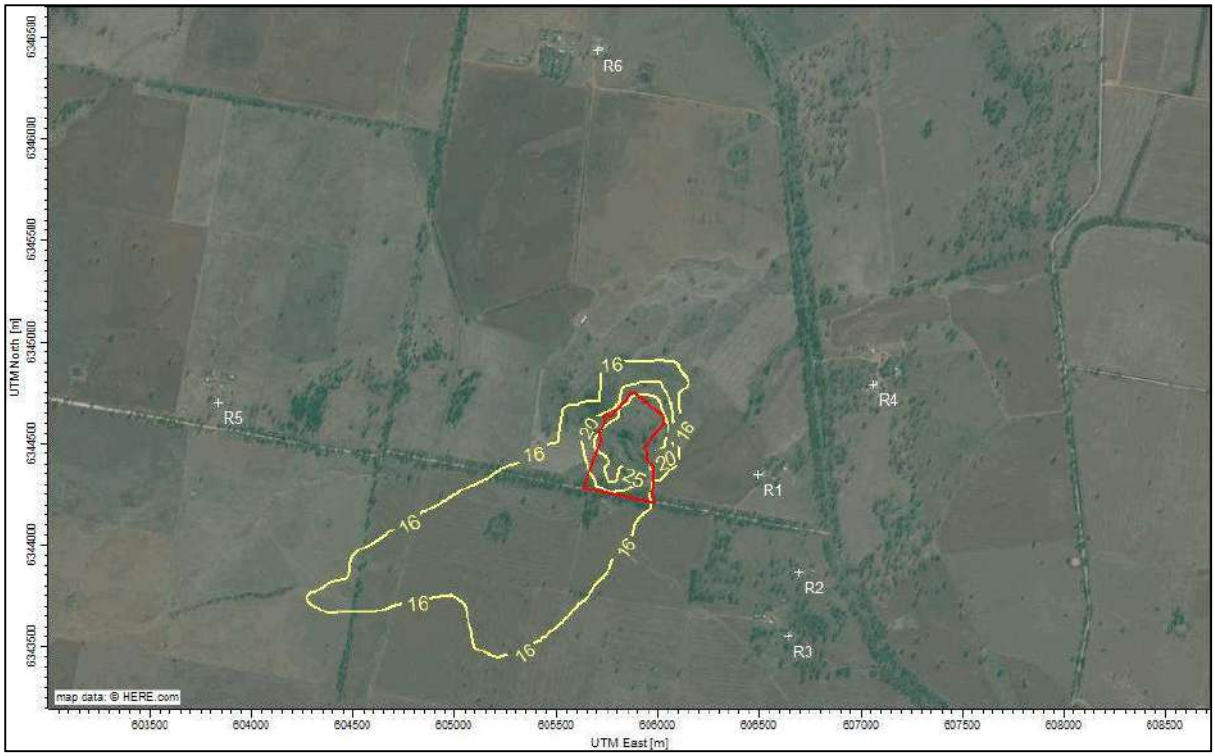

Figure 17: Future Operations: Max Predicted 24-hour Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)

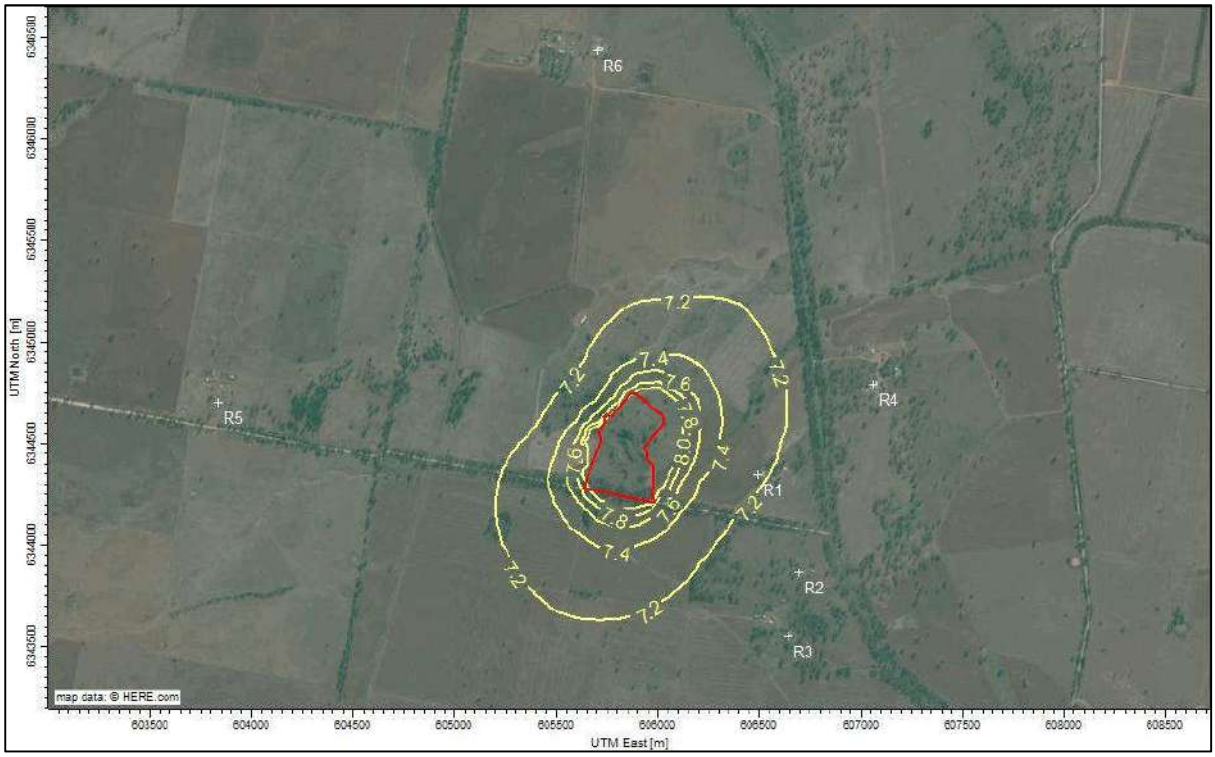

Figure 18: Future Operations: Predicted Annual Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)

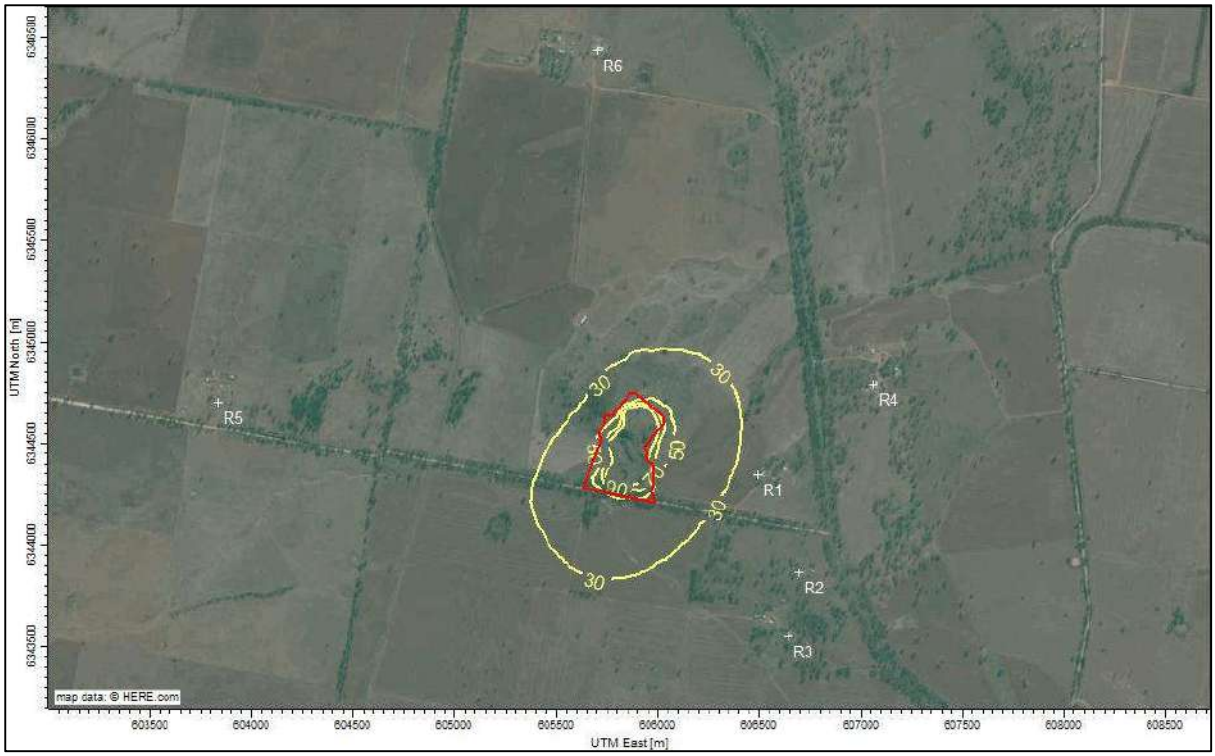

Figure 19: Future Operations: Annual Average TSP Concentrations (µg/m^3)

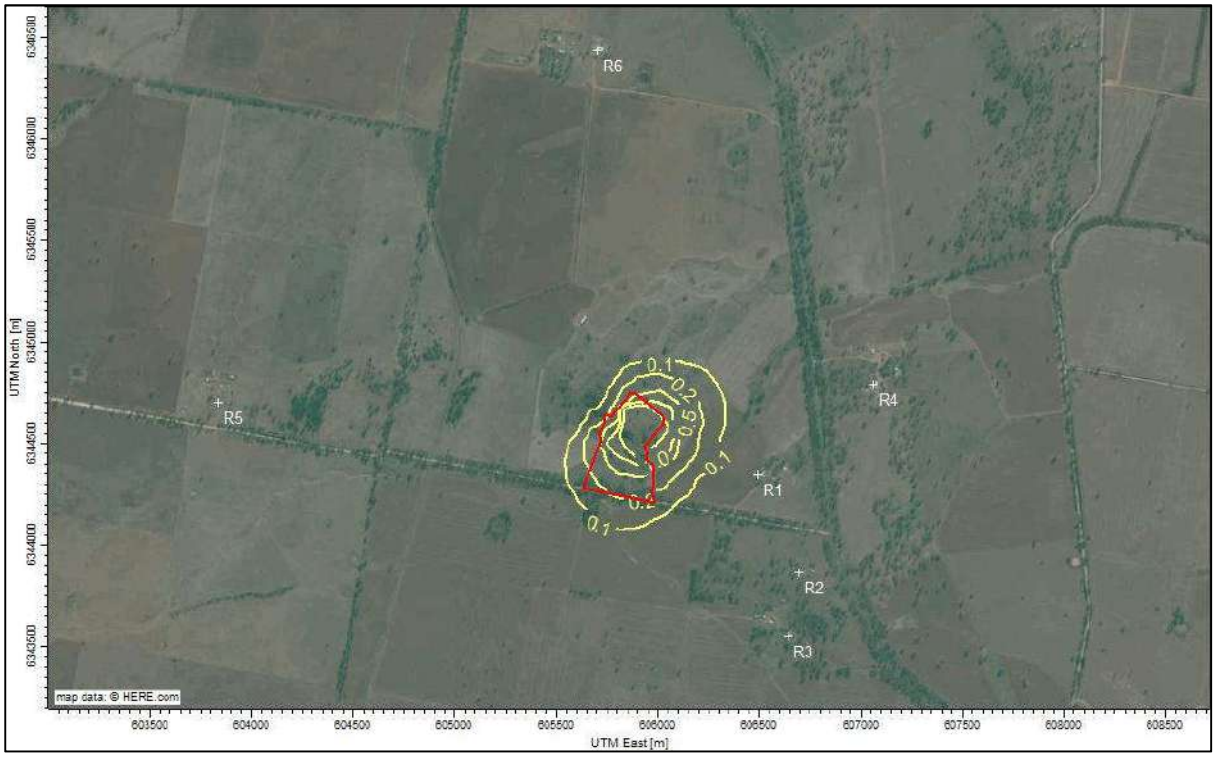

Figure 20: Future Operations: Predicted Dust Deposition (g/m^2/month)

Appendix G

PETROGRAPHIC REPORT

GEOCHEMPET SERVICES, BRISBANE

Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

[redacted]

PETROGRAPHIC REPORT ON A BALLAST SAMPLE (144053) FROM CUDAL LIME PRODUCTS FOR K&H GEOTECHNICAL SERVICES

Prepared for

BORAL RESOURCES (NSW) PTY LTD
MATERIALS TECHNICAL SERVICES

Purchase Order: 5122914

Invoice Number: 00005257

Client Ref: George Calvar

Issued By: [redacted]

K. E. Spring B.Sc.(Hons), MAppSc
15 August 2013

GEOCHEMPET SERVICES, BRISBANE

Sample Number:	144053	**Date Sampled**:	Unknown
Product Type:	Ballast	**Date Supplied**:	10/07/13
Sample Source:	Cudal Lime Products		
Client:	K&H Geotechnical Services		
Work Requested	Petrographic analysis in relation to suitability for use as ballast and marine armour rock		
Methods	In accordance with ASTM C294 Standard Guide for Petrographic Assessment of Railway Ballast and to the content of the 1996 publication of Standards Australia (AS 2758.7 – Appendix B), entitled Aggregates and Rock for Engineering Purposes- Part 7: Railway Ballast, and in accordance with ASTM D4992-07 Standard Guide for Evaluation of Rock to be used for Erosion Control		
Identification	Basalt or basaltic andesite		

Description

The ballast sample consisted 6 kg of hard, robust, angular fragments of essentially unweathered to superficially weathered, greyish black basalt. Some fragments show hints of a trivial degree of weathering in the form of a few brown, ferruginous coatings on exposed joint surfaces. The rock can only be very lightly scratched by a steel tool.

A thin section was prepared to permit detailed microscopic examination in transmitted polarised light of slices from 3 random fragments. An approximate average composition of the ballast, expressed in volume percent and based on a brief count of 100 random points in thin section, is:

Primary components

45%	plagioclase feldspar
14%	clinopyroxene
5%	opaque oxides (magnetite and/or ilmenite)
<1%	apatite

Secondary minerals

16%	chlorite and chlorite-smectite
3%	sericite
1%	calcite
15%	epidote
1%	prehnite
trace	quartz

In thin section, the rock is seen to be strongly plagioclase, augite, former olivine and opaque oxide-phyric basaltic lava. The three fragments shows a significant difference in the degree of alteration of the plagioclase phenocrysts, showing almost fresh plagioclase with well preserved oscillatory compositional zoning to plagioclases that are heavily pervaded by turbid, very fine-grained microcrystalline-epidote-sericite intergrowths.

The plagioclase phenocrysts make up around 25-35% of the rock and are mainly blocky prisms from 0.5 – 3 mm long. Augite phenocrysts are quite fresh greenish crystals (about 5%) from 0.5 – 3 mm long that often carry chloritized ovoid melt inclusions and common small opaque oxide inclusions. Mainly sub-millimetre size former olivine micro-phenocrysts now replaced by fine-grained polycrystalline quartz, carbonate and chlorite make up <1% of the rock. The two more altered fragments are weakly vesicular, with around 5% of spherical to ovoid vesicles now filled by green chlorite-smectite, or lined by green chlorite and cored by prehnite in one fragment. Opaque oxide phenocrysts are slightly rounded sub-millimetre grains, often attached to or included within augite phenocrysts and they appear to be entirely fresh. Notably large and common apatite micro-phenocrysts are present in all fragments.

The groundmasses of all three fragments are turbid, very fine-grained, probably originally glassy intergrowths charged with tiny plagioclase microlites that are well preserved in the finer-grained fragment with fresh plagioclase phenocrysts. Strong development of murky chlorite and microcrystalline epidote overprints the devitrified glass (and plagioclase microlites in two fragments), and occasional narrow chlorite-carbonate veinlets cut the rock.

Comments and Interpretations

The supplied ballast sample (labelled 144053) sourced from Cudal Lime Products is considered to be crushed and screened aggregate generated from formerly glassy basalt or basaltic andesite, a basic volcanic rock. The presence of the common apatite micro-phenocrysts suggests that these basaltic lavas have shoshonitic affinities, and the alteration reflects regional sub-greenschist facies burial metamorphic degradation.

For engineering purposes, the rock represented in the supplied aggregate sample may be summarised as:

- **basalt** or basaltic andesite (a basic volcanic igneous rock)
- now finely crystalline
- essentially unweathered (but showing minor specks of oxidation attributable to a surficial degree of weathering)
- heavily altered
- secondary mineral content about 36% (of which 16% consist of robust minerals-epidote and prehnite)
- soft, weak minerals amount to about 20% consisting of chlorite-smectite, sericite and calcite
- **hard**
- **strong**

The basalt is predicted to be **essentially durable**.

Thus, basaltic aggregate of the type represented by the supplied sample is predicted to be **suitable for use as ballast**.

Rock equivalent to the supplied sample is considered to be **adequate for use as a source of marine armour rock** (because of the 20% of soft, weak minerals may allow slow penetration by seawater) provided that a quarry assessment is made to check if blocks of sufficient size are free of weaknesses such as fractures/veining and jointing.

Free Silica Content

Estimated to be a trace amount of quartz.

Appendix H

SOIL AND WATER MANAGEMENT PLAN

GOONUMBLA QUARRY EXPANSION
SOIL AND WATER MANAGEMENT PLAN

PREPARED FOR
AUSROCK QUARRIES PTY LTD

MARCH 2018

GOONUMBLA QUARRY EXPANSION

SOIL AND WATER MANAGEMENT PLAN

PREPARED FOR:

AUSROCK QUARRIES PTY LTD

MARCH 2018

GEOLYSE

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Report Title:	*Goonumbla Quarry Expansion*
Project:	*Soil and Water Management Plan*
Client:	*Ausrock Quarries Pty Ltd*
Report Ref.:	*215453_REP_002B.docx*
Status:	*Final*
Issued:	*14 March 2018*

Geolyse Pty Ltd and the authors responsible for the preparation and compilation of this report declare that we do not have, nor expect to have a beneficial interest in the study area of this project and will not benefit from any of the recommendations outlined in this report.

The preparation of this report has been in accordance with the project brief provided by the client and has relied upon the information, data and results provided or collected from the sources and under the conditions outlined in the report.

All data and calculations contained within this report is prepared for the exclusive use of Ausrock Quarries Pty Ltd to accompany this report for the land described herein and are not to be used for any other purpose or by any other person or entity. No reliance should be placed on the information contained in this report for any purposes apart from those stated therein.

Geolyse Pty Ltd accepts no responsibility for any loss, damage suffered or inconveniences arising from, any person or entity using the plans or information in this study for purposes other than those stated above.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 BACKGROUND

The Goonumbla Quarry is within Lot 32 DP 816454, Wyatts Lane, Goonumbla, located approximately 12 km north-west of Parkes in Central West NSW.

The quarry was disused prior to the proponent seeking approval in 2013 to commence quarrying operations. Development Consent No. DA12097 was granted by Parkes Shire Council on 16 July 2013, approving the disturbance of 1.8 ha and extraction of 21,700 m^3 per year (58,590 tonnes based on a density of 2.7 tonnes/m^3).

Ausrock Quarries Pty Ltd proposes to expand the existing quarry operation to extract and process at higher rates than the current approval (DA12097). The proposal would comprise the following:

- Expansion of the existing quarry to extract up to 724,700 cubic metres (m^3), increasing the quarry footprint by 1.90 ha.
- Establish bunding and an access road around the quarry pit extension, disturbing 1.84 ha.
- Establishment of additional processing equipment.
- Construction of a 7 m wide compacted gravel access road (1.45 ha) to a potential future rail siding site (to be constructed by Australian Rail Track Corporation [ARTC]). The use of this access road is not proposed via this DA. The use of this access road would be addressed by a future DA modification.

1.2 PURPOSE

Geolyse was engaged by Ausrock Quarries Pty Ltd to prepare a Soil and Water Management Plan (SWMP) for the proposed hard rock quarry expansion as a component of an Environmental Impact Statement (EIS) to address the 'Secretary's Environmental Assessment Requirements' (SEARs) for the proposed expansion.

2.0 SITE DESCRIPTION

2.1 LOT DESCRIPTORS

The extent of existing and proposed quarrying activity is contained within Lot 32 DP 816454. The existing quarry extents are shown in **Figure 1**.

2.2 TOPOGRAPHY AND DRAINAGE

The quarry lies on the crest of a small hill in an area of gently undulating land. The site generally falls to the south and east with a small section falling towards the north-east.

Site topography and drainage has been modified by quarry activity. The quarry area has been excavated and work platforms have been created through filling for stockpiling and processing areas. Constructed drains are used to control water movement through and around the site.

Historic drainage changes include the diversion of an ephemeral drainage line that crosses the south-east corner of the site. This drainage line has a catchment of approximately 1,580 ha to the north-east of the site. Upstream of where this drainage line crosses the site boundary, it is typically a wide shallow depression with no clearly defined channel.

Topographic mapping shows that this ephemeral drainage line previously discharged to a farm dam on the site before continuing in a south-west direction, crossing Wyatts Lane and continuing to another farm dam. The farm dam on the quarry site has been filled and part of the processing area platform extends across the shallow drainage depression. The platform diverts the drainage line to the south and around the toe of the work platform. The quarry access road crosses the diverted drainage line. Once past the work platform area, the drainage line generally follows its previous path crossing Wyatts Lane. Some minor works are evident on the land to the south of Wyatts Lane which directs water to an existing farm dam.

During consultation, a neighbouring landowner to the south raised existing concerns about water crossing over Wyatts Lane flowing down the road (towards the west), blocking and washing away a driveway on the southern side of Wyatts Lane (approximately 320 m west of the quarry access point).

Flow patterns were reviewed on site in consultation with Council in early 2017. This review identified that earth windrows along Wyatts Lane contributed to flow being conveyed along the roadway to the west. Other contributing factors included limited flow capacity in the drainage line to the south of Wyatts Lane and possible flow restrictions caused by the dam embankment to the south. All of these factors are external to the existing quarry operations.

While the existing quarry footprint has diverted the drainage line on the northern side of Wyatts Lane, the existing operations have not increased flows in the drainage line or contributed to the drainage issues that are experienced on Wyatts Lane to the west.

The quarry surface water management system separates the disturbed quarry area from surrounding surface water runoff and forms a controlled drainage area. The catchment area covered by the quarry would previously have added to local surface water runoff. The system is now enclosed and surface runoff is captured and reused which would slightly reduce the total catchment runoff.

2.3 EXISTING SOIL AND WATER MANAGEMENT

The existing quarry operations has an approved soil and water management plan (SWMP) which aims to protect the water quality of off-site watercourses proximal to the site. The principles adopted in the SWMP include:

- minimisation of disturbed areas by containing all erosion and sediment controls within the working area;
- minimising the soil erosion potential during operation;
- diversion of clean water from undisturbed areas around or away from disturbed areas;
- controlling water movement through the site;
- the use of temporary erosion control measures as required;
- directing stormwater runoff from disturbed areas to a sediment basin;
- adequate maintenance of control structures; and
- progressive rehabilitation to minimise the disturbed catchment area.

An overview of the existing quarry SWMP is provided in **Figure 1**. Upslope clean runoff is currently diverted around the disturbed quarry area. The existing quarry footprint, stockpile area and processing area form a controlled drainage area from which all runoff is directed to a sediment basin.

The existing sediment basin was sized in accordance with the guidelines provided in *Managing urban stormwater: soils and construction* (Landcom, 2004) and *Volume 2E Mines and quarries* (DECC, 2008) as a Type D basin. It provides a design pond volume of 1,235 m^3.

Water collected in the sediment basin is currently used for dust suppression and process water (dust suppression during processing).

A component of the existing SWMP is re-shaping of the earth mound and work platform in the south-east corner of the site which is aimed at improving site drainage to the existing sediment basin. These works will be completed independent of the proposed quarry expansion.

Figure 1: Goonumbla Quarry

3.0 SOIL AND WATER MANAGEMENT PLAN

3.1 INTRODUCTION

The proposed quarry expansion would increase the controlled drainage area managed by the existing soil and water management measures. Therefore the existing controls would need to be augmented to accommodate the larger quarry footprint. Augmentation of the existing soil and water management measures would be undertaken consistent with the design principles adopted for the existing quarry site as outlined in **Section 2.3**.

In addition, erosion and sediment control measures would need to be employed for the proposed haul road from the quarry site to the rail siding.

These works are described in the following sections and shown on the drawings contained in **Appendix A**. All elements are subject to detailed design following approval.

3.2 QUARRY SITE

3.2.1 Surface Water Drains

The entire quarry footprint including stockpile and processing areas would be surrounded by surface water drains and diversion bunds that would:

- divert clean surface water runoff away from disturbed areas; and
- collect runoff from disturbed areas and direct it to the sediment basin.

Rock check dams would be used to control flow velocity. Discharge points for the clean water diversion drains would include level spreaders to convert channel flow to sheet flow.

The proposed quarry expansion would include permanent and temporary drains to achieve surface water control. Permanent drains would be constructed and rehabilitated to provide stable surface water conveyance. Temporary drains would be constructed and relocated as required as quarry operations progress.

Initial staging of the quarry would be designed to ensure water from the pit discharges as surface flow to the sediment basin. Once the pit cannot drain via gravity (i.e. when the pit floor goes below outside surface levels during Stage 2 of extraction – a 10 m cut to the quarry floor) all runoff would be contained in the pit and then pumped to the sediment basin as required or used directly for dust suppression.

3.2.2 Sediment Basin

A key parameter for sizing quarry sediment basins is the disturbed catchment area. The proposed quarry expansion would increase the disturbed catchment and the existing sediment basin would need to be enlarged to manage the additional runoff.

Sediment Basin Sizing

The required capacity of the sediment basin for the proposed quarry expansion was determined using the sizing guidelines provided in *Managing urban stormwater: soils and construction* (Landcom, 2004) and *Volume 2E Mines and quarries* (DECC, 2008).

Consistent with Section 6.1 of *Volume 2E Mines and quarries* (DECC, 2008) and the previous SWMP the following default parameters were adopted:

- Type D soil classification
- Soil hydrologic group D

- Erodibility (K-factor) of 0.05

A 90th percentile 5-day design criteria was adopted (35.6 mm for Dubbo; Table 6.3a (Landcom, 2004)).

The required sediment basin volume was determined as:

V = settling zone + sediment storage zone

The settling zone was calculated in accordance with the equation provided in Section 6.3.4(i) of *Managing urban stormwater: soils and construction* (Landcom, 2004) using the adopted default parameters.

The capacity of the sediment storage zone was calculated as two months soil loss as calculated with the revised universal soil loss equation (Section 6.3.4(j), (Landcom, 2004)) with the following parameters:

R = 1300 (Appendix B, Landcom, 2004)

K = 0.05 (adopted default parameter)

LS = 1.19 (80 m slope length; 5% slope)

P = 1.3 (compacted and smooth surface)

C = 1.0 (no cover)

A sediment density of 1.7 t/m^3 was adopted.

The contributing disturbed catchment area was determined from the proposed expansion plans. A summary of the required sediment basin volume is provided in **Table 3.1**.

The required volume is approximately 2,700 m^3 which is over two times the volume of the existing basin. The existing sediment basin would be enlarged to provide this design volume.

Table 3.1 – Sediment basin sizing

Basin	Disturbed catchment area ha	Settling Zone m^3	Sediment Storage Zone m^3	Volume Required m^3	Comments
Sediment Basin	11.3	2,575	111	2,686	The catchment area includes the entire proposed quarry area including the quarry perimeter access road.

3.2.3 Progressive Rehabilitation

The site would be progressively rehabilitated to reduce the amount of disturbed area.

3.2.4 Temporary Controls during Construction

Temporary erosion and sediment controls would be used during the construction stage. These may include:

- Delineation of work areas and minimisation of disturbed areas;
- Strategic watering to control wind erosion;
- Sediment trapping devices including silt fence, straw bales and rock check dams; and/or
- Use of geotextile for erosion protection in concentrated flow areas.

All temporary control measures would be maintained and would remain in place until contributing catchment areas have been adequately stabilised.

3.3 HAUL ROAD

Elements of the haul road are subject to detailed design and would incorporate the following erosion and sediment control design principles:

- The road would be shaped to drain to longitudinal table drains;
- Table drains would be shaped to discharge runoff to stable areas at regular intervals (mitre drains);
- Temporary sediment control structures (silt fence, coir logs, straw bales or rock check dams) would be placed at intervals along the table drains to control flow velocity and trap sediment;
- Small culverts would be used at drainage lines crossing the road to avoid driving through water; and
- Sediment traps would be installed where table drains discharge to drainage line crossings.

All erosion and sediment control measures would be maintained and would remain in place until contributing catchment areas have been adequately stabilised.

3.4 WATER CYCLE MANAGEMENT

The proposed quarry expansion would require water for site dust suppression and process water.

A daily water balance model was used to assess the overall water cycle for the quarry operations. The model uses 127 years of daily SILO rainfall and evaporation data for the site (1 January 1889 to 31 December 2015). The SILO data interpolates rainfall and evaporation values from surrounding climate stations to provide a long term data set for the specific location.

The water cycle is broken down into its various components and then the inflows and outflows are modelled for each section.

3.4.1 Storages

Storage Inflows

- Sediment basin – receives runoff the contributing disturbed catchments; and
- All open storages receive direct rainfall input.

Storage Outflows

- Sediment basin – water for dust suppression and process water;
- Spill from sediment basin; and
- Evaporation from the sediment basin.

3.4.2 Water Demand

Water is used on the site for dust suppression and process water. The following assumptions are used to estimate the demand.

Dust Suppression

Water for dust suppression is drawn from the sediment basin and distributed across working areas using a water cart.

The water balance model adopted the following for dust suppression water:

- Dust suppression water applied if:
    1. Rainfall on the current day is less than 5 mm; and

2. There is sufficient water in the Sediment Basin.

- The amount of dust suppression applied is the minimum of:
  1. 40% of the daily evaporation; or
  2. 3 mm.

Process Water

Water is required to suppress dust during processing.

Process water is equivalent to 2.5% of the throughput (i.e. for each tonne of material processed, 25 L of water is used).

Process water is used six days per week (Monday to Saturday) with demand based on the average daily throughput to achieve the annual extraction limit.

Water Quality

Water for dust suppression and process water is supplied from the sediment basin – there are no quality limits for this reuse.

Therefore no specific water treatment processes are required.

Domestic Water and Wastewater

Potable supplies are provided by bottled water.

Portable amenities are provided with wastewater removed off-site.

3.4.3 Water Balance results

Water balance results expressed as average annual flows are shown in **Figure 2** and show:

- There is adequate capacity in the augmented site surface water management system to supply the water demands across the site. This indicates there is adequate water on site to ensure effective dust control.
- The spill frequency from the sediment basin meets design requirements. Table 6.2 in Volume 2E (DECC, 2008) indicates that the indicative average annual sediment basin overflow frequency for a 95th percentile design criteria is 1-2 spills/year. The sediment basin spills on average once every year which is consistent with the existing approved basin.
- It is concluded from this assessment that the proposed augmentation to the existing surface water management system can be managed to meet relevant design guidelines.

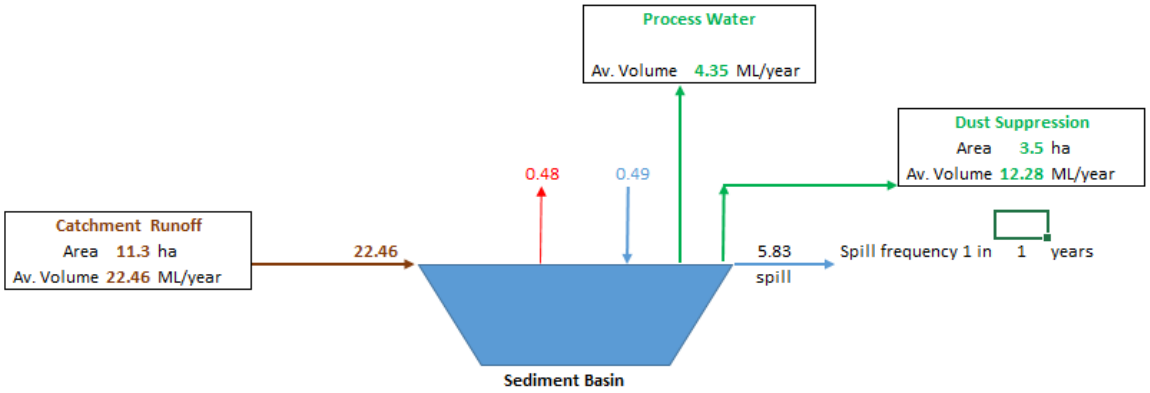


Figure 2: Goonumbla Quarry – water balance results (average annual volumes in ML/year)

3.4.4 Sediment Basin Discharge

Spill from the sediment basin would initially be contained within the working area. However, during extreme rainfall events, once ponding within the working area reaches the level of the discharge point from the site, spill may occur.

The sediment basin would be managed so that it is drawn down to maintain the design volume indicated in **Table 3.1** within 5 days following a storm so that the basin can subsequently retain runoff from the next storm. Markers would be placed in the sediment basin to indicate the required design volume.

If water needs to be discharged off-site (rather than being used on-site), it would be managed using the procedures outlined in Appendix E of *Managing urban stormwater: soils and construction* (Landcom, 2004) prior to discharge. That is, water would not be manually discharged unless the total suspended solids concentration is less than 50 mg/L.

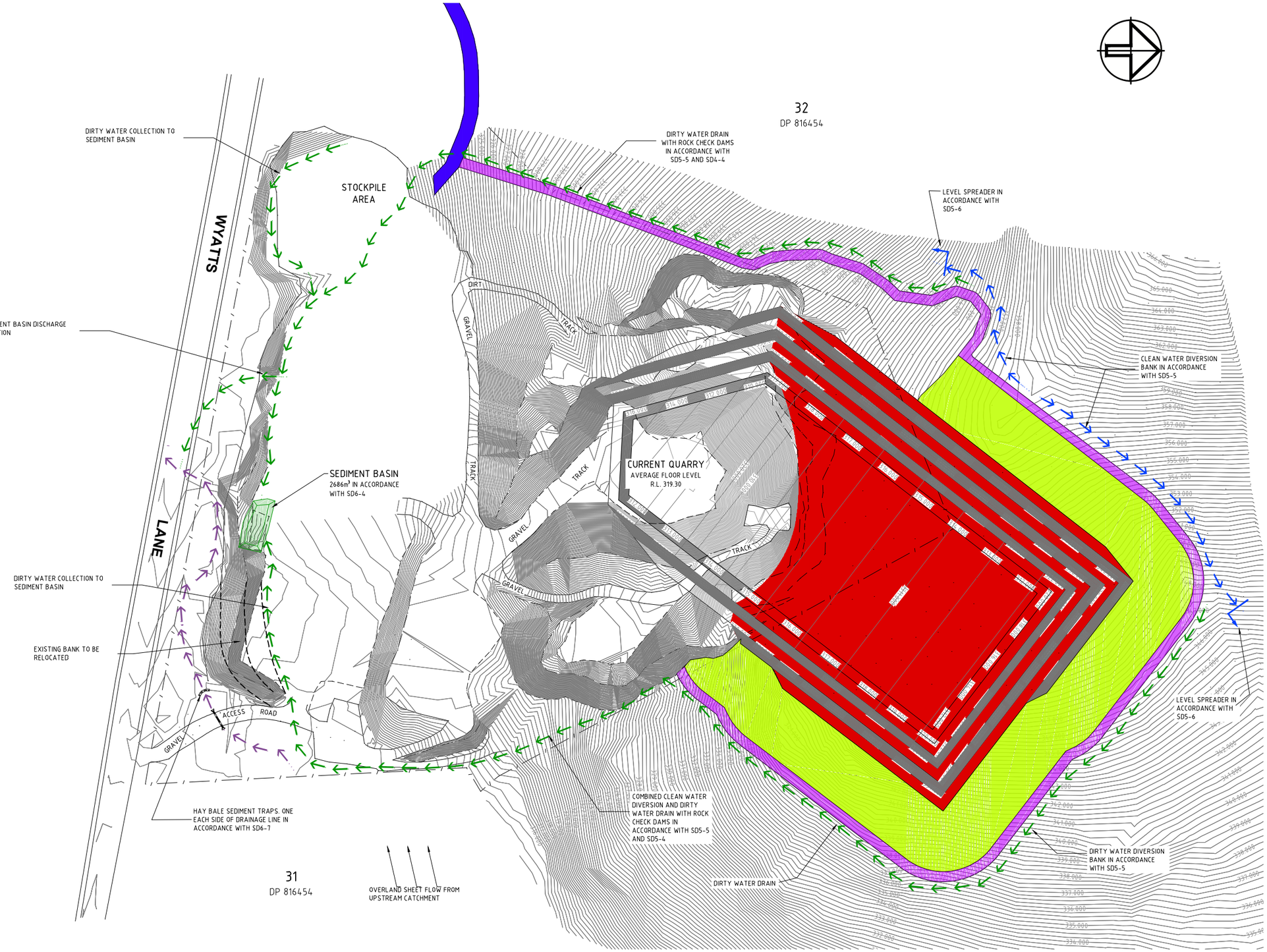
4.0 REFERENCES

Department of Environment & Climate Change (2008) *Managing urban stormwater: Soils and construction, Volume 2E Mines and quarries*.

Landcom (2004) *Managing urban stormwater: Soils and construction, Volume 1*.

Appendix A

SWMP DRAWINGS



NOTES:

1. THIS PLAN IS PREPARED FROM A FIELD SURVEY FOR THE PURPOSE OF DESIGNING NEW CONSTRUCTIONS ON THE LAND AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE.
2. VISIBLE SERVICES HAVE BEEN LOCATED ONLY. PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT AUTHORITIES SHOULD BE CONTACTED FOR LOCATION OF FURTHER UNDERGROUND SERVICES AND DETAILED LOCATIONS OF ALL SERVICES.
3. CONTOUR INTERVAL 0.25m.
4. THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.
5. SURVEY DATE : 10 MAY 2016

Sediment Basin Sizing

Disturbed catchment area	11.3	ha
Soil classification	Type D	
Soil hydrologic group	D	
Design ARI	90th	%ile
5-day rainfall depth (Dubbo)	35.6	mm
Cv	0.64	
USLE		
R	1300	
K factor	0.05	
LS	1.19	
P	1.3	
C	1	
Soil density	1.7	t/m³
Settling zone volume	2575	m³
Sediment storage zone	111	m³
Sediment Basin Volume	**2686**	**m³**

DIAL BEFORE YOU DIG www.1100.com.au

LEGEND:

- BUNDING 30M WIDE, 3M HIGH. APPROX. 1.43ha)
- QUARRY EXPANSION (4m STRIPPING)
- ACCESS ROAD (5m WIDE, 0.44 ha)
- ROAD TO SIDING)7m WIDE, 1.43 ha)
- SEDIMENT BASIN
- DIRTY WATER DRAIN
- CLEAN WATER DIVERSION BANK
- LEVEL SPREADER IN ACCORDANCE WITH SD5-6
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING WATERCOURSE
- BANK RELOCATION

REV.	DATE	DFTD.	APPD.	DETAILS
A	20-3-17	GT	MH	DRAFT ISSUE
B	27-04-17	GT	MH/AW	NOTES & AERIAL ADDED
C	15-04-17	GT	AW	STAGE 1 AND 2 ADDED
D	27-02-18	GT	AW	REVISED
E	09/03/18	AP	-	FOR REVIEW
F	13/03/18	GT	CB	REVISED

	FILE	INITIALS	DATE
SURVEY	215453.mjo	SB	18/12/15
DESIGN	-	-	-
DRAINS/ HEC-RAS MODELLING	-	-	-
ENGINEERING/ SURVEYING APPROVAL		-	-

DRAWING SCALE

SCALE 1:1000 (A1)

0 20 40 60 80 100

0 20 40 60 80 100

SCALE 1:2000 (A3)

DO NOT SCALE FROM THESE DRAWINGS. ALL MEASUREMENTS SHALL BE CONFIRMED ON SITE AND WITH GEOLYSE PTY. LTD. PRIOR TO CONSTRUCTION

APPROVAL AUTHORITY

CLIENT: AUSROCK QUARRIES PTY LTD

PROJECT: GOONUMBLA HARD ROCK QUARRY

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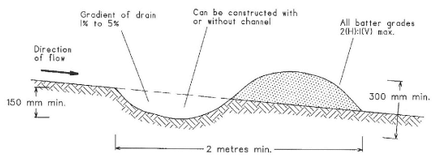
DRAWING: SOIL & WATER MANAGEMENT PLAN

PROJECT NUMBER 215453	DRAWING FILE 215453_03F_EV01-EV02.dwg	SIZE A1
SURVEY MARK	R.L. DATUM A.H.D.	SET 03
IMAGE SOURCE		
STATUS FOR REVIEW	SHEET EV01 OF EV02	

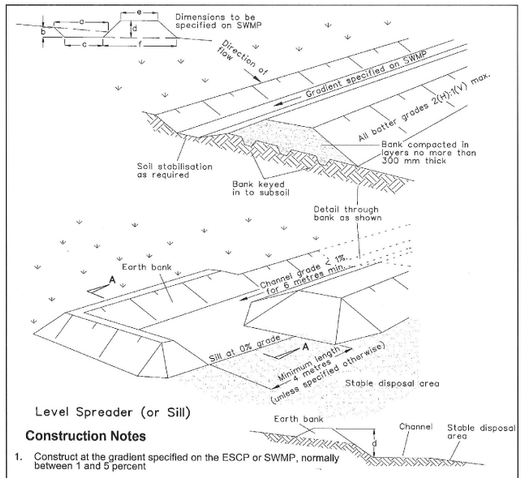


NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

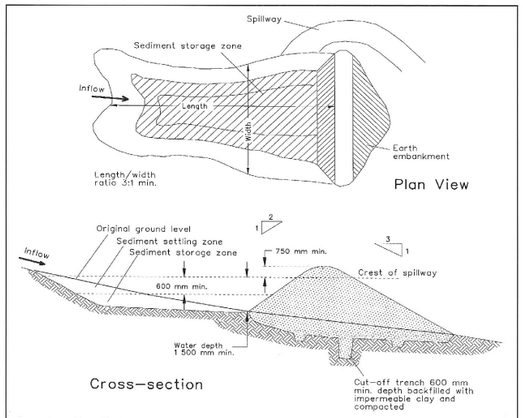
EARTH BANK (LOW FLOW) SD 5-5



Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS) SD 5-6

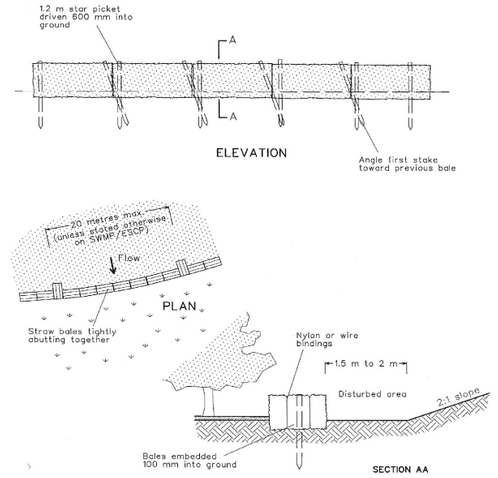


Construction Notes

1. Remove all vegetation and topsoil from under the dam wall and from within the storage area.
2. Construct a cut-off trench 500 mm deep and 1,200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
3. Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
4. Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
5. Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
6. Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
7. Construct the emergency spillway.
8. Rehabilitate the structure following the SWMP.

EARTH BASIN - WET SD 6-4

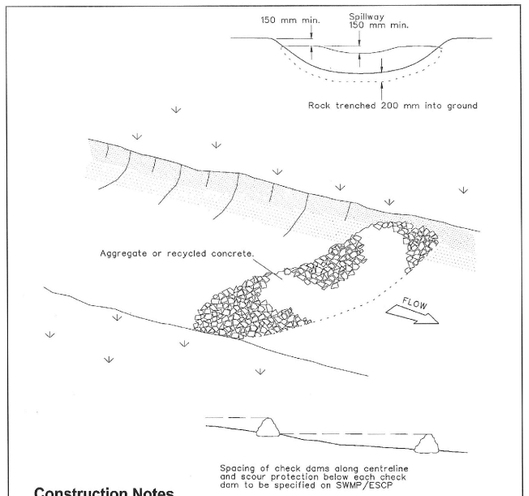
(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)



Construction Notes

1. Construct the straw bale filter as close as possible to being parallel to the contours of the site.
2. Place bales lengthwise in a row with ends tightly abutting. Use straw to fill any gaps between bales. Straws are to be placed parallel to ground.
3. Ensure that the maximum height of the filter is one bale.
4. Embed each bale in the ground 75 mm to 100 mm and anchor with two 1.2 metre star pickets or stakes. Angle the first star picket or stake in each bale towards the previously laid bale. Drive them 600 mm into the ground and, if possible, flush with the top of the bales. Where star pickets are used and they protrude above the bales, ensure they are fitted with safety caps.
5. Where a straw bale filter is constructed downslope from a disturbed batter, ensure the bales are placed 1 to 2 metres downslope from the toe.
6. Establish a maintenance program that ensures the integrity of the bales is retained - they could require replacement each two to four months.

STRAW BALE FILTER SD 6-7



Construction Notes

1. Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.
2. Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.
3. Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.
4. Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

ROCK CHECK DAM SD 5-4

REV.	DATE	DFTD.	APPD.	DETAILS
A	20-3-17	GT	MH	DRAFT ISSUE
B	27-04-17	GT	MH/AW	NOTES & AERIAL ADDED
C	15-04-17	GT	AW	STAGE 1 AND 2 ADDED
D	27-02-18	GT	AW	REVISED
E	09/03/18	AP	-	FOR REVIEW
F	13/03/18	GT	CB	REVISED

	FILE	INITIALS	DATE
SURVEY	215453.mjo	SB	18/12/15
DESIGN	-	-	-
DRAINS/ HEC-RAS MODELLING	-	-	-
ENGINEERING/ SURVEYING APPROVAL		-	-

DRAWING SCALE

DO NOT SCALE FROM THESE DRAWINGS. ALL MEASUREMENTS SHALL BE CONFIRMED ON SITE AND WITH GEOLYSE PTY. LTD. PRIOR TO CONSTRUCTION

APPROVAL AUTHORITY

CLIENT: AUSROCK QUARRIES PTY LTD

PROJECT: GOONUMBLA HARD ROCK QUARRY

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DRAWING: SOIL & WATER MANAGEMENT FIGURES

PROJECT NUMBER 215453 | DRAWING FILE 215453_03F_EV01-EV02.dwg | SIZE A1

SURVEY MARK | R.L. | DATUM A.H.D. | SET 03

IMAGE SOURCE

STATUS FOR REVIEW | SHEET EV02 OF EV02