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"Wave Hill" Quarry

ENVIRONMENTAL IMPACT STATEMENT

Johnstone Concrete and Landscape Supplies Pty Ltd
173 Old Gunnedah Road, Narrabri NSW 2390

June 2020

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

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"Wave Hill" Quarry

ENVIRONMENTAL IMPACT STATEMENT

Johnstone Concrete and Landscape Supplies Pty Ltd
173 Old Gunnedah Road, Narrabri NSW 2390

Prepared by: SMK Consultants
39 Frome Street, Moree, NSW 2400

June 2020

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DOCUMENT CONTROL

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Proponent	Johnstone Concrete and Landscape Supplies Pty Ltd
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Report Number	17-173 – Environmental Impact Statement
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0	June 2020	Peter Taylor (SMK Consultants)	Initial Issue

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CERTIFICATE

Environmental Planning and Assessment Act, 1979

Submission of an Environmental Impact Statement (EIS)
Prepared under the Environmental Planning and Assessment Act 1979 and meeting the requirements for clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

This Environmental Impact Statement has been prepared by SMK CONSULTANTS PTY LTD to accompany a Development Application made in respect of the development described as follows:

Development:	**500,000 tonne/year Hard Rock Quarry**
Applicant:	**Johnstone Concrete and Landscape Supplies Pty Ltd**
Address:	"Wave Hill" 975 Wave Hill Road Tarriaro NSW 2390
Land to be developed:	Lot 77 in Deposited Plan 754937 Lot 89 in Deposited Plan 821255

Environmental Impact Statement:
The contents of this Statement, as required by Schedule 2 of the Environmental Planning and Assessment Regulation 2000, are set out on the following pages.

Certificate: I certify that I have prepared the contents of this Statement and to the best of my knowledge:

- It has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*;
- It contains all available information that is relevant to the environmental assessment of the development to which the statement relates; and
- The information contained in this Statement is neither false nor misleading.

Signature: *Peter Taylor* **Date: June 2020**

Peter Taylor B.Sc. MEIANZ CIAg LAA
Director
SMK Consultants

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EXECUTIVE SUMMARY

This development proposal has been prepared by SMK Consultants on behalf of Johnstone Concrete and Landscape Supplies Pty Ltd ("the Applicant") to support the increased annual extraction limit of the existing "Wave Hill" quarry. The current extraction limit for the quarry is 200,000 tonne/year and it is proposed to increase this to 500,000 tonne/year.

Applicant:	Johnstone Concrete and Landscape Supplies Pty Ltd PO Box 878 Narrabri, NSW 2390
Owner:	Johnstone Family Pty Limited PO Box 878 Narrabri, NSW 2390
Land involved:	Lot 77 in Deposited Plan 754937 Lot 89 in Deposited Plan 821255
Local Government Authority:	Narrabri Shire Council
Zoning:	'RU1' under the Narrabri Local Environmental Plan 2012
Development Type:	Designated and Integrated Development
Development Description:	Increased Production of Existing Quarry Operations
Capital Investment Value:	$150,000

Approvals and Licences

The following approvals are required to amend operations at the existing quarry at Wave Hill:

- Development Approval for Regional Development – Extractive Industry from the Joint Regional Planning Panel (JRPP) under the *State Environmental Planning Policy (State and Regional Development) 2011.*
- Environmental Protection Licence from the NSW Environment Protection Authority issued under the *Protection of the Environment Operations Act (1997).*

The Proposed Development

The proposed development involves increasing the annual limit for extraction of aggregate at the existing Wave Hill Quarry, a basalt quarry located approximately 24 kilometres east of Narrabri in north-west New South Wales. The extraction limit of the quarry would increase

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from 200,000 tonne/year to 500,000 tonne/year, with no associated increase in the footprint of the existing approved development or any change in peak daily production levels.

The aim of the proposed increased extraction limit is to enable Wave Hill Quarry to effectively supply raw material to large civil construction projects that are available in the region, including the Inland Rail Project, whilst continuing to meet the local demand of the mining and construction industries in the Narrabri Shire region.

The quarry is located within 20 kilometres of the railway line and it therefore has the advantage of relatively short haulage distances and associated lower delivery costs. Higher annual extraction limits applied to the existing quarry in order to supply raw materials to the Inland Rail Project would further provide economic benefits without significant environmental impacts, as the site has already been developed and disturbed for quarry activities. No vegetation clearance will take place as part of this proposal.

It is estimated that approximately 3 million tonne of basalt remains available within the existing quarry footprint if the quarry floor is lowered to the level of the existing weighbridge (RL 315). An additional 1 million tonne of rock could be extracted if the Proponent opts to lower the quarry floor further. The SEARs stipulate a maximum extraction limit of 4 million tonne of rock during the lifetime of the quarry. Discussions with the Proponent indicate that the lifetime of the quarry is estimated to be 15years – 40 years, depending on whether the Proponent is awarded a contract to supply the Inland Rail Project. Current annual production for local demand is in the order of 100,000 to 150,000 tonnes per annum.

A rehabilitation plan is included to ensure protection of environmental values following the conclusion of quarry operations.

Overall, it is considered that approval of the proposed increase in quarry throughput would not pose a risk to local and regional environmental values.

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1 Introduction

SMK Consultants have been engaged by Johnstone Concrete and Landscape Supplies Pty Ltd to prepare this Environmental Impact Statement (EIS). The report is to accompany a Development Application to the Narrabri Shire Council for an increased annual extraction limit of 500,000 tonne/annum at Wave Hill Quarry.

An EIS is required as the development is 'Designated Development' as described in Part 1 of Schedule 3 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) for 'Extractive Industries'. The proposed quarry would be permitted to extract up to 500,000 tonne of material per annum, with the extent of extractive activities limited to the current approved footprint of Wave Hill Quarry.

A Development Application pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) will be lodged with Narrabri Shire Council who will assess the development. The application is classified as 'Regional Development' and will be determined by the relevant Joint Regional Planning Panel under the *State Environmental Planning Policy (State and Regional Development) 2011.*

The development is also classified as 'Integrated Development' pursuant to Section 4.46 of the EP&A Act, as approvals from other government agencies are required, specifically the NSW Environment Protection Authority. As a 'land-based extractive activity' that involves the extraction, processing, or storage of more than 30,000 tonnes per year of extractive materials, the proposal is classified as a 'Scheduled Activity'. The existing Environment Protection Licence 20139 issued under the *Protection of the Environment Operations Act 1997* (POEO Act) will require amendment to enable the increase in annual extractions.

The EIS addresses the environmental assessment requirements of the Secretary of the Department of Planning and Environment (the SEAR's), dated 11 July 2018. This EIS focuses on the key assessment requirements specified by the SEAR's and proposed mitigation measures where possible to reduce potential environmental impacts. It is supported by specialist technical reports.

1.1 Authors

The persons involved in the preparation of this Environmental Impact Statement and its appendices are:

- **Natasha Livingstone** B.Sc. (Hons)
- **Marie Duffy** B.Sc. (Hons) M.Sc.
- **Peter Taylor** B.Sc. MEIANZ CIAg

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1.2 Applicant Details

The applicant for the proposed development is Johnstone Concrete and Landscape Supplies Pty Ltd. The applicant's contact details are summarised in Table 1.

Table 1: Applicant Details

Organisation	**Johnstone Concrete and Landscape Supplies Pty Ltd**
Postal Address	PO Box 878
	Narrabri NSW 2390
Phone Number	(02) 6792 3036
Contact Name	Brock Johnstone
Email	admin@jcls.net.au

1.3 Background

Wave Hill Quarry is a basalt quarry which is used to supply quarry materials for construction and infrastructure projects throughout the region. The current owners purchased Wave Hill Quarry in 2003 with the quarry already operational on site. The quarry was first approved in 1997 under DA 52/1997 for the extraction of 68,640 tonnes of basalt rock per annum. In 2014, a development application (DA 60/2013) was approved to increase the annual extraction limit to 200,000 tonnes/annum in response to an increased regional demand for construction materials. The quarry is currently licensed under Environment Protection Licence (EPL) 20139.

The existing quarry currently meets local demand for materials within the locality. It is noted that the quarry usually produces approximately 100,000 – 150,000 tonnes of material per year, with occasional production peaks up to approximately 180,000 tonnes in the event of large contracts.

Construction of the Inland Rail Project through Narrabri will result in a significantly increased demand for a range of quarry materials throughout the next three years or more. The proposed increase of the current annual extraction limit is intended to ensure that Wave Hill Quarry is able to meet contractual requirements of larger contracts such as Inland Rail while ensuring that background demand for resources within the region continue to be met.

The Inland Rail Project is a Federal Government project to construct a 1,700km rail line to connect Melbourne to Brisbane via western NSW. The route predominantly passes through productive agricultural districts, and aims to provide an efficient, cost-effective freight route to inland industries and to reduce the strain on the public road network.

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The Inland Rail Project is sub-divided into 13 distinct projects. The two projects which are likely to be supplied by Wave Hill Quarry include the Narromine to Narrabri Project and the Narrabri to North Star Project. The Narromine to Narrabri Project is the longest greenfield section of the Inland Rail programme to be delivered, spanning a distance of approximately 307 kilometres. The Narrabri to North Star Project requires reconstruction of 186 kilometres of existing track and the construction of approximately 2.3 kilometres of new rail corridor.

The proposal would involve extracting a range of quarry materials from Wave Hill Quarry and transporting this material by road to construction sites along the Inland Rail route. Wave Hill Quarry is located approximately 24 kilometres east of the proposed Inland Rail route. The close proximity of Wave Hill to the Inland Rail route will decrease the construction costs of the Inland Rail by minimising costs associated with haulage and will contribute to minimising the impact of the construction period of Inland Rail upon the wider regional road network.

Overall planning and identification of specific quarry materials for the project has not been completed, however it is noted that few approved quarries are located along this route.

1.4 Project Site

The subject site is located at 975 Wave Hill Road, Tarriaro, approximately 24 kilometres east of Narrabri. A locality plan is presented in Figure 1.

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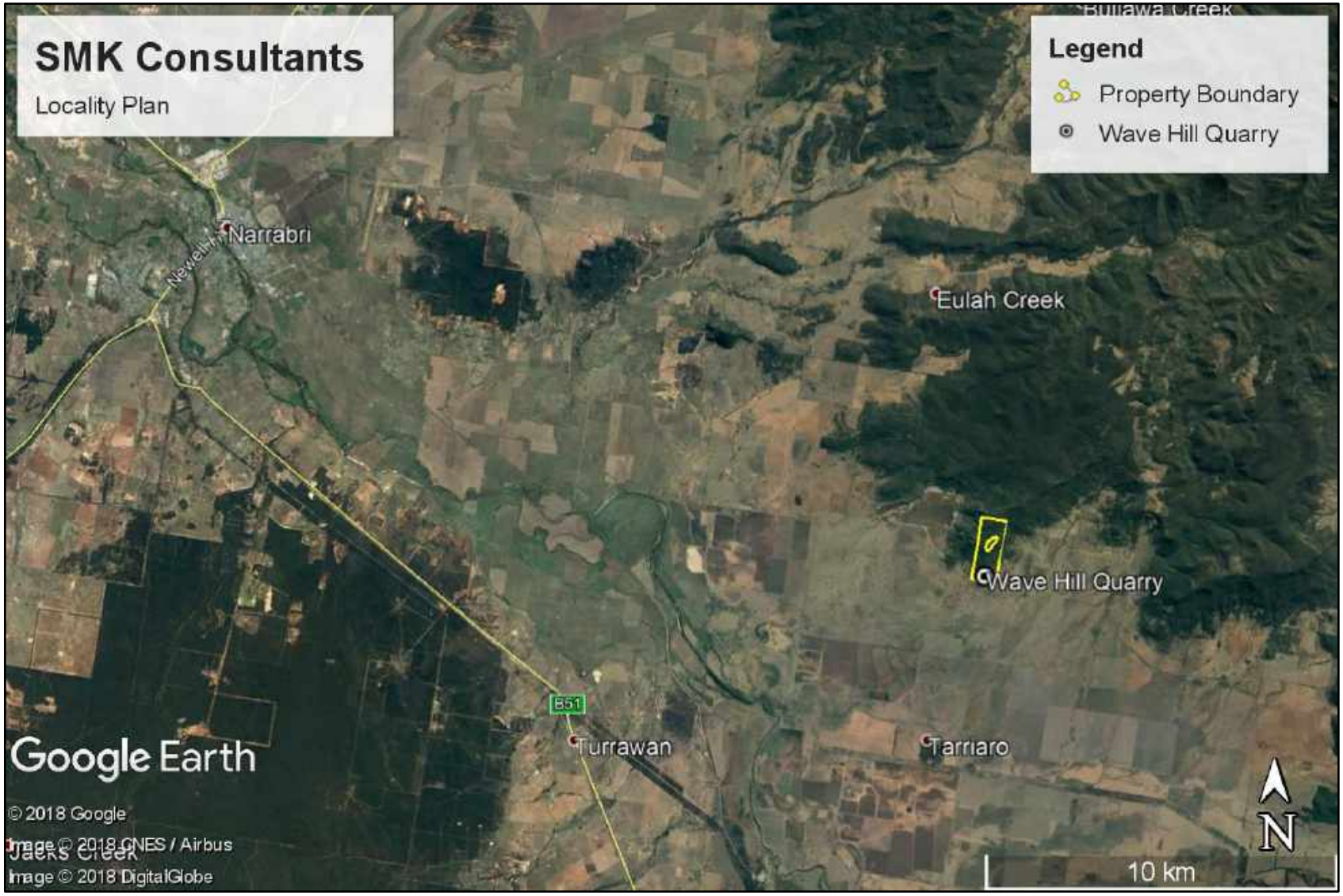

Figure 1: Wave Hill Quarry Locality Plan

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1.4.1 Property Description

The real property description of the land includes Lot 77 in Deposited Plan 754937 and Lot 89 in Deposited Plan 821255. The site is located within the Local Government Area (LGA) of the Narrabri Shire Council and consists of a combined area of approximately 123.3 hectares. The land is currently zoned RU1 'Primary Production' under the *Narrabri Local Environmental Plan 2012*. Surrounding land uses generally comprise rural agricultural land to the south (including grazing and crop production) and remnant vegetation to the north used for grazing.

Another smaller quarry, operated by Boral Limited, is located on the adjoining property, approximately 1 kilometre to the west of Wave Hill. The Boral Quarry has a current EPL for 100,000 tonnes/year.

A parcel of Crown Land (Lot 88 DP 821255) is incorporated within the property boundary of the subject site. A registered trigonometrical site (TS6956) is located within this parcel of Crown Land.

Figure 2 indicates the location of Wave Hill Quarry in relation to neighbouring landscape features.

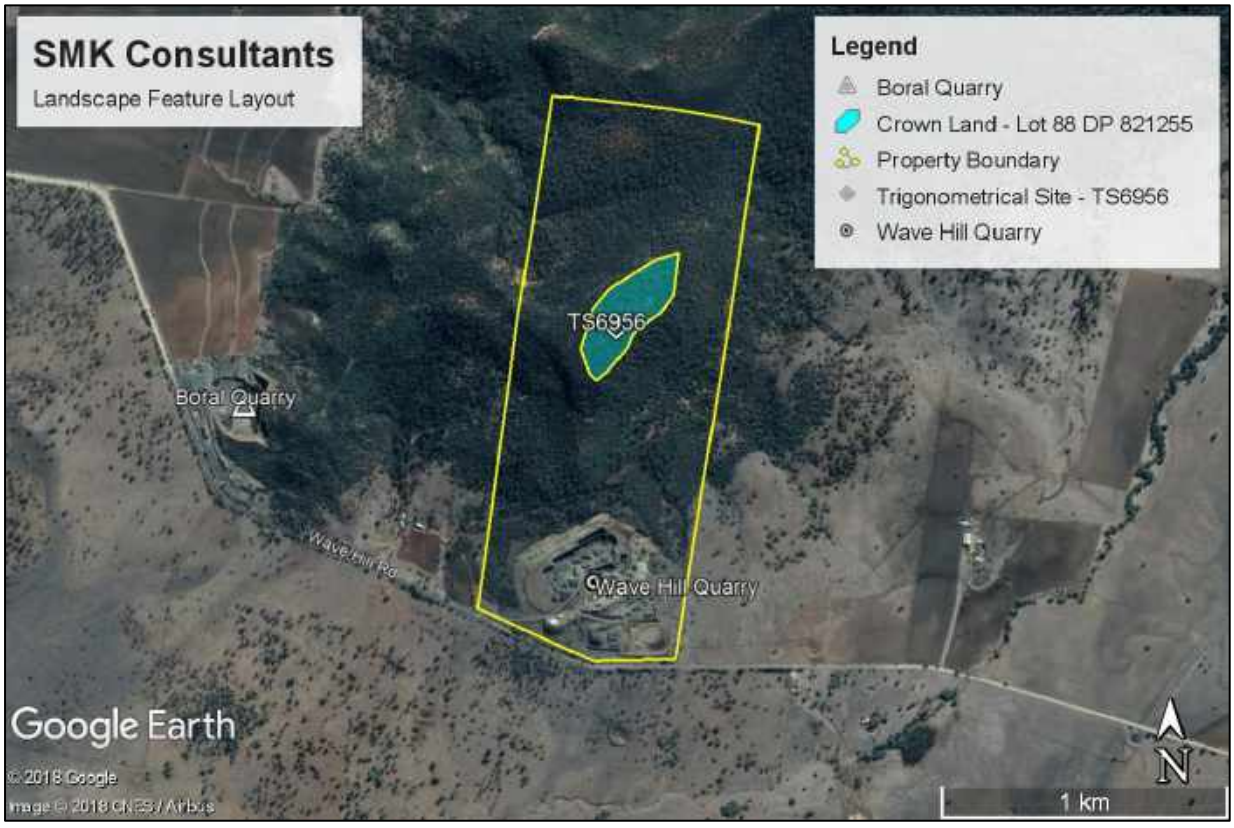

Figure 2: Locations of Wave Hill and Boral Quarries

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The current footprint of Wave Hill Quarry covers approximately 24 hectares. The proposal seeks the obtention of an increased annual extraction limit while retaining an identical footprint boundary. An outline of the existing quarry footprint in presented in Figure 3.

The quarry is located on a deposit of early Permian basalt.

1.4.2 Surrounding Land Uses

The subject lots are located on the lower western slopes of the Nandewar Range. The land to the north of the subject site is dominated by regrowth and remnant vegetation on the foothills of the Range. The quarry site is located approximately 3km south of boundary of the Deriah Aboriginal Area and 4km west of the southern boundary of Mt Kaputar National Park (Figure 4).

The remainder of the surrounding land is typically heavily cleared and utilised for agricultural production, including grazing and cropping enterprises. The main land use in the district is the cultivation of winter cereals. The rich clay soils produce high yielding crops with the generally reliable rainfall supplying sufficient soil moisture through the winter period. Many farms grow a rotation of winter and summer crops to maximize production and soil moisture utilisation. The crop rotations include extensive fallow periods and stubble retention, protecting the soil from erosion during summer storms.

The subject site is approximately 24 kilometres east of Narrabri, a rural town with a population of 5,903 as of the 2016 census. The site is also located approximately 21 kilometres north of Baan Baa, a small silo town within the Narrabri LGA with a recorded population of 163 in 2016. The wider Narrabri LGA recorded a total population of 13,084 as of the 2016 census.

Towns and villages within Narrabri LGA largely rely upon the surrounding rural community for the bulk of their income. The main industry in the Narrabri LGA is Agriculture, Fishing and Forestry, which accounts for approximately 20% of the workforce. Additional key industries include Health Care and Social Assistance (10%), Retail (9%), Education and Training (7%), Accommodation and Food Services (6%), Construction (6%), and Mining (6%).

A small number of quarries currently exist within the region, the closest of which is Boral Quarry, located approximately 1km to the west. The Boral Quarry has a current EPL for 100,000 tonnes/year.

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Figure 3: Wave Hill Property Plan

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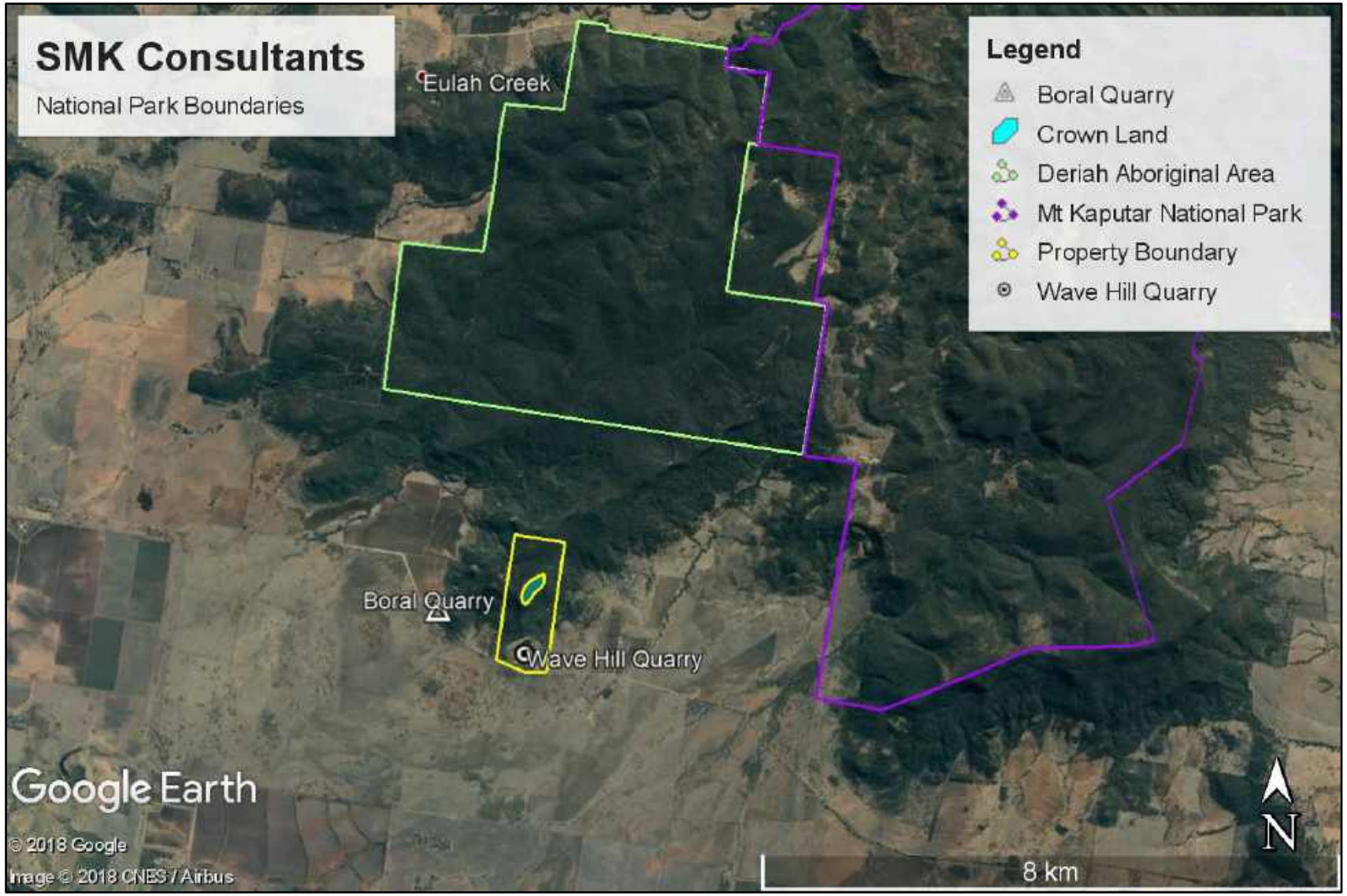

Figure 4: National Park Property Boundaries Adjacent to Wave Hill Quarry

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1.4.3 Services and Utilities

Wave Hill Quarry is accessible via Wave Hill Road (SR18). Wave Hill Road is partially sealed and functions as a collector road for a farming area, in addition to servicing traffic from the neighbouring Boral Quarry. The road is trafficable in all weather conditions apart from times of extreme flood events. The proponent has previously contributed funding to the redevelopment of Wave Hill Road. The quarry's internal access road within the property is bitumen sealed between Wavehill Road and the weighbridge site office.

The site has access to 3 phase power, with small 2kVa generators on site which serve as a backup power source for the weighbridge in the event of a power outage. Mobile phone service is available onsite and provide the primary form of telecommunications. A bore is present on site which provides a minor volume of water that could potentially be used for basic landholder rights only. The quarry has a sediment pond which also captures the 10-percent harvestable right and has been approved as a pollution control structure during previous development applications.

1.5 Approvals and Licences

The following approvals are required to increase the annual extraction limit at Wave Hill Quarry:

- Development Approval for Regional Development – Extractive Industry from the Joint Regional Planning Panel (JRPP) under the *State Environmental Planning Policy (State and Regional Development) 2011.*
- Environmental Protection Licence from the NSW Environment Protection Authority issued under the *Protection of the Environment Operations Act (1997).*

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2 Consultation

Planning and design of the Proposal has been informed by various stakeholders from inception of the Proposal. The following subsections provide an overview of the consultation undertaken and the methods used to seek input and to inform stakeholders about the Proposal, including the processes to identify issues for consideration within the EIS.

2.1 Government Agencies

2.1.1 Secretary's Environmental Assessment Requirements

A request for SEARs was lodged with the Department of Planning and Environment (DPE) on the 4th of June 2018. SEARs were supplied on the 11th of July 2018. The following table provides the nominated requirements of the EIS and the section in which these considerations are addressed. It is noted that when a request for SEARs was lodged, the Proponent intended to expand the Wave Hill Quarry to the north of the existing development and to increase the annual extraction limit to 500,000 tonne per annum. Following flora and fauna assessment results, the Proponent determined not to extend the current approved footprint of the quarry. The EIS therefore addresses the SEARs listed to the extent that it is deemed applicable to the modified proposal. DPIE – Planning was advised of the decision not to extend the quarry footprint. They advised that "*The amended proposal is not anticipated to generate additional environmental impacts when compared to the original proposal at the time SEARs were issued. As such, it is not considered necessary to obtain a new or revised SEARs.*"

Table 2: Secretary's Environmental Assessment Requirements

Requirement	Section
General Requirements The EIS must include:	
• an executive summary;	p. vi
• 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;	Sections 1 & 3
○ identification of the resource, including the amount, type, composition;	Appendix 3
○ the layout of the proposed works and components (including any existing infrastructure that would be used for the development);	Section 3.2.1
○ a detailed description of proposed extraction methods;	Section 3.2.5
○ 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;	Section 5
○ a detailed rehabilitation plan for the site;	Appendix 11
○ any likely interactions between the development and any existing/approved developments and land uses in the area, paying particular attention to potential land use conflicts with nearby	Appendix 6

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Requirement	Section
residential development; ○ a list of any other approvals that must be obtained before the development may commence; ○ the permissibility of the development, including identification of the land use zoning of the site; ○ 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; ○ a summary of all proposed environmental management and monitoring measures for the development, including detailed procedures to ensure that extraction does not exceed 500,000 tonnes per year, or 4 million tonnes over the life of the development; • a conclusion justifying why the development should be approved, taking into consideration: ○ alternatives; ○ the suitability of the site; ○ the biophysical, economic and social impacts of the project, having regard to the principles of ecologically sustainable development; and ○ whether the project is consistent with the objects of the Environmental Planning and Assessment Act 1979; and • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading.	Section 1.5 Section 4.1 Section 1.4.2, Section 5.5 Section 6 Section 7 Section 4.3.1 p. v
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 and affected communities that may be impacted by the development. 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.	Section 2
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: • **Noise** – including a quantitative assessment of potential: ○ construction and operational noise and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline, NSW Noise Policy for Industry and NSW Road Noise Policy* respectively; ○ reasonable and feasible mitigation measures to minimise noise emissions; and ○ monitoring and management measures; • **Blasting & Vibration –** ○ proposed hours, frequency, methods and impacts; and	Section 5.8 and Appendix 5

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Requirement	Section
○ 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, buildings, livestock, infrastructure and significant natural features;	Section 3.2.5 and Appendix 5
• **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*. 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 5.7 and Appendix 4
• **Water** – including: ○ a detailed site water balance and an assessment of any volumetric water licensing requirements, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; ○ identification of any licensing requirements or other approvals required under the *Water Act 1912* and/or *Water Management Act 2000*; ○ demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP) ○ 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; ○ an assessment of activities that could cause erosion or sedimentation issues, and the proposed measures to prevent or control these impacts; ○ an assessment of any likely flooding impacts of the development; ○ an assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; and ○ a detailed description of the proposed water management system, water monitoring program and other measures to mitigate surface and groundwater impacts;	Section 5.9 and Appendix 10
• **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, populations and ecological communities and groundwater dependent ecosystems undertaken in accordance with Sections 7.2 and 7.7 of the *Biodiversity Conservation Act 2016*; and ○ a detailed description of the proposed measures to maintain or	Section 5.10 and Appendix 8

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Requirement	Section
improve the biodiversity values of the site in the medium to long term, as relevant.	
• **Heritage –** including: ○ an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including a surface survey undertaken by a qualified archaeologist and 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; 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 relevant policies and guidelines listed in Attachment 1;	Section 5.11
• **Traffic &Transport –** including: ○ accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; ○ 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; ○ 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, including future options for legal access to Lot 88 DP821255;	Section 5.13 and Appendix 9
• **Land Resources–** including an assessment of: ○ invasive species; ○ potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); ○ potential impacts on landforms (topography), paying particular attention to the long-term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and ○ 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*;	Section 5.15 Section 5.3 Section 5.12.3 Section 4.4.2

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Requirement	Section
• **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;	Section 5.14
• **Hazards** – including an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks and the transport, storage, handling and use of any hazardous or dangerous goods;	Section 5.14 & Section 5.12.1
• **Visual** – including an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, including with respect to any new landforms;	Section 5.6
• **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;	Section 5.17 & Section 5.18
• **Cumulative impacts** – an assessment of the likely cumulative impacts of the proposed development in combination with other established quarries in the locality, having particular regard to air quality, noise and blasting and traffic impacts; and	Section 5.19
• **Rehabilitation –** including: ○ a detailed description of the proposed rehabilitation measures that would be undertaken throughout the development and during quarry closure; ○ 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, recognising that a rehabilitation bond will likely be required as a condition of any future development consent.	Appendix 11
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. During the preparation of the EIS you must also consult the Department's EIS Guideline – Extractive Industries – Quarries. This guideline is available at http://www.planning.nsw.gov.au/~/media/Files/DPE/Guidelines/extractive-industries-quarries- eis-guideline-1996-10.ashx . In addition, the EIS must assess the development against the *Narrabri LEP 2012* and any relevant development control plans/strategies.	Section 4.6 & Section 4.7

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2.1.2 Other Government Agency Requirements

The assessment requirements from the following government agencies were also requested as part of the SEARs:

- Narrabri Shire Council
- NSW Department of Industry – Crown Lands and Water (Crown Lands)
- NSW Department of Primary Industries – Agriculture (DPI Ag)
- Environment Protection Authority (EPA)
- NSW Department of Planning and Environment – Resources and Geoscience (DPE Resources & Geoscience)
- NSW Office of Environment & Heritage (OEH)
- NSW Rural Fire Service (RFS)
- NSW Roads & Maritime Services (RMS)
- Water NSW

A copy of the correspondence received from each agency is provided in Appendix 2.

Narrabri Shire Council

Narrabri Shire Council requested that the following issues be considered, with appropriate mitigation measures outlined:

- The new Section 94 Contributions Plan (refer to Section 4.6.7);
- The impacts of the development upon the public road network, including a Traffic Impact Assessment (refer to Section 5.13 and Appendix 9);
- Rehabilitation measures for the site to demonstrate the site can be returned to agricultural land use, including consideration of potential contamination (refer to Appendix 11);
- Impacts on residential receptors, including a Visual Impact Assessment (refer to Section 5.5 & Section 5.6); and
- Bushfire hazards and mitigation measures (refer to Section 5.12.1)

Narrabri Shire Council further requested that a pre-development application meeting be held between Council and the proponent to further discuss key points for consideration. This is addressed in Section 4.8.3.

NSW Department of Industry – Crown Lands and Water (Crown Lands)

Crown Lands requested the following issues be considered, with appropriate mitigation measures outlined (Section 4.8.3):

- The impact of the development proposal upon Crown Perpetual Lease 109315 held by Kristian John Bogdanoff be considered (with regards to dust/noise and vibration), including direct consultation with Mr Bogdanoff (see Section 2.2 and Section 4.8.3);
- Provide future options for legal access to Lot 88 DP 821255;

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- Consult with the Office of the Registrar General to assess potential impacts to TS6956 in Lot 88 DP 821255; and
- Consult with Forestry NSW with regards to the possible addition of Crown Perpetual Lease 109315 to the estate of Forestry NSW.

NSW Department of Primary Industries – Agriculture (DPI Ag)

DPI Ag have requested the following issue be considered, with appropriate mitigation measures outlined:

- Separation distances from sensitive receptors (refer to Section 5.5.1);
- Impacts on surrounding agricultural resources and land (refer to Section 5.4);
- The estimated water demand and details on a suitable and secure water supply (refer to Section 5.9);
- Include a biosecurity (pests and weeds) risk assessment and management plan (refer to Section 5.15);
- Visual factors for neighbouring farm residences and operations (refer to Section 5.6);
- Impact of proposal on the final landform and the proposed rehabilitation of the site (refer to Appendix 11); and
- Consultation with adjoining rural stakeholders (refer to Section 2).

Environment Protection Authority (EPA)

The EPA requested that the EIS consider the potential for impact on the following key environmental parameters:

- Air (refer to Section 5.7 & Appendix 4):
    - Consider the potential impacts of dust on adjacent rural residences and management of potential impacts; and
    - Prepare an air quality impact assessment (AQIA).
- Noise and Vibration (refer to Section 5.8 & Appendix 5):
    - Consider the proximity to sensitive receptors and impact of any sources upon sensitive receptors associated with the project.
- Waste, Chemicals and Hazardous Materials (refer to Section 5.14):
    - Identify, characterise and classify all waste;
    - Provide details of how waste will be handled and managed onsite to minimise pollution, including:
        - Stockpile locations and management; and
        - Erosion, sediment and leachate control measures.
    - Provide details of how the waste will be handled and managed during transport to a lawful facility.
- Soils (refer to Section 5.3):

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- Present an assessment of potential impacts on soil and land resources, providing the nature and extent of any impacts and paying particular attention to:
  - Soil erosion and sediment transport;
  - Mass movements; and
  - Urban and regional salinity.
- Include a description of the mitigation and management options that will be used to prevent, control, abate or minimise identified soil and land resource impacts.

- Water (refer to Sections 5.9, 5.14 and Appendix 10):
  - Present an assessment of potential impacts on water, with reference to:
    - Any potential water discharge;
    - Provision of a water balance, including water requirements and proposed disposal;
    - Details of erosion, sediment and leachate control measures, with particular consideration of how leachate from stockpiled material will be separated from stormwater runoff, and any proposed transport and disposal of leachate off-site;
    - How stormwater and runoff will be managed to minimise pollution and erosion; and
    - Assessment of the potential impacts of the development upon surface water and groundwater quality within the locality.

NSW Department of Planning and Environment – Resources and Geoscience (DPE Resources & Geoscience)

DPE Resources and Geoscience have requested the EIS include a resource assessment that:

- Documents the size and quality of the resource and demonstrates that both have been adequately addressed; and
- Documents the methods used to assess the resource and its suitability for the intended application (refer to Appendix 3).

NSW Office of Environment & Heritage (OEH)

The OEH request that the EIS include an adequate assessment of:

- Potential impacts to Aboriginal cultural heritage (refer to Section 5.11.2);
- Potential impacts to biodiversity (refer to Section 5.10 & Appendix 8);
- Potential impacts to land reserved or acquired under the National Parks and Wildlife Act 1974 (refer to Section 4.3.4);
- Flooding and floodplain management (refer to Section 5.12.2);
- Historic heritage (refer to Section 5.11.1); and
- Cumulative impacts (refer to Section 5.19).

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NSW Rural Fire Service (RFS)

RFS requested that the following matters be considered (refer to Section 5.12.1):

- Aims and objectives of 'Planning for Bushfire Protection' (RFS 2006);
- Potential ignition sources, storage of fuels and other hazardous materials (e.g. explosives for blasting);
- Proposed bushfire protection measures;
- Operational access for firefighting appliances to the site; and
- Emergency and evacuation planning.

NSW Roads & Maritime Services (RMS)

RMS requested that the EIS be supported by a Traffic Impact Assessment (TIA) prepared in accordance with the methodology set out in the RTA's Guide to Traffic Generating Developments (2002). These matters are addressed in Section 5.13 & Appendix 9.

Water NSW

Water NSW identified the following key assessment requirements of the EIS:

- Access to surface and groundwater resources (refer to Section 5.9 & Appendix 10 (water balance)):
    - Annual volumes of surface water and groundwater to be taken from each water source (including via inflow and seepage) as defined by the relevant water sharing plan;
    - Assessment of volumetric water licencing requirements;
    - Assessment for the impact and approvals required for taking and/or storing water;
    - Identification of adequate and secure water supply for the life of the project; and
    - A detailed and consolidated water balance.
- Impact on surface and groundwater resources (refer to Section 5.9):
    - Assessment of impacts on:
        - Surface and groundwater sources (quantity and quality);
        - Related infrastructure;
        - Adjacent licensed water users;
        - Basic landholder rights;
        - Watercourses;
        - Riparian land; and
        - Groundwater dependent ecosystems.
    - Full details of all surface water and groundwater modelling;
    - Proposed surface water and groundwater monitoring activities and methodologies; and
    - Management and disposal of produced or incidental water.

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- Flooding (refer to Section 5.12.2):
    - Assessment is required for any earthwork, embankment or levee which is reasonably likely to affect the flow of water to or from a river or lake.

2.2 Landholders

Wave Hill Quarry is located in close proximity to the western, southern and eastern property boundaries, and therefore has the potential to impact upon adjoining landholders and properties. The quarry site currently operates in accordance with an Operational Environmental Management Plan (OEMP), which stipulates a range of management measures on site to protect adjoining landholders from adverse impacts. The OEMP is reviewed on a regular basis to ensure the document remains current and reflects industry best practice standards. Should the proposal be approved, the current OEMP would be reviewed to ensure that it accurately reflects current work methods and practices on site, is up to date with current industry best practice, and incorporates any new mitigation measures detailed in this EIS.

Surrounding landholders with the potential to be impacted by the proposal include three rural dwellings, shown in Figure 5.

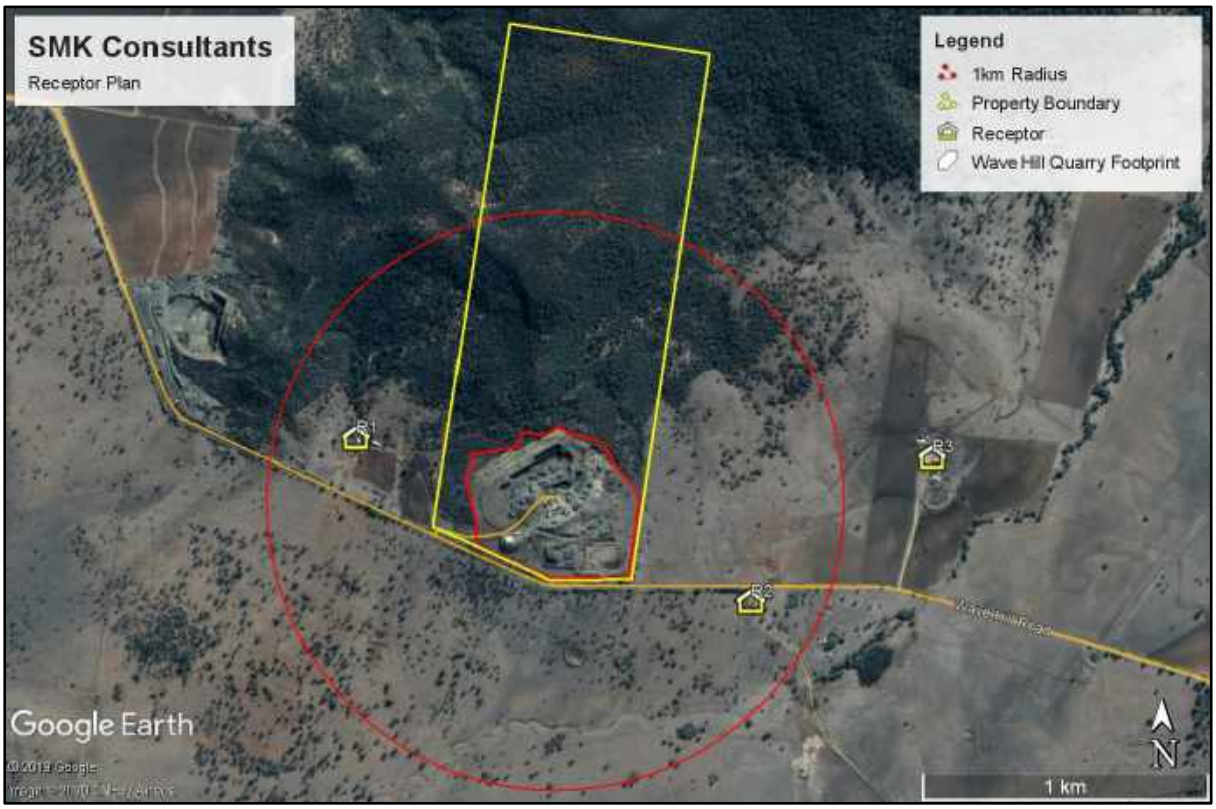

Figure 5: Adjacent Sensitive Receptors

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Table 3 outlines the separation distances between the receptors shown in Figure 5 and Wave Hill quarry.

Table 3: Sensitive Receptor Separation Distances

Receptor	Receptor Name	Receptor Type	Direction from Quarry	Distance (m)
1	Glen Aston	Rural Dwelling	West	380
2	Brenowen House	Rural Dwelling	South-East	430
3	Wavehill Residence	Rural Dwelling	East	1,030

Following obtention of development approval for current quarry operations in 2013, the Proponent was required to form a community consultation process. Consultation has been ongoing with the owners and residents of the sensitive receptors outlined in Figure 5, in relation to site operations, truck movements, noise impacts and other operational activities identified to be of concern on occasions. The Onsite Environmental Management Plan developed in following the approval included a complaint procedure process.

JCLS also consulted directly with Kristian John and Nicole Bogdanoff (sensitive receptor R1) at their residence "Glen Aston" on 22 June 2017. A number of issues were discussed, including dust and noise impacts and notification methods prior to blasting. Mr. Bogdganoff has issued a number of complaints relative to the Wave Hill Quarry operations over time, and a formal process has been developed whereby Mr. Bogdanoff can now directly address complaints to the NSW Environmental Protection Agency, with the Proponent implementing appropriate measures in response to address potential issues.

It is noted that an acoustic and air quality monitoring program is in place at each of the sensitive receptor locations, as required by the EPL pertaining to the Wave Hill Quarry (EPL 20139). This monitoring enables the regular evaluation of the impacts of the existing development upon local residents and allows for remedial actions to be taken swiftly to improve on-site practices where/when excessive noise or dust production is detected. Results of noise and dust monitoring to date indicates that Wave Hill Quarry is compliant with air quality thresholds specified by the EPA, but noise production from the quarry has occasionally exceeded noise thresholds. Complaints that are received or data that identifies exceedances is recorded and actioned upon through the process outlined in the OEMP.

JCLS has commissioned an independent consultant to prepare an air quality and dust management validation report. This program is set out under section E2 of EPL 20139.

An Air Quality Impact Assessment and a Noise Impact Assessment have been carried out to monitor the impacts of the proposal on nearby sensitive receptors. These reports are included in Appendix 4 and Appendix 5, respectively.

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3 Proposed Development

The following sections describe the hard rock quarry, processing plant and associated activities to be carried out on site.

3.1 Objectives

The objective of the proposal is to increase the annual extraction limit of Wave Hill Quarry for a period of three or more years during the development of the Inland Rail and associated projects. Once the larger regional projects are completed, the intent is to reduce the annual extraction limit stated in the Environment Protection Licence back to 200,000 tonnes per annum. This will enable the quarry to supply materials to the Inland Rail Project whilst continuing to meet background demand.

The quarry will also need to meet or exceed current best practice in terms of environmental performance and environmental guidelines. This objective will be met by:

- Undertaking and managing all activities in a considered environmental, social and economic focused manner that minimises impacts on the site's biodiversity, water, soil, cultural and other values;
- Developing and implementing environmental management systems that incorporate robust monitoring and review processes consistent with current best practice standards; and
- Developing and implementing sustainable waste management procedures in all activities.

3.2 Description of Proposal

This Development Application (DA) seeks consent to increase the current approved annual extraction limit at Wave Hill Quarry to a maximum of 500,000 tonne of quarry material per year. The current annual extraction limit is set at 200,000 tonnes per year.

Current operations on site include the following key activities:

- Drilling and blasting;
- Crushing and screening within the quarry pit;
- Stockpiling and loading of materials;
- Transporting of materials on and off site; and
- Maintenance and servicing of equipment on site.

Operations on site also involve a suite of environmental protection measures, which are outlined in an Operational Environmental Management Plan (OEMP) and are adhered to on site. The OEMP outlines protection measures associated with:

- Air quality;

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- Chemicals;
- Flora and fauna;
- Noise/vibration;
- Groundwater;
- Surface water and soil; and
- Waste management.

Upon approval of the proposed expansion, the OEMP will be updated to incorporate changes to site operations at the quarry as a result of increased production volumes, thus ensuring ongoing environmental protection.

3.2.1 Project Site Layout

The site is well-developed with existing on-site primary and secondary crushing and screening machinery, workshop, weighbridge, worker amenities, a heavy dump truck, excavators and front-end loaders.

The proposal involves the operation of an existing primary hard rock quarry, incorporating the following key components:

- Site Office and Weighbridge
- Crushing & Screening Area
- Stockpiles
- Drains
- Sediment Pond
- Roads

The layout of the site is presented in Figure 6 and Figure 7 and Appendix 1.

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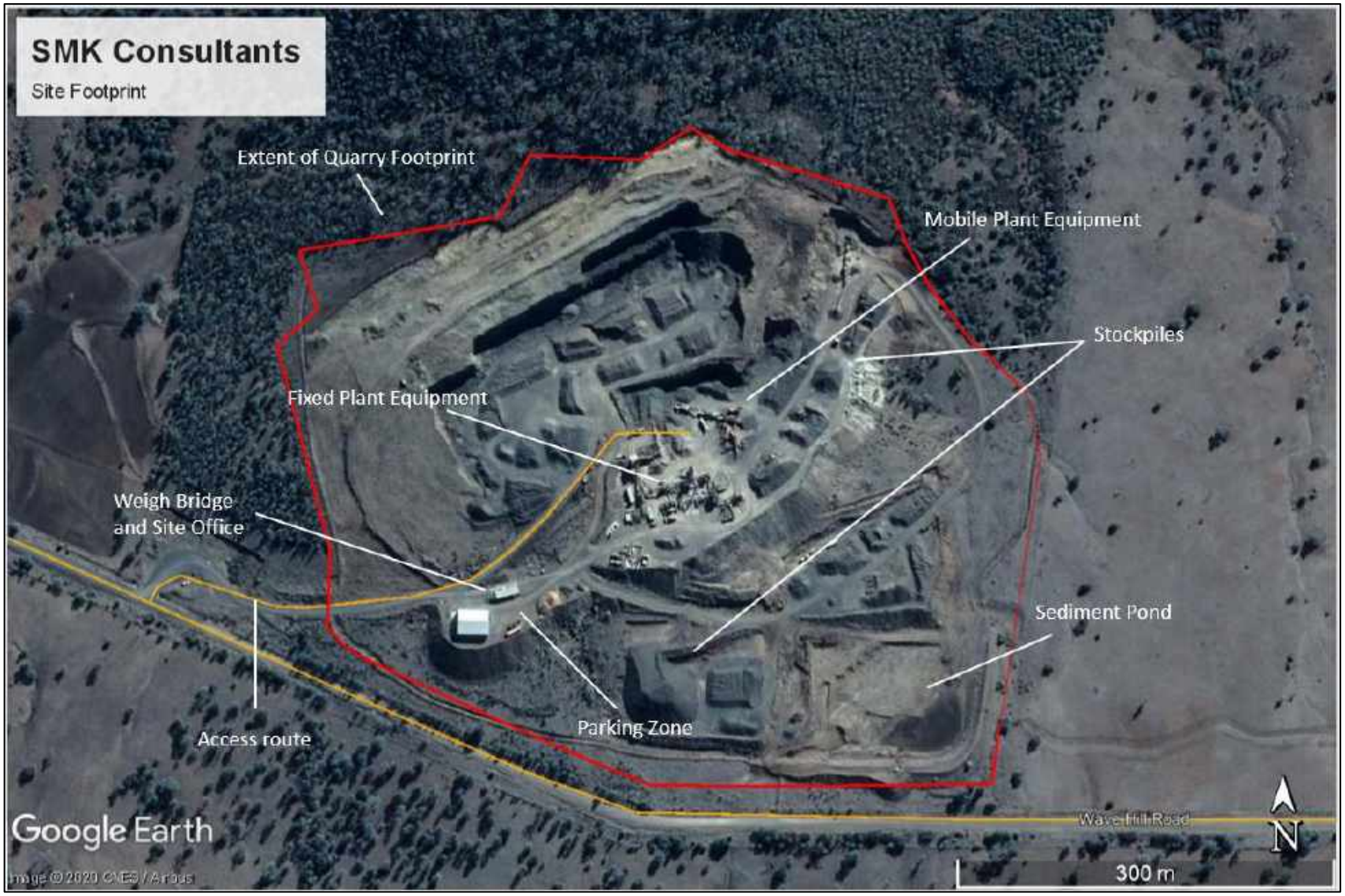

Figure 6: Wave Hill Quarry – Site Layout

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Figure 7: Layout of Fixed Plant Equipment at Wave Hill Quarry

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3.2.2 Quarry Footprint

The current quarry footprint covers approximately 24 hectares, as outlined in Section 1.4.1. The northern boundary of the quarry, which demarcates the northern limit of the extraction footprint, was clarified/approved by Narrabri Shire Council as part of a modification application in 2016. The proposal does not involve altering the development footprint. The additional quarry material will be obtained from within the existing footprint. The project may result in a shorter lifespan for the development.

3.2.3 Volumes

Any approval for the quarry activity is based around an annual extraction limit. In this case, the limit would involve the extraction of up to 500,000 tonnes of raw material per year.

3.2.4 Quarry Resources

Overall planning and identification of specific quarry materials for the Inland Rail project has not been completed, however it is noted that current Inland Rail project descriptions indicate that approximately 309km of new rail line will be constructed, and 186km of existing rail line will be reconstructed between Narromine and North Star. These works will require DGB type road base gravel, which is used as rail base material. This gravel is generally a manufactured gravel consisting of hard crushed basalt and a range of fines to achieve a stable gravel platform for the sleepers, rail line and ballast materials.

Wave Hill Quarry is located atop an outcrop of Permian basalt, which is recorded to extend over 68m below the natural ground surface. It is calculated that the current quarry site has approximately 3,068,949 tonnes of basalt remaining onsite, assuming the quarry floor is levelled to the current weighbridge level (RL 315). Additional rock could then be extracted by gradually lowering the floor of the quarry below the level of the weighbridge to reach a maximum extraction limit of 4 million tonne over the lifetime of the quarry.

At current extraction rates of 100,000 tonne per annum, the quarry has a lifetime of approximately 40 years. However, discussions with the Proponent indicate that, in the context of the current proposal, the quarry has an estimated lifespan in the order of 15.5 years beyond the current date, based on the following assumptions;

- The Proponent will quarry a maximum of 4 million tonne over the lifetime of the project;
- The rate of extraction will average up to 500,000 tonne per annum over a period of 3 years while the quarry supplies the Inland Rail Project;
- Materials will be quarried at an average extraction rate of 200,000 tonne per annum during ‘normal’ quarry operations outside of the Inland Rail contract duration.

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Testing indicates that the available basalt meets the requirements of Australian Standard AS 2758 – Aggregates and Rock for Engineering Purposes and is capable of providing material for the following uses:

- concrete aggregates;
- aggregates for sprayed bituminous surfacing;
- aggregates for gabion baskets and wire mattresses;
- asphalt aggregates; and
- railway ballast.

The material has been tested and supplied to Transport NSW, ARTC, Private Rail development and Local Council. The quarry material available has met the relevant specifications due to hardness of the rock and processing of the rock into a range of prepared gravel mixes. The quarry material is also used for production of ready mixed concrete in Narrabri.

Further detail on the available resources at the site are included within Appendix 3 'Resource Assessment'.

3.2.5 Operational Activities

3.2.5.1 Hard Rock Extraction

Extraction of the material will utilise traditional methods including drilling, blasting and a combination of mechanical methods such as ripping, excavating, use of excavators or hydraulic methods. Currently, blasting occurs approximately two to three times per year (every 4-6 months). In the event of approval of the proposal, it is predicted that the frequency of blasting on site will not increase, but rather that the blast tonnages will rise.

It is noted that explosives for blasting are not stored on site, but instead are brought on site by contractors on the day of use.

Extraction rates would be limited to below the development approval and EPL threshold of 500,000 tonnes of materials per year.

3.2.5.2 Crushing

Extracted material is passed through a primary crusher located close to the rock face and fed by an excavator. The crushed rock is then moved by loader to the secondary crusher and sieving system, allowing aggregates from 50-5mm to be manufactured.

A range of environmental protection measures are in place on site to minimise adverse impacts from crushing activities. These include:

- Dust suppression by watering;
- A 'Coolfog' foam dust suppression, heat reduction and odour control system;
- Use of dust covers and conveyor enclosures; and

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- Maintaining active monitoring of noise and dust levels, with management measures in place to slow or temporarily halt processing rates in the event of excessive dust/noise production.

3.2.5.3 Stockpiling and Loading

Following extraction, materials are to be stockpiled on site on the floor of the excavation pit behind the active face. Where possible, stockpiles are located to the south west and south east of active quarry operations to provide additional acoustic shielding between the quarry and nearby sensitive receptors. Stockpiles are also subject to watering on windy days to minimise dust generation. Runoff from the stockpile areas is captured in an onsite sediment dam to protect local surface water quality.

A range of management measures are in place to minimise environmental impacts from loading/unloading activities, including ensuring that front-end loader buckets are kept low, and ensuring that loads are covered wherever possible.

During the early stages of site operations, dust management was an issue identified at this quarry due to the exposure of the crushing plant on the elevated platform of the hill. A significant proportion of dust emissions from around the crushing plant were attributed to the fine dust which settled beneath the crushing and loading area. This dust was being disturbed by vehicles movement and on windy days. This dust is now targeted with water trucks and clean-up operation to minimise the presence of this dust under the equipment. The dust is a potential source of fines for manufactured gravels or is alternatively incorporated in over-burden materials.

3.2.5.4 Transporting Materials

Speed limits are maintained on site to ensure internal traffic safety. Loads of transported materials are covered to minimise dust generation. The internal access road between the weighbridge and Wavehill Road is bitumen sealed to reduce dust. , therefore dust generation from internal freight movements is negligible.

It is noted that the Proponent has previously partially funded the redevelopment of Wave Hill Road which has included sealing of the majority of this road. Recent pre-lodgement meetings with Council have agreed to complete the remaining 1.5 km of bitumen sealing so that the quarry will have a bitumen sealed connected along the entire length of Wavehill Road

Materials from this quarry are presently transported via agreed haul routes established under a Voluntary Planning Agreement between Council and JCLS. The haul routes and truck type will be modified as part of this application. This is further described in section 3.2.10 and appendix 9.

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3.2.6 Operating Hours

Current hours of operation will be maintained on site. These are listed in Table 4 below.

Table 4: Current and Proposed Operation Hours

Activity	Hours of Operation
Transport (empty trucks in)	6.30 am to 5.30 pm Monday to Friday 7.00 am to 5.30 pm Saturday
Transport (loaded trucks out)	7.00 am to 6.00 pm Monday to Friday 7.00 am to 5.30 pm Saturday
Light Vehicle Traffic	24 hours a day 7 days a week.
Crushing and Screening Operations	7.00 am to 6.00 pm Monday to Saturday
Stockpiling Operations	6.00 am to 6.00 pm Monday to Saturday
Drilling and Blasting	9.00 am to 3.00 pm Monday to Friday
Rock Hammering	9.00 am to 3.00 pm Monday to Friday
Staff Maintenance and Servicing of Plant and Equipment	As required
Emergency*	As required

*Emergency refers to supplying materials to the RMS, ARTC, SES and Councils or other agencies under emergency conditions as awarded by these authorities.

Potential requirements may exist for extended work hours to service short term increases in demand from the Inland Rail construction activity. This may involve 24-hour operations at some stages of the development. Any such change must be agreed to by Council and potentially NSW EPA. The current operating hours are defined within the existing approvals, including the Environment Protection Licence.

3.2.7 Development Schedule

The proposed development is restricted to an increase in annual extraction tonnage and does not involve any changes to site operations. Onsite equipment would be replaced on an as-needed basis or modernised when more efficient equipment becomes available.

The major local project identified in the region that have triggered this proposal includes the Inland Rail project and associated works along the Newell Highway. The Australian Rail Track Corporation (ARTC) estimates that construction of the Narrabri to North Star Project will commence in late 2020 and continue until 2022, while construction of the Narromine to Narrabri Project will occur around late 2021-2025. Detailed construction timelines have yet to be determined. The specific section identified for Wavehill Quarry resources is between Narrabri and Bellata. This will involve an estimated 300,000 tonne of gravel product.

Extraction of quarry materials will need to occur prior to construction commencing, and therefore it is likely that initial orders for materials for the Inland Rail Projects near Narrabri will be placed in late 2020. It is noted that this development schedule is currently delayed due to the unforeseen impacts caused by the emergence of COVID-19. A number of planned

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community meetings have already been postponed in the area and this may have a knock-on effect on the remainder of the project timeline.

3.2.8 Life of Operation

The proposed Quarry is expected to be decommissioned once the available materials are depleted. It is calculated that the life span of Wave Hill Quarry will be 25yrs – 40yrs, depending on whether the Proponent is awarded a contract to supply the Inland Rail Project. The site will then be rehabilitated in accordance with the rehabilitation plan included as Appendix 11.

The current proposal involves extending the annual limit to meet requirements for local major projects. This will incur higher operating fees. It is anticipated that the annual limit will be reduced once these larger projects move beyond the supply catchment for Wavehill Quarry. At that stage, the quarry will return to supplying the local market which is less than 200,000 tonnes per annum. The process would involve seeking an amendment to reduce the annual tonnage approved under the EPL 20139 if it is altered for a 500,000 tonne limit.

3.2.9 Employment

Currently, the site employs four permanent staff on site at the quarry, with two casual staff at the town office. Some aspects of the quarry operations, such as haulage of materials, are provided by contractors. The proposal will not result in any additional full-time staff. It is expected, however, that 5-10 additional truck drivers will be required to ensure additional haulage requirements are met over a 3-year period.

The quarry employs a wide range of specialist consultants for monitoring of emissions. This will continue as many of these are engaged from outside of the region as independent consultants. Additionally, the quarry engages a range of service providers including electricians, diesel mechanics, fabricators and Geotechnical specialists. Most of these are employed from Narrabri.

3.2.10 Traffic

Current operations on site involve the loading of heavy vehicles and subsequent haulage of materials to the Johnstone Concrete premises on the south-eastern outskirts of Narrabri. This haulage route would continue to be utilised under the current proposal to meet local demand for construction materials for smaller projects within the region.

For large tonnage contracts such as the Inland Rail Project, truck combinations will include PBS A-doubles (road trains). These larger A-double trucks will be restricted to using Turrawan Road and the Kamilaroi Highway to access the Newell Highway. Preliminary

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discussions with Council have indicated that this route will be approved for A-doubles once the Tariaro Bridge is completed, Turrawan Road is upgraded and the intersection of Turrawan Road and Kamilaroi Highway is completed. This is part of a Council project to limit the number of trucks that need to enter the eastern sector of the main town area and travel through part of the northern residential sector of Narrabri.

The following tables present an analysis of truck movements generated at present and predicted for the expanded annual limit from Wavehill Quarry.

Table 5: Existing and Proposed Annual Average Gravel Haulage truck movements

Truck size	Load Weight	Existing Average Movements per day	Proposed Average Movements per day
Annual Extractions		200,000 tonnes	500,000 tonnes
Working days available		307	307
Truck and Dog	38-tonnes	17	17
Road Train	60-tonnes	0	16
Daily Tonnage moved		646	1629
AADT		34	66
Movement per hour (11-hour day)		3.1	6

Table 6: Peak Truck Movements for 2,000 tonnes per day

Truck size	Load Weight	Existing Average Movements per day	Proposed Average Movements per day
Daily peak despatch		2,000 tonnes	2,000 tonnes
Truck and Dog	38-tonnes	53	6
Road Train	60-tonnes	0	30
AADT		106	72
Movement per hour (11-hour day)		9.6	6.5

Basic calculations indicate that annual average truck movements based on the haulage of 200,000 tonnes or 500,000 tonnes would involve 17 and 33 trucks, respectively. Therefore, if operating at maximum capacity of 500,000 tonnes/annum, the proposal would result in approximately 16-more trucks per day relative to traffic generated if the quarry operated at current maximum annual extraction levels. It should be noted that the additional trucks will be required to travel via the Kamilaroi Highway and will not travel through Narrabri via Old Gunnedah Road.

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The calculations in Table 6 present peak truck movements based on the ability of the quarry to produce and despatch 2,000 tonnes per day. This is design capacity of the quarry equipment which is not being altered as part of this application. The calculations show that the use of larger trucks has the potential to reduce daily truck movements when the quarry is operating at maximum capacity under the existing and proposed annual limit.

Light traffic to the quarry site consists of staff and occasionally contractors. This is therefore between 4-5 vehicle movements/day to and from the site. The Proponent does not expect the increased extraction limit to require any additional light vehicle traffic.

3.2.11 Water Supply

The processing will require water for inclusion in the manufactured gravel and for dust suppression. Water supplies will be obtained from an on-site harvestable right storage, which serves a dual purpose as a sediment control pond. Water requirements are in the order of 25 ML per annum. Should insufficient water be available, water purchased from Narrabri Shire Council will be trucked into the Quarry. This has occurred on a daily basis in the past 2-years or more of drought when the onsite dam has been empty.

Potable water is brought to the site on a daily basis by staff and management. A bore was drilled for this purpose during the initial development phase. The bore proved to have an extremely limited water supply of poor quality and was therefore abandoned.

3.2.12 Capital Investment Value

The proposed development is expected to require a long-term investment of $150,000. This is mainly to cover rehabilitation costs. The site is well established; all required plant machinery is already onsite, and construction works, including earthworks, have been completed. The crushers and associated machinery that is present on this site is portable and could be moved away once the quarry is closed.

The only investment in this development application will involve preparation of this EIS. All other capital investment involving upgrades to Wavehill Road have been agreed to under previous approvals issued by Council.

3.3 Site Rehabilitation

Following completion of the quarrying activities, rehabilitation of the site will be undertaken in accordance with the site's Rehabilitation Plan (included as Appendix 11).

The following objectives have been adopted to guide rehabilitation procedures for the site:

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a. To produce a stable final landform able to support the rehabilitation of the land for agricultural purposes;
b. To minimise the environmental impact of all site earthworks associated with the rehabilitation works;
c. To optimise the use of available overburden and topsoil as a substrate for vegetation; and
d. To achieve a stable and functional drainage system at the site under extreme rainfall events.

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4 Statutory Matters

4.1 Permissibility

The development proposal is considered Designated and Integrated Development under Part 4 of the *Environmental Planning and Assessment Act, 1979*.

The development is 'Designated Development' as described in Part 1 of Schedule 3 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) for 'Extractive Industries'. The proposed quarry would be permitted to extract up to 500,000 tonne of material per annum.

The development is also classified as 'Integrated Development' pursuant to Section 4.46 of the EP&A Act, as approvals from other government agencies are required, specifically the NSW Environment Protection Authority. The proposal is classified as a 'Scheduled Activity' and as such requires an Environment Protection Licence issued under the *Protection of the Environment Operations Act 1997* (POEO Act). The quarry is currently licensed under Environment Protection Licence (EPL) 20139, and an application will be lodged to amend the licence if the proposal is approved.

The proposed development is considered compatible with the objectives of the site's RU1 – Primary Production zoning, and permissible, with development consent, under the provisions of the *Narrabri Local Environmental Plan 2012* (LEP). A Development Application pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) will be lodged with Narrabri Shire Council who will assess the development. The application is classified as 'Regional Development' and will be determined by the relevant Joint Regional Planning Panel under the *State Environmental Planning Policy (State and Regional Development) 2011.*

4.1.1 Do any policy statements from Federal or State Governments have relevance?

The Federal and State Government policies relevant to this proposal are discussed in detail within this report. Main policies applicable to this application are State Environmental Planning Policies (SEPPs).

4.1.2 Are there any relevant planning studies or strategies?

No.

4.1.3 Is there any management plan, planning guidelines or advisory document that is relevant?

No.

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4.2 Commonwealth Legislation

4.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places defined in the EPBC Act as Matters of National Environmental Significance (MNES). The EPBC Act provides guidelines for a self-assessment process to determine whether a development needs referral to the Department of Environment and Energy in Canberra.

If a development requires referral, the Commonwealth Minister for the Environment for actions on Commonwealth land will grant approval based on the potential for the development to have a significant impact on matters of national environmental significance, which include:

- World Heritage Properties;
- Ramsar Wetlands;
- Nationally threatened species and communities;
- Migratory species protected under international agreements;
- The commonwealth marine environment; and
- Nuclear actions.

The potential impacts of the proposed development upon MNES have been considered as part of an Assessment of Significance, conducted in accordance with EPBC Act assessment requirements. A copy of this assessment is included in Appendix 7. The results of the assessment indicate that the development will not have significant impacts upon any identified MNES, and therefore that referral to the Department of Environment and Energy is not required. These considerations protect the objectives of the EPBC Act.

4.3 State Legislation and Planning Matters

4.3.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* provides the framework for NSW Planning Legislation. Under this Act, local councils prepare Local Environmental Plans (LEPs) that specify planning controls for specific parcels of land. The Act also provides for State Environmental Planning Policies (SEPPs) and Regional Environmental Plans (REPs). Applicable SEPPs are discussed in the section below.

Development consent is required for the proposal pursuant to Part 4 of the EP&A Act. The proposal is classified as Regional Development and will be determined by the Joint Regional

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Planning Panel (JRPP) under the provisions of the *State Environmental Planning Policy (State and Regional Development) 2011*.

Pursuant to Part 1 of Schedule 3 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), the development is 'Designated Development' as a land based extractive industry which seeks to extract, process or store more than 30,000 m^3 of extractive material per year and will disturb a total surface area of more than 2 ha of land.

The proposal is also classified as 'Integrated Development' pursuant to Section 4.46 of the Act as approval from the NSW Environmental Protection Authority is required.

This EIS has been prepared in accordance with the requirements of the EP&A Act. It provides an environmental impact assessment and details of how the quarry will be developed and operated to protect the environment, the community and provide for ecologically sustainable development.

4.3.2 Environmental Planning and Assessment Amendment (Siding Spring Observatory) Regulation 2016

The aim of the *Environmental Planning and Assessment Amendment (Siding Spring Observatory) Regulation 2016* is to ensure that development in the vicinity of the Siding Spring Observatory does not impact the effectiveness of the observatory, upon which the Dark Sky Region in NSW is centred.

Clause 92 of the *Environmental Planning and Assessment Amendment (Siding Spring Observatory) Regulation 2016,* under the *Environmental Planning and Assessment Act 1979,* requires consent authorities to take into consideration the Dark Sky Planning Guideline when determining a development application for Regional development, State significant development or designated development on land within 200km of the observatory.
The proposal is a designated development and is located 130km north east of the Siding Spring Observatory. It therefore requires consideration of the Dark Sky Planning Guideline.

The factors that affect the observing environment include the following:

- The distance between the light source and the telescope;
- The quantity of light;
- The type of light emitted; and
- The direction in which the light shines.

These factors are measurable and can be appropriately managed. The following sections provide a consideration of the factors and details of the Applicant's commitments to ensure the project has minimal impact on the observatory.

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4.3.2.1 Distance between the Light Source and Telescope

The Siding Springs Observatory is located approximately 130 kilometres south west of Wave Hill Quarry. The elevation profile between the Observatory and Wave Hill Quarry is included in Figure 8. The Observatory is located on a high peak and as such has a direct line of sight to the Quarry.

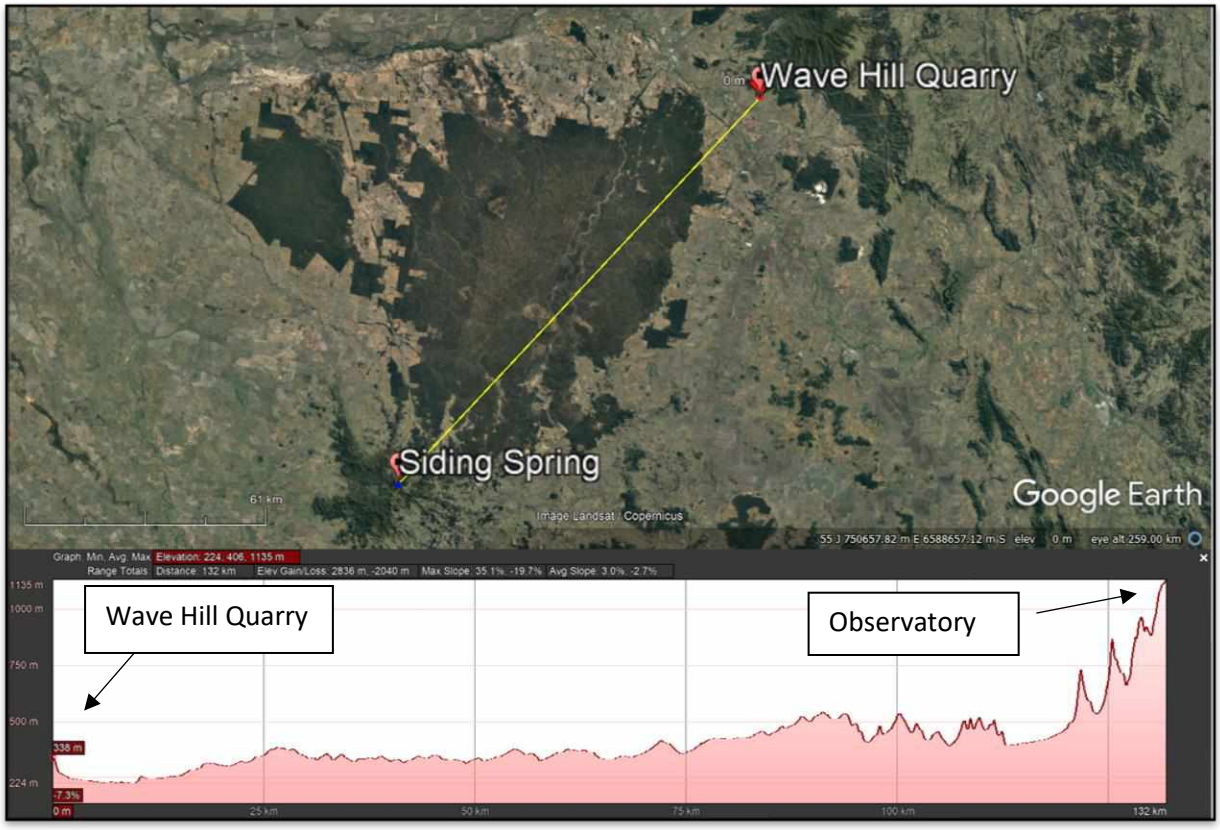

Figure 8: Elevation Profile between the Siding Spring Observatory and Wave Hill Quarry

The proposed standard operational hours are 6am – 6pm. It is also requested that the operation be allowed to operate 24 hours per day in exceptional circumstances. This would require notice provided to the Narrabri Shire Council and a written approval granted to allow the operation for a set period of time. The majority of quarry equipment is fitted with lights to enable early morning start-up operations to commence. No changes would be required to lighting.

4.3.2.2 Quantity of Light

The proponent shall ensure that the development is operated in a manner that does not adversely impact observing conditions at the Siding Spring Observatory. Should 24-hour operations be implemented at any stage, night lighting measures will be implemented to

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manage cumulative impacts. This would include ensuring that lighting is directed in a downward direction and not skyward.

4.3.2.3 Type of Light Emitted

The proponent would only use outdoor lighting with a colour temperature below 3,000 Kelvin to minimize the impact of light on the observing environment.

4.3.2.4 Direction of Light

To control the direction of the light, the proponent would be required to ensure that all lighting is directed downwards. If required, outdoor lights would be fully shielded.

Any additional lighting to be installed at the Quarry site will therefore conform with the design principles outlined in the Dark Sky Planning Guideline 2016. This would include the following mitigation measures:

- Eliminate upward light spill
- Direct light downwards (not upwards)
- Use shielding fittings where required
- Avoid 'over' lighting
- Awareness of lighting requirements, switching lights off when not required
- Use energy efficient light bulbs
- Use asymmetric beams, where floodlights are used
- Ensure lights are not directed towards reflective surfaces
- Use warm white colours.

SMK Consultants has commenced consultation with the Siding Spring Observatory (see Appendix 13 for a copy of correspondence). Prior to light installation, a lighting plan should be prepared, and a copy provided to both Narrabri Shire Council and the Director of the Siding Spring Observatory for consideration.

4.3.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* came into effect in August 2017 and replaced the *Threatened Species Conservation Act 1995*. The BC Act outlines requirements in relation to the listing of threatened species, biodiversity impact assessment, offsetting and related offences. The assessment of biodiversity values on land and the impacts of activities on those biodiversity values are to be carried out in accordance with the Biodiversity Assessment Method (BAM). The objective of the BAM is to adopt a standard approach that will result in no net loss of biodiversity in NSW.

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The Act also outlines the Biodiversity Offset Scheme (BOS). Development that is subject to the BOS scheme includes development needing consent under Part 4 of the EP&A Act (excluding complying development), activities under Part 5 of the EP&A Act, State significant development and State significant infrastructure.

Where development or an activity is, "likely to significantly affect threatened species", a Biodiversity Development Assessment Report (BDAR) must be prepared and consent authorities are required to consider the likely impact of the proposed development on biodiversity values before granting approval.

The threshold test of whether development or an activity is "likely to significantly affect threatened species" (and therefore whether a BDAR is required) is reached if:

- the BOS Threshold is met;
- the development is carried out in a declared Area of Outstanding Biodiversity Value (AOBV); and
- the test in section 7.3 of the BC Act is met.

Th initial development proposal included a 15-hectare extension of the existing approved footprint. This involved clearing of an additional 15-hectares. A BDAR was undertaken over this land with the outcome of determining the potential offset cost for clearing. This cost was in excess of the short-term value of the additional major projects that may be available to the quarry. As a result of this potential cost, the proposal to clear additional land will not proceed. This proposed development will not alter the currently approved footprint of Wave Hill Quarry. Therefore, the development will not involve any vegetation clearance and the BOS threshold will not be met. The development has therefore been based on the first two principles of the BC Act, mainly "Avoid" and "Minimise".

The development is not located in or near an Area of Outstanding Biodiversity Value (AOBV). Deriah Creek, a riparian area of Biodiversity Value (BV), is located approximately 500m south of the property boundary. This creek will be protected from potential impacts associated with quarry operations by implementation of environmental management measures on site (including sediment and erosion control measures).

Proponents are also required to carry out a 'Test of Significance; for all development proposals that do not exceed the Biodiversity Offset Scheme Threshold. The required test of significance (as outlined in Section 7.3 of the BC Act) has also been included in Appendix 8.

Overall, it was determined that the proposal is not likely to significantly affect threatened species, and that further assessment under the BAM and the preparation of a BDAR is not required.

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4.3.4 National Parks and Wildlife Act 1974

The proposal has been prepared in accordance with the requirements of this Act. The subject site is located approximately 3km south of the boundary of the Deriah Aboriginal Area and 4km west of the southern boundary of Mt Kaputar National Park, as shown in Figure 4, Section 1.4.2. The development is not predicted to have any adverse impacts upon either of these places.

In 2012, the quarry footprint was subject to an archaeological survey as part of the application process to increase the quarry annual extraction limit to 200,000 tonnes. The survey did not identify any sites or items of indigenous cultural significance and considered that the probability of the site containing items of cultural significance would be moderate to low as a result of historic disturbance of the location. The report concluded that the development should be permitted to proceed with caution.

The current proposal will not result in the expansion of the existing quarry footprint and does not entail works in undisturbed land areas within the existing footprint. Therefore, it is considered that the proposal is unlikely to pose any additional risk to any potential Aboriginal heritage values which may be present within the locality.

In the event that items of indigenous cultural significance are uncovered during the course of quarry operations, an Unanticipated Finds Protocol will be implemented. These considerations protect the objectives of the Act.

4.3.5 The Heritage Act 1977

The *Heritage Act 1977* provides for the protection of the State's natural, built, marine and moveable heritage. The Act establishes the Heritage Council of NSW which maintains the State Heritage Register and Inventory. No heritage items recorded on the Register or the Inventory are located on the subject land.

4.3.6 Rural Fires Act 1997

The Lot on which the subject site is located is identified as Category 1 bushfire prone land. The development has been designed to comply with the NSW Rural Fire Service (RFS) guideline "Planning for Bush Fire Protection" (RFS 2019). The development does not involve the erection of any buildings or dwellings. The quarry will be free of vegetation and other readily flammable materials. A 10m firebreak will be maintained around any structures present onsite. All weather roads will provide access for fire-fighting and the firebreak will provide access around the Quarry. Water available for quarrying activities will provide an adequate supply for fire-fighting purposes. Overall, the potential fire risk posed by the

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development is minimal. The development is therefore considered compliant with the *Rural Fires Act 1997*.

4.3.7 Protection of the Environment Operations Act 1997

An Environmental Protection Licence (EPL) issued under Section 48 the *Protection of the Environment Operations Act 1997* (POEO Act) is required for any scheduled development or activity listed in Schedule 1 of the Act. Subclause 19 of Schedule 1 lists 'land-based extractive activities' involving the extraction, processing or storage of more than 30,000 tonnes per year of extractive materials as a scheduled activity.

Section 45 provides details of matters to be taken into consideration in licensing functions. It requires that the appropriate regulatory authority consider the pollution likely to be caused by the proposed development, the likely impact of that pollution on the environment, and the practical measures that would be taken to mitigate that pollution.

Potential sources of pollution caused by Quarry operations at Wave Hill are listed below in conjunction with the corresponding sections in this EIS which detail the potential adverse impacts of the proposal on the environment and the mitigation measures proposed to mitigate those impacts:

- Water pollution – Section 5.9, Appendix 10
- Dust emissions – Section 5.7, Appendix 4
- Noise pollution – Section 5.8, Appendix 5
- Waste and hazardous materials – Section 5.14
- Environmental harm with associated adverse impacts on threatened species – Section 5.10, Appendix 7, Appendix 8

The existing quarry has an approved EPL (Licence No. 20139), which approves extraction of 200,000 tonne in accordance with current consent conditions for the quarry. An application to amend the licence will be lodged with the EPA if development consent is granted for the proposal.

4.3.8 Water Management Act 2000

The object of the *Water Management Act 2000* is the sustainable and integrated management of the State's water sources for the benefit of both present and future generations by applying the principles of ecologically sustainable development to protect, enhance and restore water sources and their associated ecosystems, ecological processes, biological diversity and their water quality.

The objects of this Act were considered throughout the planning and design phases of this development. Quarries require a secure and reliable water supply to operate. The Quarry

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will utilise a harvestable rights dam to obtain the water supply required for onsite operations. The dam was approved under existing development consents as a required sediment control system. Use of this collected water in necessary to ensure that the dam is emptied to maintain capacity.

During the initial stages of developing the quarry, the current owner drilled a test bore hole to determine whether groundwater was available in the local fractured rock aquifer. This aquifer proved to be very poor and the use of this bore was not pursued by obtaining a water entitlement suitable for use at the quarry. The aquifer carried minimal water.

The watercourses and groundwater in the vicinity of the property will be protected through rigorous design and management practices, including diversion banks and sediment traps. Appropriate buffers are to be maintained in order to minimise the risk of stream pollution.

4.4 State Environmental Planning Policies and Development Codes

Table 7 presents a summary and comment on State Environmental Planning Policies and development code relevance to the proposed development.

Table 7: State Environmental Planning Policies and Development Codes

SEPP No. & Codes	Title	Relevance
No. 1	Development Standards	Not Relevant
No. 21	Caravan Parks	Not Relevant
No. 33	Hazardous & Offensive Development	Not Relevant
No. 36	Manufactured Home Estates	Not Relevant
No. 50	Canal Estate Development	Not Relevant
No. 52	Farm Dams and Other Works in Land and Water Management Plan Areas	Not Relevant
No. 55	Remediation of Land	Refer to following section for review
No. 64	Advertising and Signage	Not Relevant
No. 65	Design & Quality Residential Apartment Development	Not Relevant
	Affordable Rental Housing 2009	
	Building Sustainability Index: BASIX 2004	Not Relevant
	Concurrences 2018	
	Educational Establishments and Child Care Facilities	
	Exempt and Complying Development Codes 2008	Not Relevant
	Housing for Seniors or People with a Disability 2004	Not Relevant
	Infrastructure 2007	Refer to following section for review
	Mining, Petroleum Production and Extractive Industries 2007	Refer to following section

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SEPP No. & Codes	Title	Relevance
		for review
	Miscellaneous Consent Provisions 2007	Not Relevant
	Primary Production and Rural Development 2019	Refer to following section for review
	Koala Habitat Protection 2019	Refer to following section for review

4.4.1 State Environmental Planning Policy No. 55 – Remediation of Land

The objective of this policy is to provide a State-wide planning approach for the remediation of contaminated land. Where it is proposed to rezone the land or to carry out a development that would change the use of the land, a consent authority must consider whether the land is contaminated and if it is, whether the land is suitable for the proposed development in its present state or whether remediation is required. Even where no change of use is proposed a consent authority must consider whether the land is suitable for the proposed development if the land has been used for a purpose listed in Table 1 of Appendix 1 in Contaminated Land Planning Guidelines (NSW Government, 2018 (Draft)).

A review of the site has indicated that the majority the land on which Wave Hill quarry is operating was previously cleared and used for livestock grazing. A smaller section was cleared in recent years to facilitate extractive activities. A visual inspection of the land did not reveal any signs of chemical contamination such as sheep dips, chemically affected patches of vegetation or bare or discoloured areas. No refuse or waste has been disposed on the site intentionally or indiscriminately. Fuel is only kept on the site in sealed portable containers such as fuel trailers and no spillages are present. The visual inspection and consideration of the land area's past and its present use have led to the conclusion that it is unlikely for there to be contamination which would render the land unsuitable for use as a quarry.

4.4.2 State Environmental Planning Policy - Mining, Petroleum Production and Extractive Industries 2007

The Mining, Petroleum Production and Extractive Industries SEPP recognises the importance of mining, petroleum production and extractive industries to the NSW region and aims to provide for the proper management and the orderly development of land containing minerals, petroleum products and extractive materials. The SEPP aims to establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment and sustainable management of these resources.

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Clause 12 of the SEPP provides a number of matters that a consent authority must consider before determining a development application. These matters are similar to, but are in different terms to, the relevant matters contained in the Narrabri Local Environment Plan and are considered in the body of this report.

Clause 13 requires that Council must consider the compatibility of development proposals on land in the vicinity of existing mines etc. or of land containing mineral or extractive resources. This provision is to ensure that these resources are not sterilised by incompatible development on surrounding land and is a matter for Council to consider. It is noted that Wave Hill is one of only a small number of existing quarries which supplies construction materials throughout the region.

Clause 14 requires the consent authority to ensure that the development is undertaken in an environmentally responsible manner to avoid or minimise:

- Impacts on significant water resources;
- Impacts on threatened species and biodiversity; and
- Greenhouse gas emissions.

These are matters for Council and are addressed below.

Clause 15 requires that the consent authority consider whether the proposed resource recovery is efficient. Modern equipment and best practice management principles are used in the operation of the quarry to ensure that resource recovery is efficient and economically viable.

Clause 16 (1) requires the consent authority to consider whether a consent should contain conditions to:

- Require some or all of the material to be transported by means other than by public road;
- Require the preparation and implementation of a code of conduct relating to the transport of materials on public roads.

It is noted that the site access to Wave Hill is bitumen sealed to prevent the tracking of mud or dirt onto public roads, and that the Proponent has previously partially funded the upgrade of Wave Hill Road. Approval of the development would support construction of the Inland Rail Project, which will assist in reducing the strain upon the public road network in the long run by providing a viable alternative to freight by road for extractive industries throughout the region.

Clause 16 (2) requires the consent authority to provide a copy of the development application to each roads authority for the roads used and the Roads and Maritime Service

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within seven (7) days of receipt. This is a matter for Council. It is noted that the impact of the development upon the public road network has been considered and that a Traffic Impact Assessment is included in Appendix 9.

Clause 16 (3) provides that the consent authority must not determine the development application until it has taken into consideration any submission received from the roads authorities and the Roads and Maritime Service within 21 days after the Authority was provided with a copy of the application, and provide each of them with a copy of the determination. This is a matter for Council.

Clause 17 requires that the consent authority must consider whether or not the consent should be issued subject to conditions requiring rehabilitation of the land affected by the development. This is a matter for Council. The project proposal includes a rehabilitation component.

4.4.3 State Environmental Planning Policy (Infrastructure) 2007

The Infrastructure SEPP provides a consistent planning regime for infrastructure and the provision of services and public works across NSW, along with providing for consultation with relevant public authorities during the assessment process.

The subject proposal is not identified in Schedule 3 of the SEPP as traffic generating development to be referred to the Roads and Maritime Services as the proposal is defined as 'any other purpose' and will not generate 200 or more motor vehicle movements per hour.

4.4.4 State Environmental Planning Policy – Primary Production and Rural Development

The Primary Production and Rural Development SEPP aims to support the orderly, environmentally sustainable and economic use and development of land for primary production and development. It also facilitates the future recognition and protection of State significant agricultural lands.

The Shire supports the use of land for Extractive Industry within zone RU1 Primary Production under the *Narrabri Local Environmental Plan 2012*. This development does not include the erection of any buildings or dwellings, or subdivision of land. The proposed quarry operation will be undertaken in a way that minimises land use conflicts in the area. Furthermore, it is intended to rehabilitate the development footprint to its natural state, thus returning it to a favourable condition for agricultural grazing over time as revegetation takes place.

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4.4.5 State Environmental Planning Policy (Koala Habitat Protection) 2019

The State Environmental Planning Policy (Koala Habitat Protection) 2019 was introduced on March 1, 2020. It replaces the SEPP 44 – Koala Habitat Protection (1995) and has been updated and improved to increase the level of protection of koala habitat within NSW. Overall, the Policy aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

The State Environmental Planning Policy (Koala Habitat Protection) 2019 includes the following key changes:

- An updated definition of koala habitat;
- Two new SEPP maps;
- An expanded list of tree species;
- New SEPP Guidelines; and
- A streamlined development assessment process.

4.4.5.1 Habitat Definition and Feed Tree Species

The new SEPP no longer defines potential koala habitat. The definition of core koala habitat has been updated to allow areas with demonstrated koala presence in highly suitable habitat to be recognised, without the requirements of the previous definition which were difficult to meet. Core koala habitat will now be defined as:

a) An area of land where koalas are present, or
b) An area of land:
    i. Which has been assessed by a suitably qualified and experienced person in accordance with the Guideline as being highly suitable koala habitat; and
    ii. Where koalas have been recorded as being present in the previous 18 years.

The list of feed tree species has also been updated, increasing the number of species from 10 to 123 species. These 123 species were categorised into 9 distinct regions (Koala Management Areas), according to what trees koalas prefer to use in each area.

4.4.5.2 Mapping

Two new maps have been in introduced and are available for viewing:

a) **The Koala Development Application Map** – this identifies areas that have highly suitable koala habitat and are likely to be occupied by koalas. On land where there is no approved Koala Plan of Management, the map will be used to identify land where Council needs to consider the development application requirements in the Guideline.

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b) **The Site Investigation area of Koala Plans of Management Map** – This identifies land that council are to focus their survey efforts on, particularly when identifying core koala habitat.

4.4.5.3 Development Assessment Process

Under SEPP 44, an initial flora survey was required to survey land within Development Applications, and, where potential koala habitat had been established, a koala survey was required. If land contained core koala habitat, the proponent had to prepare an Individual Plan of Management to manage any impacts on the resident koala population. Each Plan of Management required approval from the Secretary of the Department. The new Koala Development Application Map eliminates the need to conduct any surveys. Instead of preparing an Individual Plan of Management, proponents are required to prepare their development application in accordance with the criteria in the new Guideline, for council to consider when assessing the application.

4.4.5.4 Wave Hill Quarry Assessment

Land within the local government areas listed under Schedule 1 is subject to consideration under this Policy. The Narrabri Shire is included in Schedule 1 of the SEPP and therefore an assessment is required. Narrabri Shire is in the Northwest Slopes Koala Management Area. A list of feed tree species for this management area is provided in Schedule 2 of the SEPP. Feed tree species of this management area include Rough-barked Apple, White Cypress Pine, Belah and Blakey's Red Gum.

The NSW Department of Planning, Industry and the Environment's online mapping tool was searched to determine the assessment of koala habitat value within the proposal footprint and its vicinity. Part of the development footprint is included in the Site Investigation Area for Koala Plans of Management layer, and a small area is included in the Koala Development Application Map layer. Figure 9 presents the distribution of both of these Koala habitat categories across the subject site and its vicinity.

Aerial imagery on the NSW Department of Planning, Industry and Environment online planning tool indicates that both of the Koala Habitat maps are outdated. The area within the subject site which is included in the Koala Development Application Map, and much of the area within the site which is included in the Site Investigation Area for Koala Plans of Management, are presently devoid of vegetation.

The footprint of the development was entirely cleared by the previous quarry owner and developer, and vegetation currently present within the subject site is limited to a very small area of scattered regrowth to the north-west of the subject site. This vegetation is disturbed

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and in poor condition, consisting of immature trees, shrubs and groundcover downslope of the quarry footprint. This is also isolated from larger patches of vegetation in the vicinity.

Given observations onsite, it is concluded that no Koala habitat is present within the subject site. If Koala were present in the area, it is likely that they would preferentially use higher quality remnant vegetation to the north of the subject site. It is also noted that no clearing will take place as part of the proposed works. On this basis, it is considered that the requirements of the SEPP do not need any further consideration.

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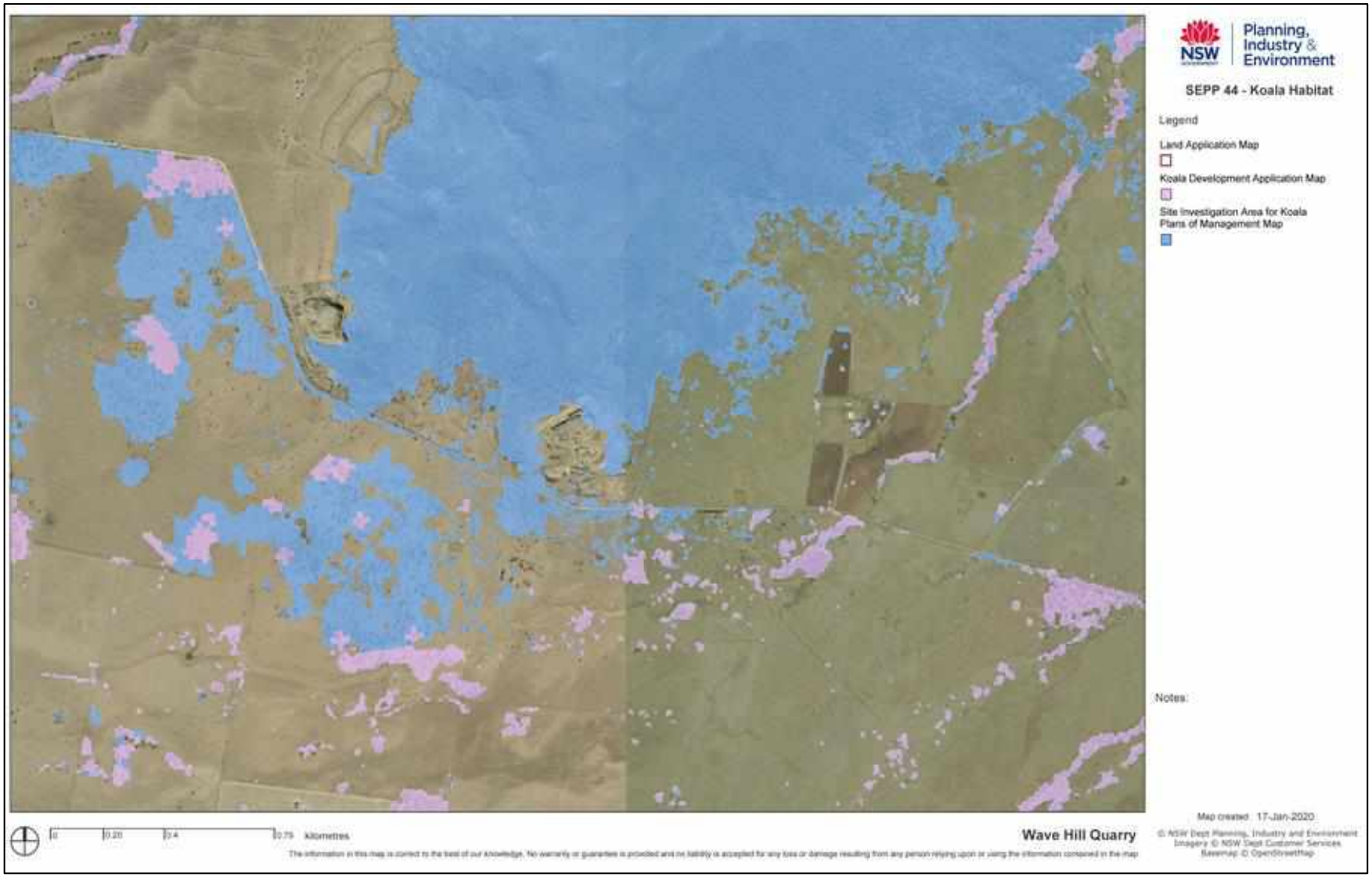

Figure 9: Koala Habitat Map of Wave Hill Study Area (NSW DPI&E)

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4.5 Regional Plan

The New England North West Regional Plan applies to the Narrabri local government area. The Plan aims to present planning goals that will achieve a sustainable future that maximises the advantages of the region's diverse climates, landscapes and resources.

The New England North West is one of the State's largest agricultural and food producers. The provision of quality rail network will provide for an increase in productivity for agriculture in the region through lower freight transport costs that can effectively compete with road freight services. This will provide for bulk shipping through a high capacity freight network that contributes to productivity and competitiveness. The strengthening of these connections will attract investment, business and residents to the region.

The Plan outlines the following regionally focused goals:

- A strong and dynamic regional economy
- A healthy environment with pristine waterways
- Strong infrastructure and transport networks for a connected future
- Attractive and thriving communities

The key priorities for the Narrabri area of relevance to this proposal include:

- Continue to develop access and logistic infrastructure on appropriate sites to encourage new industry opportunities; and
- Encourage diversification in agriculture, horticulture and agribusiness to grow these sectors and harness domestic and international opportunities.

The proposed development will support the development of the Inland Railway Project, providing access to new markets and encouraging a variety of new agricultural and industry opportunities within the domestic and international markets. Overall, the proposal is in alignment with the aims of the New England North West Regional Plan.

4.6 Local Planning Instruments

4.6.1 Narrabri Local Environmental Plan 2012

The *Narrabri Local Environmental Plan 2012* (LEP) is the current local government planning policy for the Narrabri Shire. The framework of the LEP is derived from the *Environmental Planning and Assessment Act 1979*. Wave Hill Quarry is located in Zone RU1 – Primary Production of the Narrabri Shire.

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The aims of the LEP are as follows:

a) to encourage the orderly management, development and conservation of resources by protecting, enhancing and conserving:
   i. land of significance for agricultural production, and
   ii. timber, minerals, soil, water and other natural resources, and
   iii. areas of high scenic or recreational value, and
   iv. native plants and animals including threatened species, populations and ecological communities, and their habitats, and
   v. places and buildings of heritage significance,
b) to provide a choice of living opportunities and types of settlements,
c) to facilitate development for a range of business enterprise and employment opportunities,
d) to ensure that development is sensitive to both the economic and social needs of the community, including the provision of community facilities and land for public purposes.

Comment

The proposed development is considered consistent with aims of the Local Environment Plan. In particular, the proposal will facilitate the development of the Inland Railway Project which will enhance Australia's existing national rail network and serve the interstate freight markets by providing for future rail freight demand and stimulating growth for regional development along the Inland Rail corridor.

4.6.2 Land Use Definition

According to the LEP, a Quarry is defined as a land use involving "extractive industry". Extractive industry is further defined in the LEP as "the winning or removal of extractive materials (otherwise than from a mine) by methods such as excavating, dredging, tunnelling or quarrying, including the storing, stockpiling or processing of extractive materials by methods such as recycling, washing, crushing, sawing or separating, but does not include turf farming."

Comment

The intended land use, as defined in the LEP as extractive industry, is a permissible land use, with development consent, within the RU1 – Primary Production zone.

4.6.3 Zone RU1 – Primary Production

The LEP states that the objectives of the zone are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.

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- 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 allow for non-agricultural land uses that will not restrict the use of other land for agricultural purposes.

Comment

The proposal is for an 'extractive industry', which is permissible, with development consent, within the RU1 Primary Production Zone. The protection of natural resources and places has been fully taken into consideration in the planning for this development. The continued utilisation of the land will minimise fragmentation and alienation. The proposal is not considered to conflict with adjoining land uses. The proposed development is therefore considered to be both compatible and consistent with the surrounding land uses and would be considered to satisfactorily meet the objectives of the RU1 - Primary Production Zone.

4.6.4 Heritage Conservation

Section 5.10 of the LEP deals with heritage items and heritage conservation areas. These are listed in Schedule 5 of the LEP. The objectives of this clause are as follows:

a) to conserve the environmental heritage of Narrabri,
b) to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views,
c) to conserve archaeological sites,
d) to conserve Aboriginal objects and Aboriginal places of heritage significance.

Comment

The proposal is not in the vicinity of any heritage items in accordance with Council's Local Environmental Plan or under State or Federal legislation. A preliminary assessment of the site's Archaeological Heritage has been included in Section 5.11. The conclusion to the assessment indicated it was unlikely that items of heritage significance exist within the development area. No sites of European heritage would be disturbed by the proposal.

4.6.5 Bushfire Hazard Reduction

Section 5.11 of the LEP deals with land that is considered bushfire prone and may require bushfire hazard reduction work. Bushfire hazard reduction work authorised by the *Rural Fires Act 1997* may be carried out on any land without development consent.

Bushfire hazard reduction work includes the following:

a) The establishment or maintenance of firebreak on land, and

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b) The controlled application of appropriate fire regimes or other means for the reduction or modification of available fuels within a predetermined area to mitigate against the spread of a bushfire,

But does not include construction of a track, trail or road.

Comment

The subject site and the Lot to which it pertains are mapped as Category 1 Bushfire Prone Land. The development does not involve the erection of any buildings or dwellings. The site will be kept clear of vegetation and other readily flammable materials, and a 10m firebreak will be maintained around any structures present onsite (e.g. fixed or mobile plant equipment). It is noted that all weather roads provide operational access to permit evacuation and fire fighting in the event of a fire.

4.6.6 Development Control Plan

Narrabri Shire Council has a number of Development Control Plans (DCPs). Of these, the following plans are relevant to the proposed development:

- Notification Policy; and
- Parking Code.

4.6.6.1 Development Control Plan - Notification Policy

The objectives of the Notification Policy are as follows:

- Provide public participation in, and promote public awareness of, the development control process;
- Outline clearly what types of development applications require notification and/or advertisement;
- Identify the specific requirements of letters of notification, displaying a notification on the land and advertising in the local paper;
- Outline a Council Officer's right to discretion when determining notification and/or advertisement of an application;
- Outline where a development application can be viewed and how submissions can be made; and
- Specify the notification and/or advertisement requirements surrounding a modification to a development consent.

Comment

It is a matter for Council to determine the advertising requirements of the development once the application has been lodged. The proponent will undertake advertising measures as required by Council (such as erection of signs on site) during the assessment period.

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4.6.6.2 Development Control Plan - Parking Code

The objectives of the Parking Code are as follows:

- To provide a consistent guide for Council and developers;
- To provide adequate parking for people using, and employed by, developments within the Shire, and
- To provide an acceptable quality of parking within the Shire.

The Parking Code applies to all proposed traffic generating developments within the Shire, and adopts the standard for design and level of provision of parking areas as outlined by the 'Guide to Traffic Generating Developments' (RTA 2002).

The provision of adequate parking will be supplied on site. The parking zone is located behind the site office, as shown in the site plans in Appendix 1.

4.6.7 Development Contribution Plan

The Narrabri Shire Section 7.11 Contributions Plan 2016 enables the Council to require that developers make a monetary contribution to the Council, for the purpose of providing public amenities and public services that are required or demanded by that development, in accordance with the Section 7.11 (previously Section 94) of *the Environmental Planning and Assessment Act 1979*.

Amongst other forms of development, the plan relates to extractive industries that result in increased numbers of laden heavy vehicles causing pavement damage to rural roads managed by the Council, which is consistent with the proposed development. The plan states that approval of such developments will require a monetary contribution to contribute to the cost of Council maintaining the haul routes.

The purpose of the plan is as follows:

- To authorise one of the following to require a Section 7.11 contribution to be made towards the provision, extension or augmentation of public amenities and services that are required as a consequence of the development, or which were provided in anticipation of, or to facilitate, such development:
    - The Council, when granting consent to an application to carry out development to which this plan applies; or
    - An accredited certifier, when issuing a complying development certificate (CDC) for development to which this plan applies.
- To provide a clear and transparent basis for levying contributions under the provisions of Section 7.11 (previously section 94) of the EP&A Act;
- To provide the framework for the efficient and equitable determination, collection and management of section 7.11 contributions;

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- To establish the relationship between the expected development and the public amenities and services included in this plan, to demonstrate the required contributions are reasonable;
- To allow for the provision of the required public amenities and services by alternative means where this is acceptable to the developer and the Council (for example; through a planning agreement); and
- To ensure that the broader Narrabri Shire community is not unreasonably burdened by the provision of public amenities and services required as a result of development affected by this plan.

Comment

The proposed development is for the continued and intensified operation of an extractive development within the Narrabri Shire Council. This type of development is typically considered a traffic generating development under the Development Contribution Plan. Under the provisions of the *Environmental Planning and Assessment Act 1979* Council may include a condition of consent that details the following:

- Require land to be dedicated free of cost;
- Require money to be contributed for works and facilities to be provided in the future;
- Require money to be contributed towards the cost of works in kind, in satisfaction of Section 7.11 requirements; or
- Require or accept a combination of any of the above.

In applying Section 7.11 contributions the Council must be fair and reasonable, and as such the contributions levied on development within the Narrabri Shire are limited to essential or baseline works.

The Proponent currently pays a Section 7.11 contribution to Council in association with traffic generated from the existing quarry site under current consent conditions for the site. It is expected that fair and reasonable contributions will continue to be made to Council in accordance with the increased traffic generated by the development, and the provisions of Section 7.11, if the proposal is approved.

4.7 Draft Planning Instruments

No draft planning instruments of relevance to this proposal were identified.

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4.8 Development Application and Licence Requirements

4.8.1 Development Assessment

Under Part 4 of the *Environmental Planning and Assessment Act 1979*, extractive industries require development consent under the relevant Local Environmental Plan (LEP). The subject land is located within the Narrabri Shire and the *Narrabri Local Environmental Plan 2012* is the appropriate planning instrument. The subject land is zoned as RU1 Primary Production. The proposed land use (extractive industry) is considered permissible with consent within this zone.

Under Schedule 3, of the *Environmental Planning and Assessment Regulation 2000*, the following extractive industries (being industries that obtain extractive materials by methods including excavating, dredging, tunnelling or quarrying or that store, stockpile or process material by methods including washing, crushing, sawing or separating) are considered designated development:

a) That obtain or process for sale or reuse, more than 30,000 cubic metres of extractive material per year, or
b) That disturb or will disturb a total surface area of more than 2 hectares of land by:
    i. clearing or excavating, or
    ii. constructing dams, ponds, drains, roads or conveyors, or
    iii. storing or depositing overburden, extractive material or tailings, or
c) That are located:
    i. in or within 40 metres of a natural waterbody, wetland or an environmentally sensitive area, or
    ii. within 200 metres of a coastline, or
    iii. in an area of contaminated soil or acid sulphate soil, or
    iv. on land that slopes at more than 18 degrees to the horizontal, or
    v. if involving blasting, within 1,000 metres of a residential zone or within 500 metres of a dwelling not associated with the development, or
    vi. within 500 metres of the site of another extractive industry that has operated during the last 5 years.

Given the scale of the proposal, the development constitutes Designated Development. Part 4 of the *Environmental Planning and Assessment Act 1979* outlines the assessment requirements for Designated Development.

The proposal also requires approval under the *Protection of the Environment Operations Act 1997* and is therefore considered Integrated Development. As part of the integrated assessment process, the Shire must refer the Development Application and EIS to the relevant state agencies for assessment.

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4.8.2 Approvals required from State Agencies and Conditions that apply to the proposal

The following approvals are required:

1. Development Consent in accordance with the provisions of Part 4 of the Act. The proposal is classified as Regional Development and will be determined by the Joint Regional Planning Panel (JRPP) under the provisions of the *State Environmental Planning Policy (State and Regional Development) 2011.*
2. NSW Environment Protection Authority environmental protection licence (EPL) under the provisions of the POEO Act.

4.8.3 Consultation with relevant Utilities and Agencies

A request for the Secretary's Environmental Assessment Requirements (SEARs) was submitted to NSW Planning and Environment (NSW P&E). NSW P&E notified relevant government agencies requesting their environmental assessment requirements. A copy of the SEARs is included as Appendix 2.

4.8.3.1 Narrabri Shire Council

Narrabri Shire Council requested that a pre-development application meeting be held between Council and the proponent to further discuss key points for consideration. This meeting was held on 13 January 2020. The meeting included Council planning, engineering an executive staff. The meeting discussed haulage routes, the Voluntary Planning agreement, progress with Council works on Tarriaro bridge over the Namoi and agreements to upgrade Turrawan Road and Turrawan/Kamilaroi Highway intersection to allow road trains to access the quarry via Kamilaroi Highway in preference to travelling through Narrabri town area for larger projects, such as Inland Rail. The meeting resulted in an agreement on haul route and assessment of the planning agreement. No other matters were raised by Council.

4.8.3.2 Crown Lands

Crown Lands requested the following consultations be carried out and issues be considered, with appropriate mitigation measures outlined:

- The impact of the development proposal upon Crown Perpetual Lease 109315 held by Kristian John Bogdanoff be considered (with regards to dust/noise and vibration), including direct consultation with Mr Bogdanoff;
- Provide future options for legal access to Lot 88 DP 821255;
- Consult with the Office of the Registrar General to assess potential impacts to TS6956 in Lot 88 DP 821255; and
- Consult with Forestry NSW with regards to the possible addition of Crown Perpetual Lease 109315 to the estate of Forestry NSW.

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The issues raised by Crown Lands are addressed below.

4.8.3.2.1 The impact of the development on Crown Perpetual Lease (CPL) 109315

The proposed quarry footprint is not changing relative to the existing development approval, therefore no additional impacts are predicted on Crown Perpetual Lease 109315. The leaseholder, Mr. Bogdanoff, was nevertheless consulted with regards to impacts resulting from quarry operations (see Section 2.2).

4.8.3.2.2 Consult with Forestry NSW regarding the possible addition of CPL 109315 to the estate of Forestry NSW

It is noted that the Applicant has no legal right over Crown Perpetual Lease 109315 and this is a matter between Crown Lands, NSW Forestry and the leaseholder. Forestry NSW was consulted regarding the initial proposal on 11 September 2018 (i.e. expanding the quarry footprint in tandem with an increase in the annual extraction limit). Forestry NSW stated that their interest in Crown Lease 109315 was restricted to timber resource on that land and requested to be kept informed on the development application associated with the proposal. A copy of the EIS will be sent to the Forestry NSW upon lodgement.

4.8.3.2.3** Consult with the Office of the Registrar General to assess potential **impacts to TS6956 in Lot 88 DP 821255

SMK Consultants consulted with the Office of Registrar General (ORG) on 12 September 2018 on this matter (ORG Correspondence Ref No. 2018/18). The ORG stated that the disturbance, displacement or destruction of TS6956 requires prior approval from the Surveyor General. It is noted that the proposal does not alter the existing development footprint. The northern boundary of the Wave Hill Quarry is approximately 360m south of the boundary of Lot 88 DP821255, on which TS6956 is located, and approximately 500m south of TS9656. Given the available separation, it is concluded that the proposal will not have any adverse impacts on TS9656.

4.8.3.2.4 Provide future options for legal access to Lot 88 DP821255

TS6956 is located within a parcel of crown land (Lot 88 DP 821255), which has legal access by an easement through Lot 89 DP 821255. The current alignment of the easement passes directly through the existing quarry footprint and therefore is currently not usable as a practical access. The ORG was consulted on 12 September 2018 with regards to the permissibility of alternative easement routes to Lot 88 DP 821255 (ORG Correspondence Ref No. 2018/18). Two potential routes were proposed, and the ORG considers them both acceptable, subject to approval from Crown Lands. Consultation with Crown Lands regarding this matter was initiated on 25 May 2020. The two potential easement routes are shown in Figure 10 and Figure 11.

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It is noted that Lot 88 DP 821255 is located at the top of a steep and inaccessible hill (which includes frequent cliff faces), which is wholly covered by remnant vegetation and which has never had a road constructed to the top of the site. This lot is understood to have always been accessible only by foot. Therefore, it is considered that the alignment of the existing easement through Lot 89 DP 821255 refers to an indicative rather than literal access route through the property to Lot 88 DP 821255.It is noted that Lot 88 DP 821255 will continue to be accessible on foot only, as it is not feasible to construct a road through Lot 89 DP 821255 due to the steep terrain.

Figure 10: Alternative Easement Access to Lot 88 DP 821255 – Option 1

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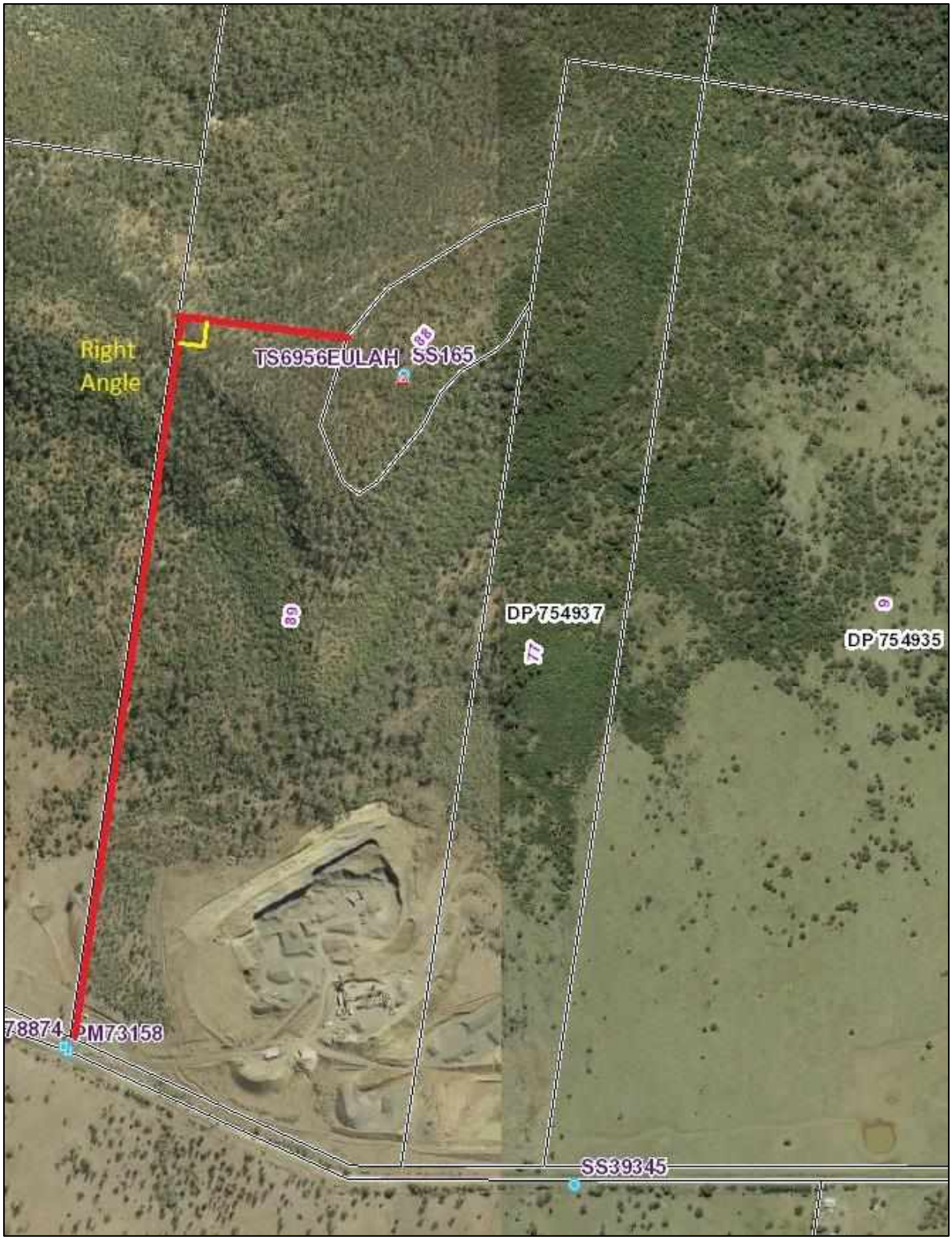

Figure 11: Alternative Easement Access to Lot 88 DP 821255 – Option 2

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5 Environmental Impact Assessment

Items considered include matters set out under Part 5 of the *Environmental Planning and Assessment Act 1979*. A summary of the major points of that consideration follows.

5.1 Meteorological and Climatic Data

Wave Hill is situated in north-west NSW. It is situated on steeply sloping ground with the elevation ranging from approximately 275-375m AHD. The climate is best described as warm temperate.

The following information is based on Bureau of Meteorology (BOM) information for Narrabri Airport (Site: 54038), which is the closest recording station to the subject site that could provide comprehensive rainfall data. This weather station was opened in 2001 and remains operational today.

Table 8: Climatic Information – Narrabri Airport (2001-Present) (BOM 2019)

Monthly Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average	67.9	51.8	59.9	26.5	23.9	50.1	28.7	29.6	31.0	36.6	70.9	64.6	540.5
10th %ile	12.6	15.4	5.8	0.8	0.5	11.8	2.0	3.2	0.6	5.4	17.9	17.6	361.7
90th %ile	132.2	112.3	151.6	67.6	40.5	97.4	66.8	54.5	81.1	60.2	135.1	132.4	710.8

Rainfall statistics show a mean average rainfall at Narrabri Airport of 540.5mm per annum with the majority of total rainfall occurring in the summer months.

Based on an annual average evaporation of approximately 1800 mm (10) and an annual average rainfall of 540.5mm, the site generally has a moisture deficit on an annualised basis of over 1200mm.

The closest weather station to provide more comprehensive climate data is the Narrabri Airport BOM site (Site: 54038). The Narrabri Airport recording station is located approximately 24km east of the proposed development site. Table 9 provides a summary of the average monthly and annual climate conditions.

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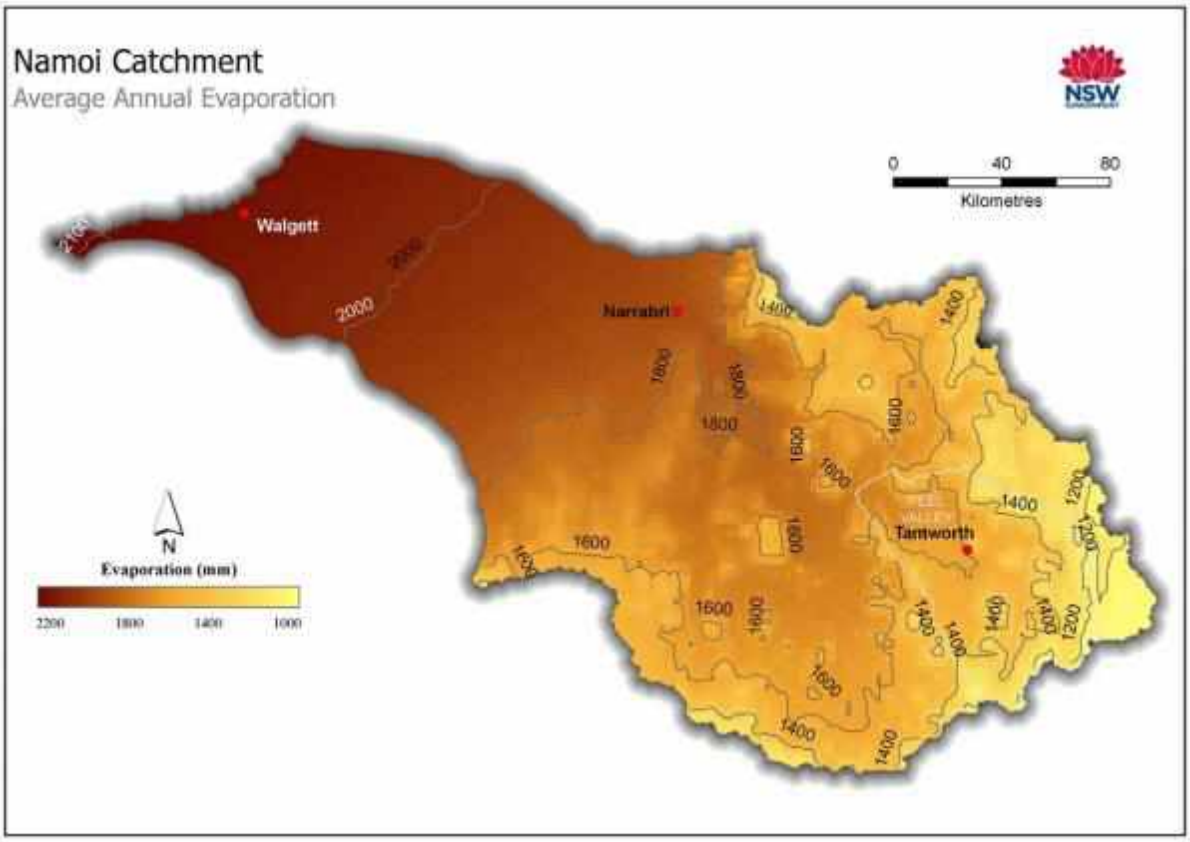

Figure 12: Average Annual Class A Pan Evaporation Within the Namoi Catchment

Table 9: Climatic Information – Narrabri Airport 54038 (2001-Present) (BOM 2019)

Monthly	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Av. Max Temp (°C)	34.9	33.8	31.1	27.1	22.5	18.5	18.1	20.1	24.2	28.3	31.2	33.0	26.9
Highest Temp (°C)	47.8	46.5	40.0	34.8	29.7	26.0	26.5	31.7	34.9	40.8	44.0	43.1	47.8
Av. Min Temp (°C)	20.5	19.6	16.8	12.5	7.5	5.8	4.0	4.6	8.1	12.3	16.1	18.5	12.2
Lowest Temp (°C)	8.4	9.2	4.1	0.3	-3.0	-4.6	-6.0	-3.6	-1.2	2.1	4.3	6.9	-6.0

The long-term temperature figures show that the region experiences significant daily and seasonal temperature variations, with recorded temperatures ranging from 47.8°C to -6°C. Relative humidity is generally low.

The average wind speed and direction for the area varies according to the season and time of day. Wind data sourced from Narrabri West Post Office (Site Number 053030) was examined to identify predominant wind directions in the locality. The wind roses depicting the average annual wind speed and direction are shown in Figure 13.

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The *New England North West Climate Change Snapshot* (2014) projections indicate a warmer climate will result in altered rainfall patterns and more intense bushfires, droughts and floods.

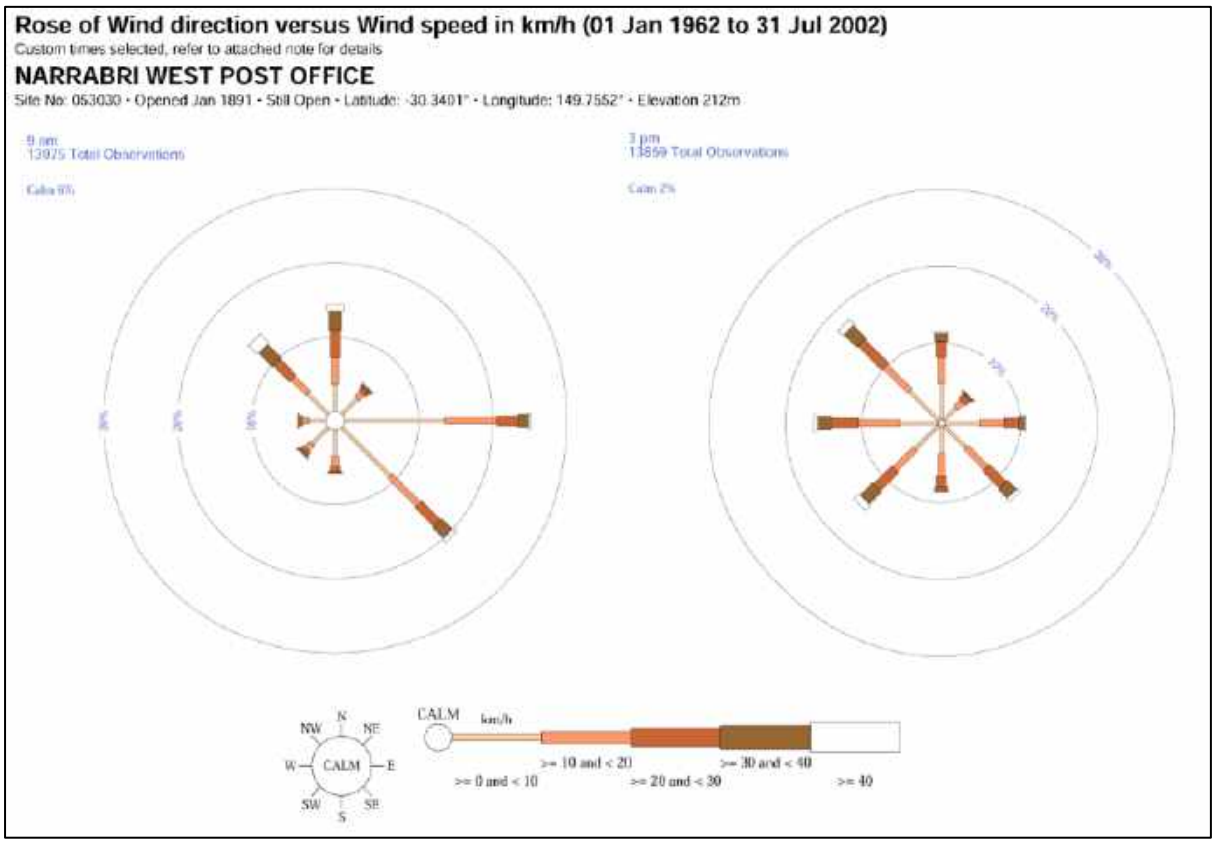

Figure 13: Wind Roses for Narrabri West Post Office (BoM Data 1962-2002)

5.2 Topography and Geology

Wave Hill Quarry is located within the North West Slopes and Plains of NSW. The subject site is at the foot of the western foothills of the Nandewar Range.

The average slope across the existing quarry site based on surveyed heights is approximately 15 degrees. The existing quarry has a median elevation of 325m AHD. Elevation across the site, prior to excavation, ranged from approximately 275m to 375m AHD.

Figure 14 (below) outlines the topography of the existing quarry footprint in the context of the surrounding landscape. The footprint of Wave Hill Quarry as defined in the subject proposal will remain identical to that of the existing quarry.

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The quarry site is located within the Gunnedah Basin, a sedimentary basin with a Palaeozoic basement of folded metasedimentary and volcanic rocks that outcrop around the southern and eastern margins.

Geological mapping of the region surrounding the subject site has been accessed using the NSW Department of Planning and Environment (Resources and Geoscience) online mapping tool. The online mapping tool presents a 1:1,500,000 scale geological map that has been compiled from numerous geological maps and regional geological synthesis datasets from the Geological Survey of NSW and Geoscience Australia. The map represents a simplified, generalised description of geological characteristics of New South Wales. From this, the geology of the region surrounding the subject site is outlined in Figure 15 (below). Table 10 provides a description of the geological formations present within the area.

Mapping indicates the subject site is directly underlain by Permian Mafic Volcanics, which include basaltic lava flows and tuffs, and that the surrounding locality includes a wide array of igneous, sedimentary, alluvial and colluvial deposits. Field investigations confirmed the geology of the area to be consistent with the desktop findings.

The basalt of the subject site extends over 68m below the natural ground surface. Sample testing of the basalt indicates that the intrusion is predicted to be of sound quality for the purposes of extraction and use. A detailed resource assessment is presented in Appendix 3.

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Figure 14: Topography of Landscape Near Wave Hill Quarry

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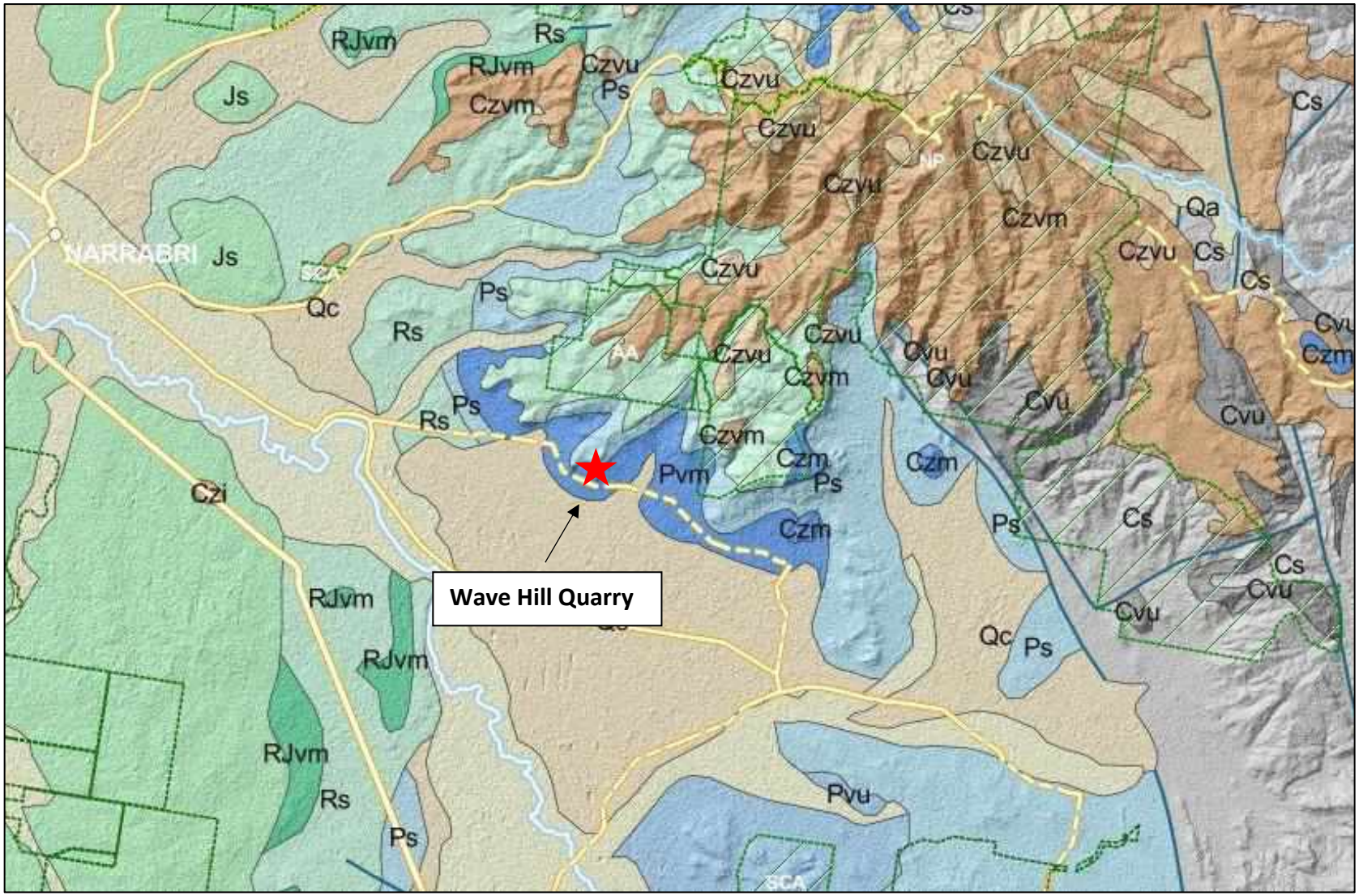

Figure 15: Geology of the Locality (Legend Presented in Table 10)

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Table 10: Legend for Figure 15

Abbreviation	Name	Age	Description
Pvm	Permain Mafic Volcanics	252-299 MYO	Basaltic lava flows and tuffs. Typically rich in plagioclase. Also some intercalated sedimentary rocks.
Czm	Cainozoic Mafic Intrusives	0-66 MYO	Intrusive mafic rocks associated with volcanoes. These rocks typically include iron-magnesium minerals like pyroxene.
Ps	Permian Sedimentary Rocks	252-299 MYO	Sandstone, siltstone and mudstone. Deposited in fluvial and floodplain systems, or in shallow marine environments. Also includes coal seams in some areas.
Pvu	Permian Silicic-Intermediate Volcanics	252-299 MYO	Latite and trachytic tuff with associated sandstone.
Rs	Triassic Sedimentary Rocks	201-252 MYO	Quartz-lithic to quartz-rich sandstone with conglomerate, mudstone and siltstone. Deposited in high energy braided river systems.
RJvm	Triassic-Jurassic mafic volcanics	145-252 MYO	Mafic rocks including dolerite, basalt, trachyte, tuff and breccia.
Js	Jurassic sedimentary Rocks	145-201 MYO	Sedimentary sequences dominated by sandstone with minor conglomerate units and claysone.
Qa	Quaternary Alluvial Deposits	0-2.5 MYO	Current and recent mud, silt, sand and gravel deposited by river (alluvial) systems.
Qc	Quaternary Colluvial Deposits	0-2.5 MYO	Colluvial deposits are unconsolidated sediments that are found downslope from hills. They form by erosion of hills and by creep or sheetwash.
Czvm	Cainozoic Mafic Volcanics	0-66 MYO	Mafic volcanic rocks are those that were erupted from widespread volcanic activity through the eastern part of the state over the last 65 million years. Basalt lava flows are typical examples.
Czvu	Cainozoic Silicic-Intermediate Volcanics	0-66 MYO	Rhyolite (quartz and feldspar rich) and dacite (feldspar rich) eruptive rocks.
Cvu	Carboniferous Silicic-Intermediate Volcanics	300-359 MYO	These rocks were erupted explosively from volcanoes. Ignimbrite sheets smother the ground from pyroclastic flows. These rocks are rich in quartz and feldspar.
Cs	Carboniferous Sedimentary Rocks	300-359 MYO	A wide range of sedimentary rocks, including feldspar-rich sandstone, siltstone, mudstone and conglomerate units.

5.3 Soils

5.3.1 Existing Environment

The NSW Soil and Land Information Database eSPADE, managed by OEH, includes online soil profile records. A number of soil profiles have been recorded at and adjacent to the existing

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quarry site, as indicated in Figure 16. A summary of the key characteristics recorded for each soil profile is presented in Table 1111.

Figure 16: Locations of Soil Profiles Recorded on eSPADE

Table 11: Summary of eSPADE Soil Profile Characteristics

Profile	Year of Record	Soil Type (ASC)	Description
1	2007	Black Vertosol	Hillslope under unknown on basalt lithology. Slope 15% (estimated), local relief low (30-90 m), elevation 350.0 m, aspect south. Surface condition is self mulched, profile drainage is imperfectly drained, erosion hazard is slight, and no salting evident. Emerson aggregate test showed aggregate slaking.
2	2007	Red Chromosol	Hillslope under unknown on basalt lithology. Slope 15% (estimated), local relief low (30-90 m), elevation 340.0 m, aspect south. Surface condition is loose, profile drainage is mod. well drained, erosion hazard is slight, and no salting evident. Emerson aggregate test showed no change.
3	2007	Black Dermosol	Hillslope under unknown on basalt lithology. Slope 15% (estimated), local relief low (30-90 m), elevation 300.0 m, aspect south. Surface condition is self mulched, profile drainage is mod. well drained, erosion hazard is slight, and no salting evident. Emerson aggregate test showed aggregate slaking.
4	2007	Black Vertosol	Hillslope under unknown on coarse-acidic lithology. Slope 20% (estimated), local relief high (90-300 m), elevation 380.0 m. Surface

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Profile	Year of Record	Soil Type (ASC)	Description
			condition is self mulched, profile drainage is mod. well drained, erosion hazard is slight, and no salting evident. Emerson aggregate test showed no change.
5	2007	Red Dermosol	Hillslope under unknown on coarse-intermediate lithology. Slope 15% (estimated), local relief high (90-300 m), elevation 380.0 m, aspect south. Surface condition is self mulched, profile drainage is mod. well drained, erosion hazard is slight, and no salting evident. Emerson aggregate test showed no change.
6	2007	Leptic Tenosol	Hillslope on siltstone/mudstone, sandstone-lithic lithology. Slope 20% (estimated), local relief high (90-300 m), elevation 450.0 m, aspect south. Surface condition is loose, profile drainage is well drained, erosion hazard is slight, and no salting evident. Emerson aggregate test showed no change.
7	2007	Red Vertosol	Hillslope under unknown on siltstone/mudstone, sandstone-lithic lithology. Slope 20% (estimated), local relief high (90-300 m), elevation 450.0 m, aspect south. Surface condition is self-mulched, profile drainage is mod. well drained, erosion hazard is slight, and no salting evident. Emerson aggregate test showed no change.

Soil mapping undertaken by OEH (2017) indicates that the landscape surrounding Wave Hill Quarry is associated with Vertosols, Chromosols, Rudosols/Tenosols and Sodosols (Figure 17). The mapping is consistent with soil profiles recorded on eSPADE and with site observations.

Overall, the soil of the subject site includes Vertosols, Chromosols and Dermosols. Soils are finely textured and well structured, ranging from imperfectly to well drained, with slight erosion hazard and no evidence of salting.

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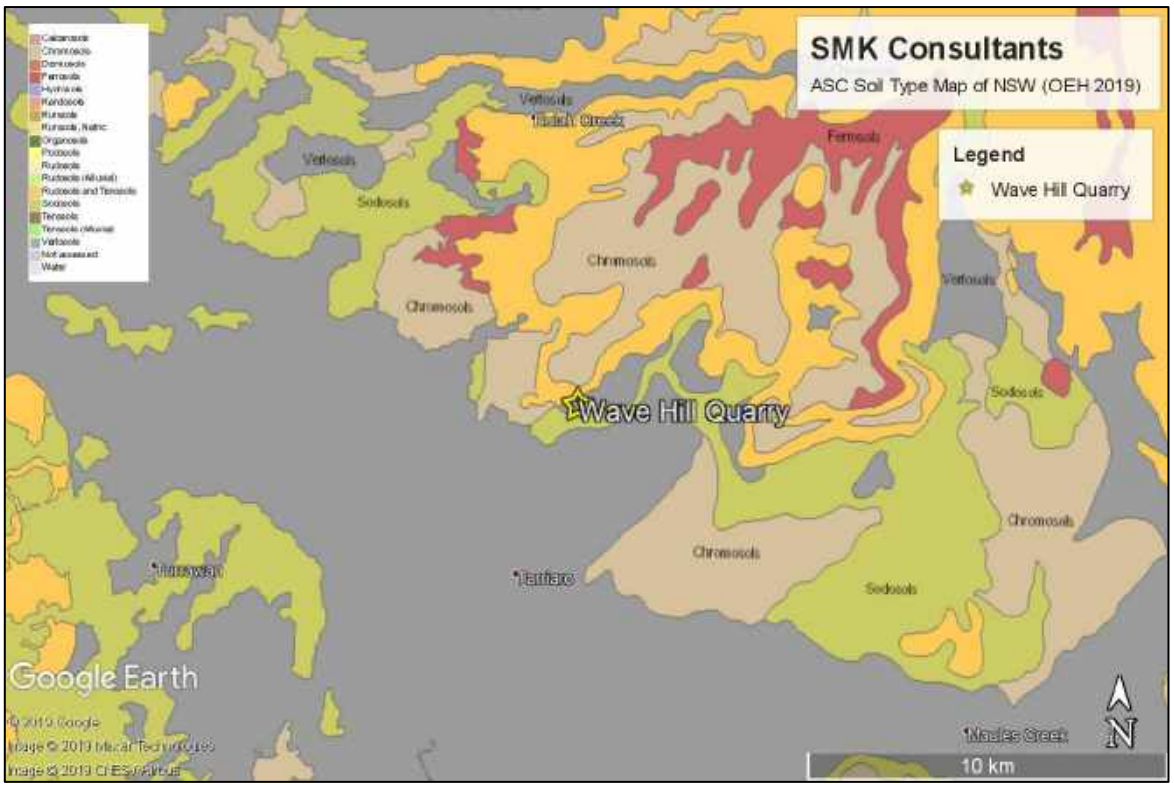

Figure 17: Soil Types Near Wave Hill Quarry (Soil Mapping Source: OEH 2019)

5.3.2 Potential Impacts

5.3.2.1 Soil Erosion

Soils onsite is shallow (roughly 0.5m, or less, in depth) and is comprised of clay soils underpinned by basalt. In an undisturbed state, soils on site are of slight erosion hazard, being well-structured and with minimal evidence of slaking and no evidence of dispersion when subjected to Emerson aggregate testing.

The primary risk to soil as a result of the proposed quarry modification is that of soil erosion. The potential for increased soil erosion is minimal however, as no soil stripping will take place as part of the current proposal. The excavation footprint of Wave Hill Quarry has been entirely cleared of vegetation and stripped of overburden. Any potential risks of soil erosion would arise from existing site features, such as stockpiles and earthen bunds, and ongoing site activities.

5.3.2.2 Salinity

The subject site is not considered to have an existing salinity issues and the development proposal, as designed, will not increase the risk of salinity on the property.

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5.3.2.3 Acid Sulphate Soils

Deposits of Acid Sulphate Soils (ASS) are commonly found less than five meters above sea level, particularly in low-lying coastal areas. Mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes are ideal areas for acid sulphate soil formation.

As the subject is not coastal and is situated at elevations greater than 300m above sea level, it is unlikely that ASS are located within or adjoining the property. There was no evidence of ASS during the site inspection.

5.3.3 Mitigation Measures

The applicant is conscious of the need to conserve all soil resources available onsite and to ensure that they are responsibly managed and are available for the rehabilitation of disturbed areas within the project site, whilst preventing erosion.

A number of soil erosion management measures are already implemented on site and these measures will be maintained for the duration of the quarry operation. These include:

- A controlled drainage system and sediment pond, to ensure surface runoff containing high sediment loads is captured and retained within the impact footprint of the development;
- Where stockpiles are to be retained for periods in excess 6 months, the stockpiles would be seeded with a cover crop of non-persistent pasture species;
- Implementing dust management measures to reduce dust production and subsequent aeolian erosion from site (as outlined in Section 5.7);
- Undertaking progressive rehabilitation where possible to minimise the area of exposed soil at any given time; and
- Ensuring that erosion and sediment control measures are only removed from the site once the area is successfully rehabilitated following the conclusion of quarry activities.

In most cases, water management controls duplicate as a means of soil erosion control. A range of water management and drainage controls present onsite are outlined in Section 6 and Appendix 10 (Soil and Water Management Plan). The implementation of these controls would either divert “clean” water (via non-scouring drains/banks) around disturbed areas or direct runoff (“dirty” water) from disturbed areas to detention structures. A sedimentation pond is present in the south-eastern section of the quarry footprint to reduce the external impact of the works. This is below ground-level and the risk of offsite discharge of sediment laden water is considered as minimal.

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5.3.4 Assessment of Impacts

The proposal should not result in the pollution of land/waters so long as best management practices for erosion and sediment control continue to be implemented throughout the course of quarry operations. Achieving a high standard of erosion and sediment control and general site housekeeping will continue to be a priority throughout the lifetime of quarry operations.

5.4 Land Capability

5.4.1 Existing Environment

Land and soil capability assessment is based on the biophysical features of the land, including slope, wind hazard, soil pH, surface structural stability, salinity, rocky outcrop, water logging potential and existing erosion of a landform. The following table summarises the appropriate land use for each capability class.

Table 12: Land and Soil Capability Classes

Class	Most Intensive Use	Land Definition
Class 1	Regular cultivation including intensive crops	Suitable for a wide range of agriculture. It may be regularly cultivated. Very slight to negligible limitations.
Class 2	Regular cultivation	Suited to a wide range of horticulture in rotation with pastures. Several minor constraints may limit suitability for continuous cultivation. These include stony and shallow phases of soil and moderate erosion hazard.
Class 3	Regular cultivation, but must be consciously managed to prevent degradation	Suited to grazing, including the use of improved pastures. Cultivation is limited to cash or forage crops in rotation with pastures.
Class 4	Grazing, intermittent cultivation with specialised practices	Suitable for grazing, but not for cultivation. Pasture improvement relies on minimum tillage techniques. Productivity may be seasonally high but overall is low as a result of major environmental constraints.
Class 5	Grazing, very occasional cultivation for pasture establishment	Non-arable land suitable for grazing but not cultivation. Maintain or improve perennial pastures and preserve ground cover.
Class 6	Grazing only	Non-arable and often non-trafficable. Land suitable for grazing but not cultivation. Maintain or improve perennial pastures and preserve ground cover.
Class 7	Unsuitable for rural production	Includes steep (slope 33 to 50%) or extremely erodible, or saline or shallow soils. Generally unsuited to agriculture or at best suited only to light grazing.
Class 8	Unusable for any agricultural purpose	Extremely severe limitation, includes precipitous slopes (>50%), areas with large proportion of rock outcrop and frequently inundated. Agricultural production is very low or zero as a result of severe constraints and as a results retirement form agriculture

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Class	Most Intensive Use	Land Definition
		for conservation purposes may be the best option.

The NSW Soil and Land Information Database eSPADE, managed by OEH, identifies the quarry site as having a land and soil capability ranking of Class 4. The land capability classes for the subject site and surrounding land are shown in Figure 18.

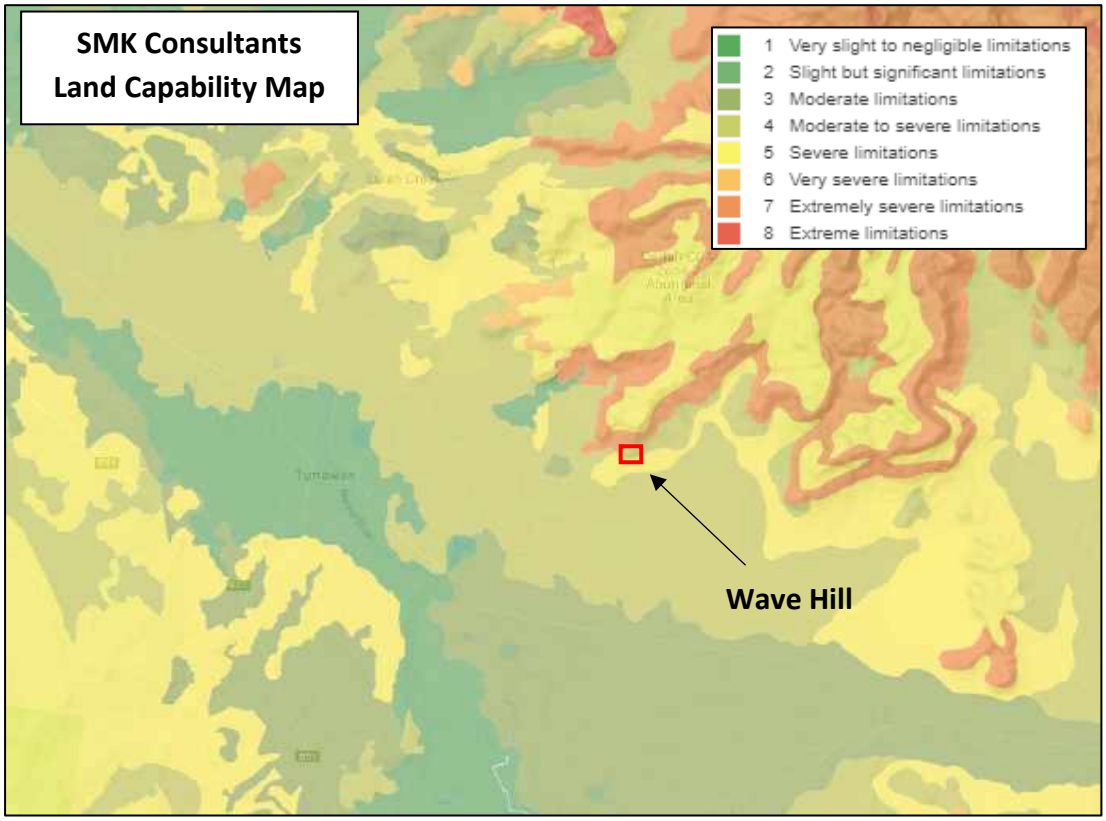

Figure 18: Land and Soil Capability Classes (eSPADE (OEH))

Field inspection of the subject site and surrounding locality indicates that the land upon which the quarry footprint is located would be better classified as having an original land capability of 5, as a result of the steep slope and shallow soils upon which the site is located.

5.4.2 Management Issues and Constraints

The required final land capability of the site following rehabilitation is determined by:

- The intended land use following quarry closure; and
- The original land capability of the site.

The Narrabri Shire Council has requested as part of SEARs that the site be rehabilitated to a standard such that the site is suitable to return to agricultural use. The original land capability of the existing quarry footprint is mapped by OEH as 4, yet is more accurately

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described as 5 due to the steep topography and shallow soils of the site. It is therefore considered that the site should be rehabilitated to a Land Capability Class of 5.

Factors which may affect the ability of the Applicant to return the final landform to the desired land and soil capability, and therefore require assessment, include:

- Reduced capability of the final landform; and
- Erosion of the rehabilitated final landform.
-

5.4.3 Mitigation Measures

The objective of the proposal with respect to land capability is to return the existing quarry site to a land capability class of 5 such that the site is suitable for future agricultural use.

Appendix 11 includes a rehabilitation plan with detail on the final landform based on the proposed final slopes and vegetation.

The following design features of the final landform are recommended to achieve the desired land capability objectives:

- The final batters of the extraction area would be safe, stable, non-eroding and non-polluting;
- Drainage of the final landform would be to defined locations to prevent rilling and erosion caused by uncontrollable flow of surface water.

The proposed soil stripping, stockpiling and respreading measures and controls would also assist in maintaining the value of the soil for rehabilitation purposes and therefore maximise land capability. Soil replacement should occur in accordance with the following:

- Soil would be replaced in the reverse order to stripping, subsoil followed by topsoil.
- An alkaline (not acidifying) fertiliser would be added to the respread soil to assist with any nitrogen or potassium deficiency.

The proposed management controls to be implemented would ensure that the final landform and potential for future agricultural activities is not compromised by excessive erosion, pollution or restricted availability of water.

5.4.4 Assessment of Impacts

It is assessed that implementation of the proposed soil management and rehabilitation methods would provide for LSC Class 5 (or better) within the footprint of the existing quarry.

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5.5 Land Use Conflict

5.5.1 Surrounding Land Uses

Wave Hill Quarry is located at the foothills of the Nandewar range. The area to the north of the subject site is dominated by regrowth and remnant vegetation on the range, whilst the area to the south of the site is dominated by agricultural enterprises including grazing and crop production. The site is located approximately 1km from the Boral Quarry which is to the west of the subject site.

Sensitive receptors in the area include rural dwellings. The distances of each receptor from the proposed development, as calculated from the closest edge of the proposed Quarry footprint, have been included as Table 13. The locations of sensitive receptors within a 1-kilometre radius of Wave Hill are presented in Figure 19. The closest township, Narrabri, is located 24 km to the west of Wave Hill Quarry. Given the distance, the township is not considered likely to be impacted by the Quarry operation.

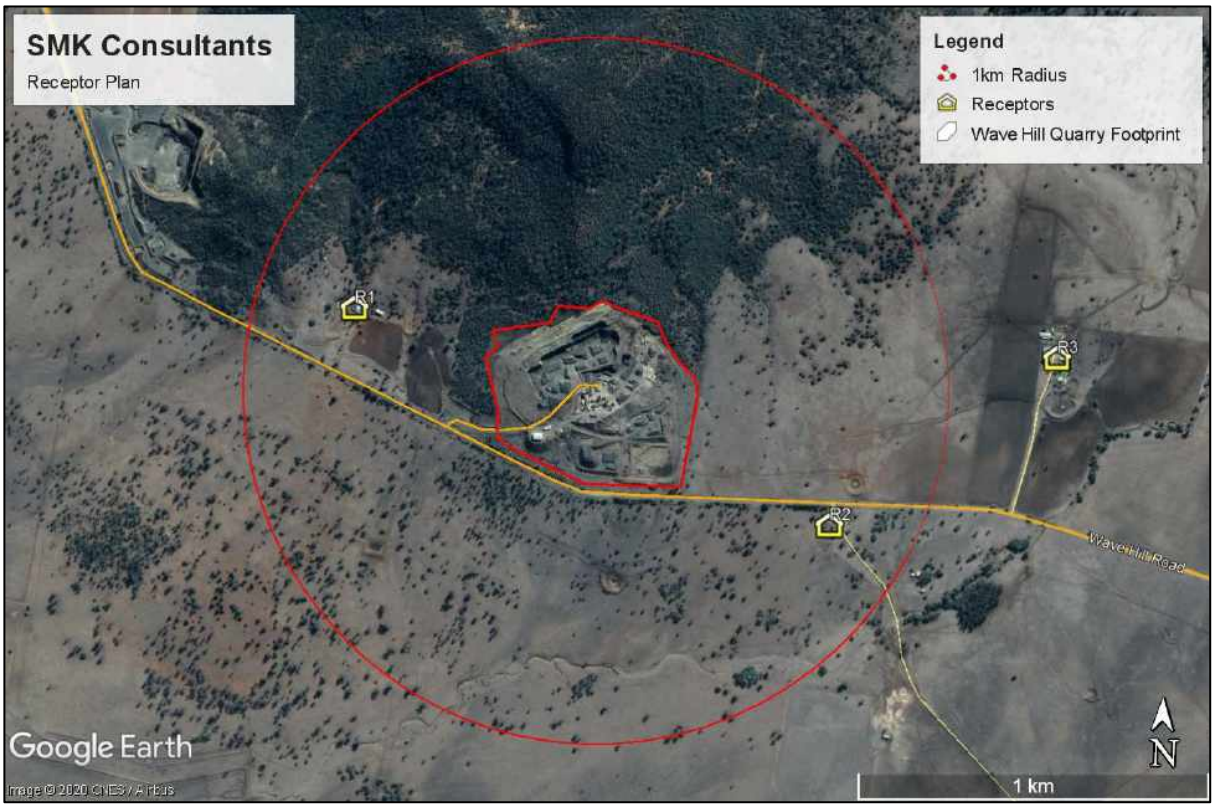

Figure 19: Sensitive Receptors in the Wave Hill Quarry Locality

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Table 13: Separation Distances from Sensitive Receptors

Receptor ID	Address	Receptor Type	Direction	Approx. Distance from Quarry Boundary (m)	Approx. Distance from Blasting Area (m)
R1	'Glen Aston' 939 Wave Hill Road	Rural Dwelling	W	380	720
R2	'Brenowen' 1092 Wave Hill Road	Rural Dwelling	SE	425	810
R3	'Wave Hill Residence' 1143 Wave Hill Road	Rural Dwelling	E	1,027	1,250
Narrabri		Rural Town	BW	23,500	23,500

5.5.2 Potential Impacts

The potential for land conflict typical occurs as a result of adverse dust, noise or aesthetic impacts. There is also potential for increased erosion and associated sediment pollution of surface water.

5.5.3 Management and Mitigation Measures

Quarries should be separated from sensitive receptors by a sufficient distance to limit any adverse impacts resulting from dust, noise or aesthetic considerations to an acceptable level. The minimum buffers recommended for mining, petroleum production and extractive industries are outlined in Table 14.

Table 14: Recommended Minimum Buffer Distances

Mining, Petroleum Production & Extractive Industries		
	Normal Operations (m)	**Blasting (m)**
Residential areas & urban development	500	1000
Rural dwellings	500	1000
Education facilities & pre-schools	500	1000
Rural tourist accommodation	500	1000
Watercourses & wetlands	SSD	SSD
Bores & wells	SSD	SSD
Potable water supply/catchment	SSD	SSD
Property boundary	SSD	SSD
Roads (public)	SSD	SSD

SSD: Site Specific Determination. Source: Department of Primary Industries (2007) Living and Working in Rural Areas Handbook

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Blasting is required as part of extractive operations at Wave Hill Quarry, therefore both the minimum buffer distances applying to normal operations and blasting listed in Table 14 apply to nearby sensitive receptors. The closest homestead 'Glen Aston' (R1) on an adjoining property is located approximately 380m to the west of the quarry site and 720m to the west of the blasting site. The available separation distances are therefore lower than the minimum buffer distance requirements for normal operations and blasting outlined in Table 14. Similarly, sensitive receptor R2 'Brenowan', located south-east of the quarry, is closer to the quarry than the minimum recommended buffer distance for blasting, however it is over 600m away from the location of extractive activities within the quarry site, therefore exceeding minimum recommended distances for normal operations. The available separation distance between R3 'Wave Hill Residence' and the quarry exceeds minimum buffers listed in Table 14 for both quarrying activity types.

Detailed Air Quality Impact Assessments and Noise Impact Assessments were carried out to determine the potential adverse impacts of the proposal on the identified sensitive receptors. Results of the assessments are outlined in Sections 5.7 and Section 5.8 respectively. Full copies of the assessments are included in Appendix 4 and Appendix 5. Both assessments include a range of mitigation measures to minimise potential adverse impacts resulting from quarry operations and blasting. The assessments conclude that provided these mitigations measures are appropriately implemented and efficiently monitored, the modification of Wave Hill quarry operations will not result in significant adverse impacts to the identified sensitive receptors in the vicinity of Wave Hill quarry.

A Land Use Conflict Risk Assessment (LUCRA) was also undertaken to identify landuse compatibility and potential conflict between neighbouring landuses, and the identification of conflict avoidance or mitigation measures. The LUCRA identifies a comprehensive suite of management methods which will be implemented to minimise the risk of social impacts and subsequent land use conflict as a result of the quarry activities on site. A copy of the assessment has been included as Appendix 6. The LUCRA risk assessment concludes that in the event of a conflict occurring, with appropriate mitigation measures in place, only minor to negligible consequences would be experienced.

The following existing management and mitigation measures would also continue to be implemented throughout the project life cycle in order to avoid or reduce impacts on surrounding land uses:

- The development as proposed would not divert any surface water runoff away from existing agricultural enterprises;
- Operations would be undertaken in a manner which minimises noise and dust emissions.

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An erosion and sediment control plan has also been provided to minimise the potential for impacts associated with siltation of waterway or dust deposition on crops or pasture (refer to Appendix 10).

Overall, the siting of the proposed development is therefore considered sufficient to minimise the risk of land use conflict and adverse amenity impacts associated with the development.

5.5.4 Assessment of Impacts

The development is considered permissible within the current zoning. It is noted that the development is an existing development and that the Applicant has not received any complaints relating to quarry operations or blasting in the last 12 months. The proposal does not comply with recommended separation distances for two of the three identified sensitive receptors, however additional detailed assessments have shown that, providing the relevant proposed mitigation and management measures are implemented, the development will not introduce any new impacts to such an extent as to unacceptably reduce the amenity of rural residents.

Therefore, the proposed development is not considered to pose a significant risk of causing land use conflict within the locality.

5.6 Visual Amenity

5.6.1 Potential Impacts

In general, the potential for visual impacts from quarries arises from any near vertical rock faces and equipment that may be visible from nearby residences and public places.

5.6.2 Management and Mitigation Measures

The quarry is visible from Wave Hill Road; however, it is elevated some 30 metres above the road. Screening is provided by the workshop and material stockpiles, which, along with the elevation of the quarry above the road, reduces its visual impact. Furthermore, the fact that an operational quarry is already present at this location means that no new feature will be added to the landscape. The quarry is existing and infrastructure such as roads and loading areas have been formed to allow operation of the existing site over the past decades. The extraction process occurs below ground.

The closest receptors are shielded from a direct view of the plant and associated quarry equipment by natural vegetation screen (to the south and west) and by stockpiles and sparsely distributed vegetation (to the east).

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In addition, the following measures are recommended to improve the visual amenity of the development:

- Retention and protection of any remaining vegetation located between the identified extraction zone and neighbouring sensitive receptors and Wave Hill Road.
- Rehabilitation and revegetation of the site with appropriate species following the project completion.

5.6.3 Assessment of Impacts

It is considered that no unreasonable adverse visual impacts will occur as a result of the proposal, given the presence of the existing development. The adoption of recommended mitigation measures will ensure that existing visual impacts:

(i) Are not exacerbated by the proposal;
(ii) Will be limited to a short to medium term duration;
(iii) Will be reversed following project completion through the implementation of rehabilitation measures.

5.7 Air Quality

5.7.1 Potential Impacts

Advitech Pty Ltd (Advitech) were engaged to prepare an Air Quality Impact Assessment (AQIA) for the proposed Quarry. This section presents a summary of the assessment and a copy of the full report has been included as Appendix 4.

The activities associated with the proposed operations with the potential to generate dust are:

- Blasting operations within the quarry extraction area;
- Operation of front end loader and excavator within the extraction area;
- Operation of the crushers and vibrating screens;
- Wind erosion from stockpiled quarry materials; and
- Dust generated from haul truck movements along short unpaved internal roads.

NSW EPA sets out impact assessment criteria for ground level concentration of air pollutants in *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, 2016*. The four pollutant types assessed in the Wave Hill AQIA are shown in Table 15.

Table 15: NSW EPA Impact Assessment Criteria

Pollutant	Description	NSW EPA Criteria	Units	Averaging Time
TSP	Total suspended particulates	90	µg/m3	Annual
PM_{10}	Particulate materials with an	50	µg/m3	24 hours

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Pollutant	Description	NSW EPA Criteria	Units	Averaging Time
	aerodynamic diameter less than 10 µm	25	µg/m3	Annual
$PM_{2.5}$	Particulate materials with an aerodynamic diameter less than 2.5 µm	25	µg/m3	24 hours
		8	µg/m3	Annual
Deposited Dust	Dust is assessed as insoluble solids as defined by AS 380.10.1	2[1]	$g/m^2/month$	Annual
		4[2]		

Source: Air Quality Impact Assessment, Appendix 4

[1] Maximum increase in deposited dust level

[2] Maximum total deposited dust level

Advitech modelled cumulative emissions to air impacts from the proposed intensified extractive operations at Wave Hill Quarry in combination with impacts from existing operations at the neighbouring Boral Quarry on identified sensitive receivers (see Table 13, Figure 19 in Section 5.5.1). Background air quality data used in the model was obtained from the Tamworth air quality monitoring station, the closest monitoring station providing background air quality data to the proposed development site. The Level 1 assessment assumed a worst case background concentration by using the maximum reported values of each pollutant since monitoring began in 2000 (TSP and PM_{10}) and 2016 ($PM_{2.5}$).

5.7.1.1 Annual Average Predicted Concentrations

Modelling results show that predicted concentrations of the annual average levels of PM_{10} , TSP and deposited dust at identified sensitive receptors do not exceed assessment criteria set out by NSW EPA. Annual average levels of $PM_{2.5}$ exceed assessment criteria at each of the 3 identified sensitive receptors, however it is noted that annual average $PM_{2.5}$ background levels (8.4 µg/m3) already exceed the criteria, and that only cumulative impacts from both the Wave Hill and Boral Quarries only result in a minor increase (maximum of 0.3 µg/m3).

5.7.1.2 Twenty-Four Hour Average Predicted Concentrations

Predicted cumulative PM_{10} concentrations (e.g. maximum background levels, predicted increments from Wave Hill Quarry and Boral Quarry) exceeded 24-hour criteria at all 3 identified sensitive receptors. Similarly, predicted cumulative $PM_{2.5}$ concentrations exceeded 24-hour criteria at the sensitive receptor R1, while receptor R2 registers predicted concentrations at the guideline value of 25$\mu g/m^3$.

Given that background concentrations accounted for 95% of the criteria value for PM_{10} and $PM_{2.5}$, it was determined likely that predicted exceedances were the result of elevated background levels. A Level 2 contemporaneous and background assessment was therefore carried out to determine if any additional exceedances of the $PM_{2.5}$ and PM_{10} impact assessment criteria were due to the proposed development. Results of this assessment

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indicated that there no exceedances of the 24-hour PM_{10} impact assessment criteria, and no additional exceedances of the 24-hour $PM_{2.5}$ impact assessment criteria at nearby sensitive receivers.

5.7.2 Management and Mitigation Measures

Advitech recommends the implementation of the following management measures to reduce any potential particulate impacts that may occur from quarrying operations at Wave Hill Quarry:

- Carry out activities on the premises in a manner that will minimise the emission of dust;
- Employ dust suppression sprays on plant crushing and screening equipment; and
- Apply water sprays (greater than $2L/m^2/hr$) to trafficable areas during haulage to reduce air emissions associated with truck movements.

It is also recommended to implement a suite of dust control measures on site to limit particulate matter emissions as part of best practice management methods onsite. Table 156 outlines sources of dust from the quarry, and associated management measures.

Table 156: Dust Mitigation Measures to be Adopted at Wave Hill Quarry

Potential Impact Site	Methods to Control Air Pollution
Roads	• Covered loads when transporting and watering of haul roads. • Grading of roads. • Well-defined haul routes to minimise area of disturbance. • Speed limits (recommended 40km/h).
Wind Erosion of Exposed Materials and Stockpiles	• Minimising areas of disturbance. • Progressive rehabilitation.
Crushing, Screening and Handling	• Ensure dust covers in place. • Ensure water sprays are activated for dust management.
Loading and Handling Materials	• Keep front-end loader bucket low when handling and transporting materials.
Monitoring and Proactive Management	• Monitor meteorological conditions. • Cease activity on dry windy days. • In the event of increased dust production, increased dust suppression management measures, including by increasing watering rates, decreasing processing rates, slowing truck speeds and ensuring that dust housing protections remain in place. • Initiate Shut down procedures during periods of excessive dust generation or upon receipt of complaint and investigate and initiate additional controls.

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5.7.3 Assessment of Impacts

Cumulative air quality impacts from the proposed intensification of quarry operations at Wave Hill Quarry (from 200,000 tonnes/annum to 500,000 tonnes/annum) were modelled in conjunction with those of existing quarry operations at the nearby Boral Quarry. Results indicate that increase in annual production at Wave Hill Quarry would result in increased particulate matter concentrations and dust deposition at nearby sensitive receptors. However, these increases are not predicted to cause any additional exceedances of the NSW EPA assessment criteria for PM_{10}, $PM_{2.5}$, TSP or deposited dust.

The quarry operation has installed a range of dust suppression equipment within the secondary crusher system which applies a mist of water and fluids to settle dust from the crushed rock as it passes through the conveyor system. This equipment is being constantly modified to improve dust suppression within the products being manufactured. Additionally, a water truck is permanently located at the site to water haul roads and apply water around the base of the secondary processing structures. The aim of this is to settle the fine dust created during crushing and traffic movement which has in the past proven to be a source of dust during windy conditions.

5.8 Noise and Vibration

Advitech Pty Ltd (Advitech) were engaged to prepare a Noise Impact Assessment (NIA) for the proposed Quarry. A copy of this report has been included as Appendix 5. The proposed development does not involve any construction activities and the NIA therefore only considers noise levels associated with quarry operations.

The NIA provides an assessment of all potential acoustic and vibration impacts on nearby sensitive receivers in accordance with several guidelines including the NSW Noise Policy for Industry (2017) and the NSW Road Noise Policy (2011). Three identified sensitive receptors are taken into consideration when assessing operational impacts. The nearest of these, Receptor 1 (R1), is located approximately 300m west of extractive operations (see Figure 19, Section 5.5.1 for a sensitive receptor plan). Potential sensitive receptors along Wave Hill Road and Maules Creek Road are considered for the assessment of off-site transport noise impacts.

5.8.1 Potential Impacts

5.8.1.1 Operational Noise

Project Noise Trigger Levels (PNTL) were determined using ambient and background noise measurements from the site. PNTL were adopted based on the most stringent criteria and were conservatively set at 40 dB(A) (day); 40 dB(A) (evening); and 36 dB(A) night. Noise

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generation above these levels may potentially result in adverse noise impacts to nearby sensitive receivers.

Noise modelling results predicted the potential impacts of quarry operations upon sensitive receptors as follows:

- Exceedances of up to 4dB(A) are expected at receiver R2 if quarrying operations utilising the mobile plant are conducted during calm conditions;
- Exceedances of up to 4dB(A) are expected at receiver R2 if quarrying operations utilising the mobile plant are conducted in unison with pre-blast drilling activities during calm conditions;
- Exceedances of up to 1dB(A) are expected at receiver R2 if quarrying operations utilising the fixed plant are conducted in unison with pre-blast drilling activities during calm conditions.

The results of noise modelling indicate that no adverse impacts will be incurred by sensitive receptors in the following scenarios:

- Both fixed and mobile quarrying operations, and pre blast drilling activities (operating in isolation from each other) are predicted to comply with the PNTL under prevailing conditions (south-east winds up to 3m/s);
- Both fixed and mobile quarrying operations in conjunction with pre blast drilling activities are predicted to comply with the PNTL under prevailing conditions (south-east winds up to 3m/s); and
- All receivers will be below the PNTL criteria if truck loading and stockpiling activities are to occur before 7am under both standard and prevailing meteorological conditions.

5.8.1.2 Maximum Noise Level Triggers

Maximum noise level events were assessed with regards to their potential to cause sleep disturbance, according to criteria set out in the NPfI. Maximum noise level triggers for the projects are $L_{Aeq,15min}$ 40 dB(A) and L_{AFMax} 52dB(A).

5.8.1.3 Road Traffic Noise

Noise levels generated by traffic associated with quarry activities were assessed against relevant criteria determined in accordance with the NSW EPA's Road Noise Policy (RNP). The assessment focused on traffic impacts experienced by potential sensitive receptors along Wave Hill Road and Maules Creek Road. The assessment criteria are set out in Table 17.

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Table 17: Road Traffic Noise Assessment Criteria

Day (7am-10pm)	Night (10pm-7am)
$L_{Aeq,(15\ hour)}$ 60 (external)	$L_{Aeq,\ (9hour)}$ 55 (external)

Given that the final route plan had not been finalised at the time of the assessment, detailed potential impacts on sensitive receptors could not be accurately predicted.

5.8.2 Management and Mitigation Measures

5.8.2.1 Operational Noise

The NIA recommended that 2 separate stockpiles present to the south-east of the quarry be consolidated to form a single, continuous stockpile of 5 metres in height to act as a noise barrier against the operation of mobile equipment on the quarry. This would ensure that the amenity of nearby receptors, in particular R2, is not adversely impacted.

When pre-blast drilling is carried out, the Noise Impact Assessment recommends a number of mitigation measures to reduce noise levels below the PNTL at all sensitive receptors and during all quarry activities:

- When the drill rig is operated as part of pre-blasting activities, the front of the drilling plant is positioned away from R2, the most affected receptor;
- Minimize instances where pre-blast drilling operations are carried out in conjunction with mobile or fixed plant operations, to the extent that it is possible;
- Implement drilling plans that increase the distance between drilling operations and receiver R2, progressing towards the north west or north; and
- Where possible, schedule periods in which both drilling and quarrying activities are operational around time of high background noise (e.g. local traffic), to mask noise generated onsite.

5.8.2.2 Road Traffic Noise

As detailed route plan had not been finalised at the time of assessment, mitigation measures were recommended in order to minimise any potential adverse road impacts associated with the final route:

- Consultation with residents adjacent to the final haul route;
- Development of a traffic management plan to ensure that drivers:
    - Adhere to sign-posted speed limits;
    - Maintain and operate vehicles in a manner that does not generate excessive noise;
    - Schedule haulage to maximise periods of respite;

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  - Include a monitoring plan to ensure plan adherence and a complaints handling procedure.
- Use larger vehicles to minimise haulage trips as far as practicable;
- Remain below signposted speeds in built up areas to reduce potential impact levels.

5.8.3 Assessment of Impacts

5.8.3.1 Operational Noise

The assessment included noise modelling which indicated that offsite noise levels generated by the proposed operations are likely to be below the PTNL at all receivers, during all assessment periods, provided the recommended mitigation measures are put in place. Even with the implementation of the above mitigation measures, contributions at receiver (R2) may exceed assessment criteria by up to 1dB(A) when the drill rig for pre blasting activities is carried out in conjunction with the operation of fixed quarrying plant in calm conditions. In the event that this occurs, such minor residual impacts are considered negligible.

5.8.3.2 Maximum Noise Levels

The loading of quarried material onto hoppers or trucks was identified as the activity with greatest potential to generate maximum noise level impacts. It is important to note that these impacts may only manifest in association with incoming traffic onto the site from 6:30 – 7:00am (i.e. 30 minutes during the night period). Notwithstanding, review of modelling results indicates that L_{AMax} noise levels at adjacent sensitive receivers will be less than the night-time assessment criteria, and no adverse impact is expected.

5.8.3.3 Road Traffic Noise

Review of modelling results of impacts at noise receptors along Wave Hill Road and Maules Creek Road show that noise levels may increase by up to 2dB(A) at some receptors as a result of traffic generated by the quarry. However, all noise levels at all sensitive receptors would remain below the assessment criteria throughout standard operational hours (6am-6pm), including under peak demand.

In relation to noise generated along haul routes, similar noise emission levels will occur along Wavehill road. New haul routes have been agreed to with Narrabri Shire Council, mainly the use of Turrawan Road to link with Kamilaroi Highway. As a result of this new route, traffic generated from the expanded quarry output will not travel through the residential sector of Narrabri, other than via the Newell Highway. Road noise from gravel trucks moving through Narrabri, mainly Barwan Street, is not predicted to be altered.

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5.8.3.4 Blasting

Predicted blasting impacts associated with ground vibration and overpressure were assessed against criteria outlined in Australia and New Zealand Environmental Council (ANZEC) guidelines. Results of the assessment indicate that compliance with these criteria are likely. It is, however, recommended to monitor blasts until compliance in demonstrated.

5.8.3.5 Cumulative Impacts

The impacts of noise generated by operational noise, road traffic noise and blasting at Wave Hill Quarry were assessed in association with those generated at Boral Quarry. Boral Quarry is located 1km west of Wave Hill Quarry, on Wave Hill Road. Results of the cumulative impact assessment indicate cumulative adverse impacts resulting from quarry operations and road traffic are unlikely to occur. Blasting can be managed, through consultation, such that cumulative blasting impacts are avoided.

5.9 Water

5.9.1 Surface Water

Wave Hill Quarry is located within the Murray Darling Basin as part of the Namoi Catchment. The subject site is well above the 1% AEP flood height as a result of the local topography.

The topography of the area slopes towards the extraction area. Four first order streams rise in the property to the north of the quarry site; two of these flow west and merge before converging with Barra Creek to the west. The other two streams flow in an easterly direction, eventually merging with Deriah Creek.

The subject site is located at an elevation of approximately 275AHD, whilst Deriah Creek is located at an elevation of approximately 265m at its closest point to the quarry. The site drains therefore towards Deriah Creek, which is located approximately 500m south of the property boundary. Deriah Creek converges with Barra Creek, which joins the Namoi River approximately 10km west of the subject site. Figure 20 shows the Namoi Catchment area and Figure 21 shows the surface water network in the vicinity of Wave Hill Quarry, as shown on SIX Maps, an online mapping tool developed by NSW Land and Property Information.

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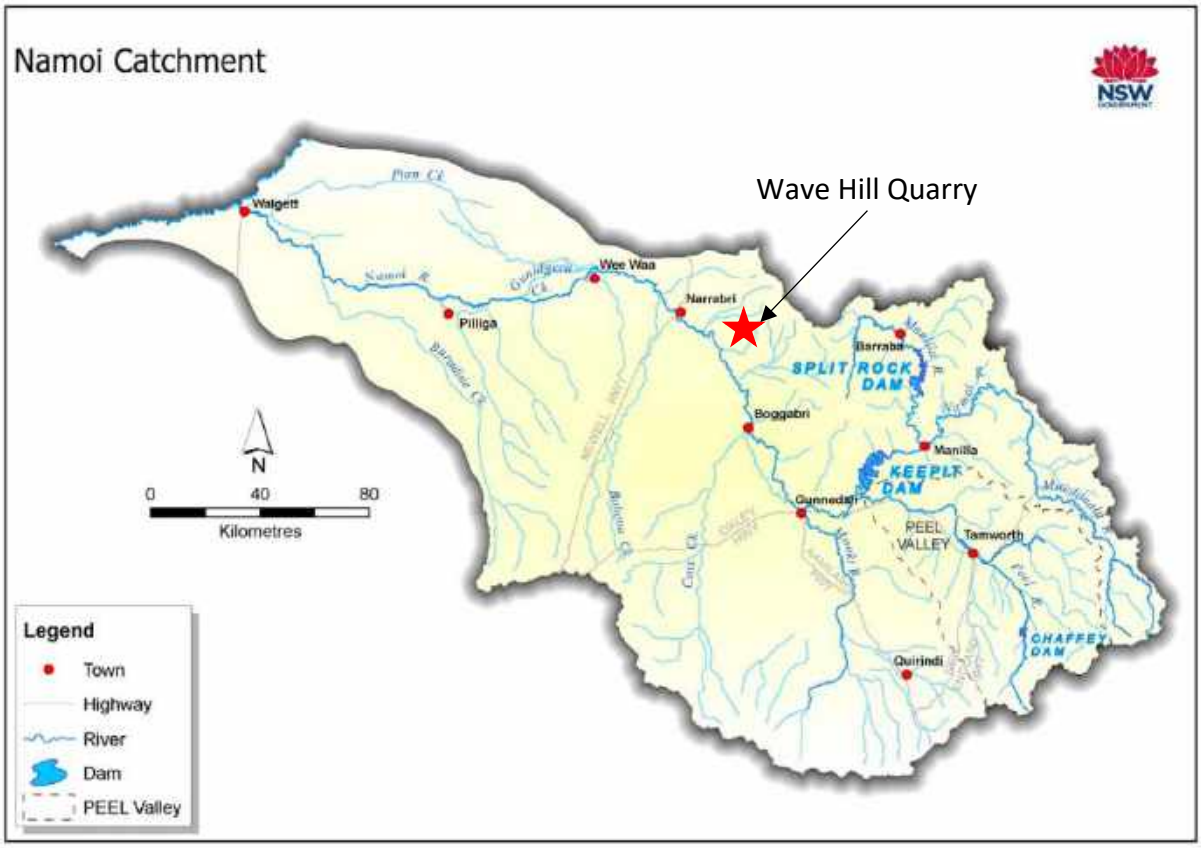

Figure 20: Location of Wave Hill Quarry Within the Namoi Catchment

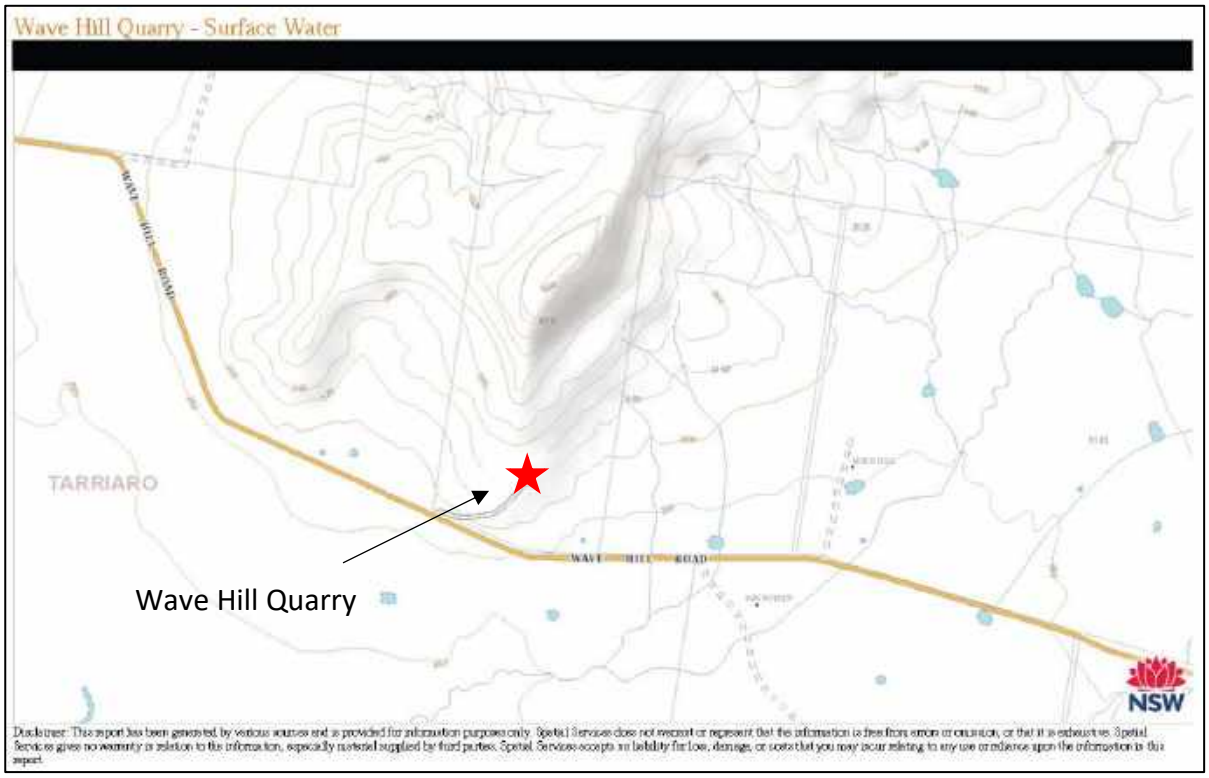

Figure 21: Surface Water in Wave Hill Quarry Locality (SIX Maps)

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5.9.1.1 Potential Impacts

Potential impacts on surface water which may occur as a result of the quarry operation include:

- Pollution of surface water through:
  - Increased turbidity of surface waters due to sediment loss and erosion from stockpiles, haul roads or other disturbed areas;
  - Impurities, incidental minerals or other leachates from the disturbed rocks and soil;
  - Stormwater runoff from plant and equipment areas, fuel storage areas, chemical spills and uncontrolled surface runoff;
- Increased risk of erosion on slopes through increased flow rates.

To protect surface water quality within the Namoi Catchment, appropriate drainage and sediment capture systems have been installed at the existing quarry to prevent erosion and ensure runoff does not contaminate offsite areas or waterways. Bunds have been installed which direct run-off into a dam. This is located downhill from the lowest point of the quarry site. In the event of any uncontrolled releases of silty water from the quarry site, these bunds would aid in directing water into the dam and reducing the risk of contaminated surface run-off entering Deriah Creek.

5.9.1.2 Management and Mitigation Measures

The adoption and/or continued implementation of the following mitigation measures shall ensure protection of surface water quality:

- Minimising the disturbed area by working in sections to reduce the exposure area and stabilising disturbed land as soon as possible to minimise erosion;
- Use drains, diversion banks or bund walls to direct clean stormwater away from disturbed areas, working areas and stockpiles;
- Use diversion drains, and contour drains to capture and slow down water in sloped areas, and use stones or vegetation to stabilise drains in these high velocity areas;
- Ensure that the storage and use of hazardous and dangerous materials occurs in accordance with relevant legislation, and ensuring spillages are contained;
- Minimise gradients of access tracks and maintain table drains;
- Collect all runoff from working areas in the sediment ponds;
- Capture sediment in erosion prone areas by placing hay bales, silt fences or other suitable control devices in drainage lines;
- When storing fuels, chemicals and other potentially environmentally hazardous substances:
  - Chemicals and fuels in containers of greater than 25 litres must be stored within a secondary containment system.
  - All waste will be stored in a suitable receptacles and removed from site as required.

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- All hazardous chemicals, corrosive substances, toxic substances, gases, dangerous goods, flammable and combustible liquids must be stored and handled in accordance with the relevant legislative requirements and Australian Standards including but not limited to the provisions of:
  - AS 1692-2006 – Steel tanks for flammable and combustible liquids
  - AS 3780:2008 – The storage and handling of corrosive substances
  - AS 1940:2004 – The storage and handling of flammable and combustible liquid
  - AS 3833:2007 – Storage and handling of mixed classes of dangerous goods in packaged and intermediate bulk containers
- Bunding will be constructed of material which is impervious to the material that is to be stored in the bunded area.
- Bunds will be kept in good condition (no cracks, gaps, leaks).
- Stormwater captured within bunding is to be removed as soon as practicable and appropriately disposed of as contaminated water.
- Empty hydrocarbon and chemical containers are to be stored closed, in place on a concrete hardstand or within a bunded area.
- A collection sump or valve must be provided in the floor of the bunding to facilitate the removal of liquids.
- Where vehicle access to the bunded area is required, access must be by way of a rollover bund.
- Develop site-specific procedures for storing hazardous materials including details on:
  - Quantities of hazardous materials will be kept to a minimum, commensurate with their usage and shelf life.
  - Safety Data Sheets of stored hazardous materials will be readily accessible at the place of storage.
  - Permanent and temporary containers that hold hazardous materials will be labelled with the relevant safety and risk phrases.
  - The volume and types of hazardous materials stored will be known, current and documented.
  - Hazardous materials that may degrade in storage and thus become more dangerous will be identified and managed.
  - Storage and containment areas (including secondary containment) will be inspected for signs of loss or damage and any deficiencies will be addressed.
  - Hazardous materials no longer in use will be identified and assessed to determine if they should be removed from site.
  - Dangerous goods will not be held in transport storage areas for longer than five consecutive working days. Where they are required to be

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stored for longer periods, they will be moved to permanent hazardous materials storage areas.

- When refuelling:
  - Temporary bunding, drip trays or impermeable matting must be used to prevent spillage from any in field refuelling or maintenance of plant and equipment, or any other activity that could result in spillage of a chemical, fuel or lubricant to soil.
  - Refuelling of plant and vehicles must be conducted in designated areas away from sensitive receptors and at least 100 m away from watercourses, water holes, lakes or wetlands. All in field refuelling must include the use of a temporary bund to contain any spills.
  - Refuelling will utilise auto shut off valves.
  - Maintain appropriate spill kits and PPE at designated locations on site (e.g. refuelling locations, chemical storage facilities, mobile equipment).
  - Ensure employees are familiar with, and trained in the use of, proper spill clean-up procedures.
- Dewatering of Stormwater:
  - Quarrying activity impacted waters are to be captured within the on-site temporary sediment pond.
  - Water collected within the sediment pond, and the receiving environment, will be monitored prior to discharge if a bywash event occurs.
  - Water quality monitoring will be undertaken to determine if water is fit for discharge or reuse on site for dust suppression.
  - Where possible, only water meeting discharge threshold requirements established under the EPL will be released and be undertaken in a controlled manner to ensure that no scouring of the bed and banks of the receiving watercourse occurs.
- Erosion and Sediment Control:
  - Site Management
    - Land-disturbing activities must be undertaken in such a manner that allows all reasonable and practicable measures to be undertaken to allow stormwater to pass through the site in a controlled manner and at non-erosive flow velocities up to the specified design storm discharge.
    - Minimise soil erosion resulting from rain, water flow and/or wind, adverse effects of sediment runoff, including safety issues.
    - Prevent, or at least minimise, environmental harm resulting from work-related soil erosion and sediment runoff.
    - Ensure that use of land/properties adjacent to the development are not diminished as a result of the adopted ESC measures.

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- Site Access
  - Site exit points must be appropriately managed to minimise the risk of sediment being tracked onto public roadways.
- Drainage Control
  - Collect all runoff from working areas in sediment ponds, designed to contain and control water in a 1 in 10-year storm event, to be designed and installed in accordance with DECC (2008) *Managing Urban Stormwater - Soils and Construction (Volume 2E).*
  - Wherever reasonable and practicable, all stormwater runoff entering the site from external areas must be diverted around or through disturbed areas in a manner that minimises soil erosion.
  - Within the internal drainage area reporting to the sediment basin, silt traps and sediment control devices will be implemented to slow the velocity of the water, ensuring no unnecessary erosion occurs and that the sediment basin remains efficient in settling out sediment.
- Sediment Control
  - Efforts shall be employed to trap sediment within the site, and as close as practicable to its source.
  - Sediment traps must be installed and operated to both collect and retain sediment.
  - Where sediment basins and other sediment control devices pose a safety risk to workers these areas should be isolated (fenced) from commonly accessible areas to maintain site safety.
  - All reasonable and practicable measures must be taken to prevent the release of sediment from the site.
  - Suitable all-weather maintenance access must be provided to all sediment control devices.
  - Sediment control devices must be de-silted and made fully operational as soon as reasonable and practicable after a sediment-producing event, whether natural or artificial, if the device's sediment retention capacity falls below 75% of its retention capacity.
- Site Maintenance
  - All erosion and sediment control measures, including drainage control measures, must be maintained in proper working order at all times.
  - Sediment removed from sediment traps and places of sediment deposition must be disposed of in a lawful manner that does not cause ongoing soil erosion or environmental harm.

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5.9.1.3 Assessment of Impacts

The implementation of the appropriate mitigation measures in accordance with the above recommendations and best practice management techniques are considered sufficient to avoid potential contamination of offsite surface waters.

Water will be required onsite for dust suppression. This water will be sourced from an on-site harvestable right storage, which serves a dual purpose as a sediment control pond. Water requirements are in the order of 25 ML per annum and the capacity of the sediment pond is approximately 50.1 ML. Should sufficient water not be available at any point, Council water will be trucked into the Quarry using haul trucks. The proposal does not have any water licensing requirements.

5.9.2 Groundwater

The development is located atop of porous rock aquifers within the Gunnedah Basin Groundwater Management Area, as shown in Figure 22 and Figure 23. The primary aquifer beneath the subject site is known as the 'Gunnedah-Oxley Basin MDB Groundwater Source' (GOB Aquifer), which includes the Permian and Triassic rocks associated with the Gunnedah Basin and the overlying younger Jurassic and Cretaceous rocks associated with the Oxley Basin. The Water Sharing Plan for the area is the Water Sharing Plan for the Murray-Darling Basin Porous Rock Groundwater Sources (2011) (PRGS WSP).

Discrepancy occurs between Long-Term Average Annual Extraction Limit (LTAAEL) (calculated by the NSW Office of Water in accordance with the Water Management Act 2000) and Sustainable Diversion Limits (SDLs) (calculated by the Murray Darling Basin Authority in accordance with the Basin Plan 2012) for the GOB Aquifer as a result of differences in methodologies used. To this end, the PRGS WSP states that the GOB Aquifer has a LTAAEL of 205.64 GL, whilst the Basin Plan 2012 states that the GOB Aquifer has an SDL of 127.5 GL.

The Basin Plan 2012 further defines the Baseline Diversion Limit (BDL) of the GOB Aquifer to be 22.1 GL. The BDL is an estimate of how much water (on average) was extracted per year from the water source prior to the development of the basin plan in 2012. Therefore, it is considered that the current extraction rates from the GOB Aquifer are within sustainable limits, notwithstanding the discrepancy in estimated sustainable take limits.

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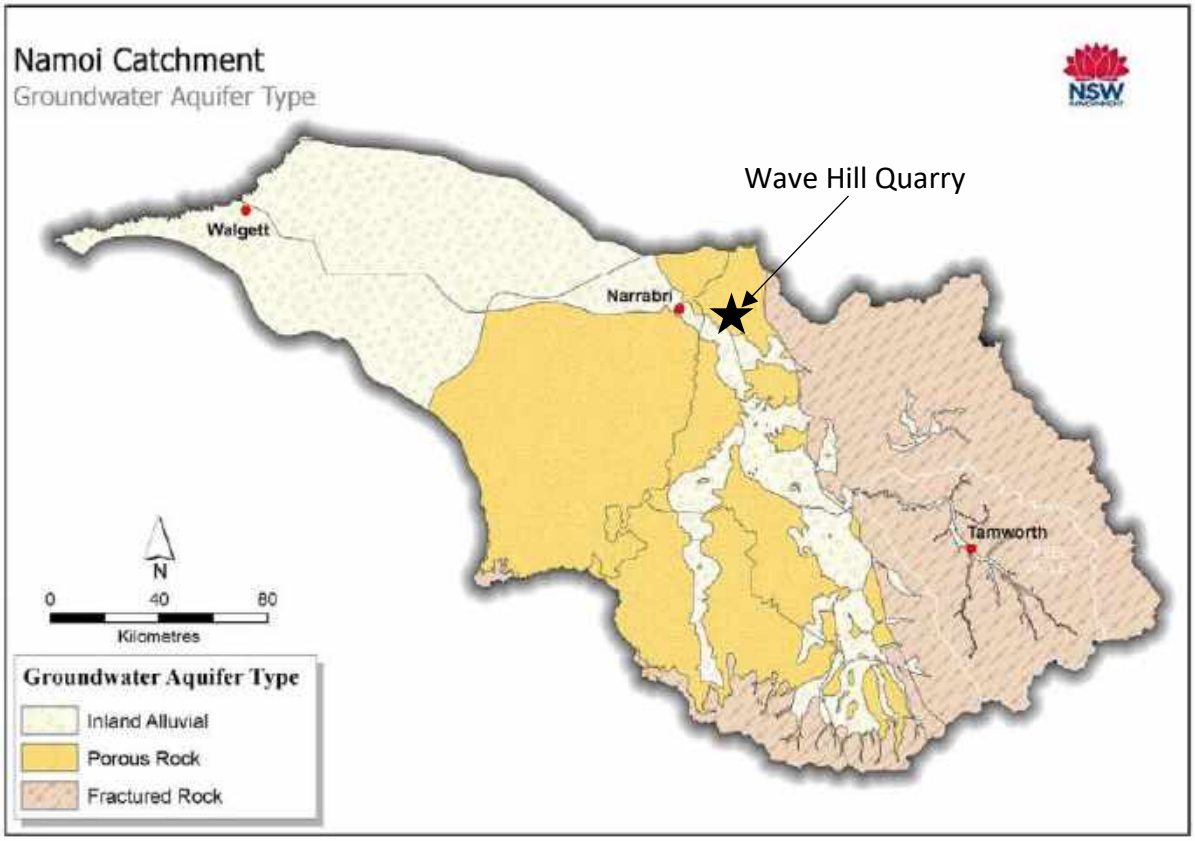

Figure 22: Aquifers in the Namoi Catchment

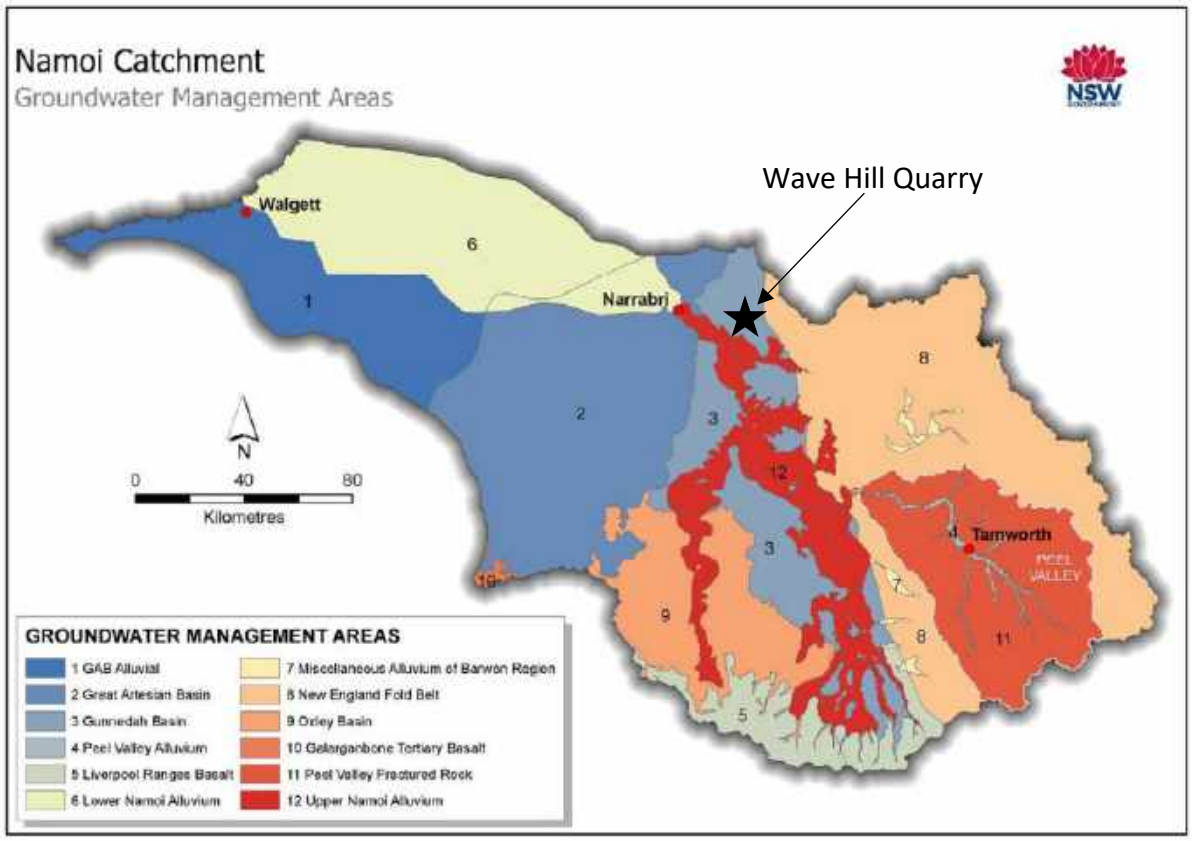

Figure 23: Groundwater Management Areas in the Namoi Catchment

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An investigation bore drilled on the property (GW970345) had minimal yield. It was determined not to pursue a water access licence for this bore on the basis that the potential supply from the bore was minimal.

Publicly available bore logs were examined within the locality surrounding the proposed quarry site. Bore logs indicate that the region is dominated by clay soil. Depth to bedrock varies from <1m to >16m below the natural surface, which is expected as a result of the transition of soil profiles from shallow uphill soils to the deep colluvial/alluvial soils further downhill. Bedrock varies and consists of basalt, shale, gravels and pink oxides of uncertain geological material. Groundwater depth varies yet is typically >10m below the ground surface. It is noted that groundwater at the quarry site is deep and was only encountered at a depth of 63m. The locations of examined bore logs, and summaries of bore log data, are presented in Figure 24 and Table 18.

Figure 24: Locations of Bore Logs Near Wave Hill Quarry (Water NSW 2020)

Table 18: Bore Log Data

Bore ID	Depth of Bore (m)	Dominant Soil Type	Depth to Bedrock (m)	Bedrock Type	Basalt Thickness (m)	Depth to WBZ* (m)
GW970345	68	Clay	4	Basalt	>64	63
GW011470	21.3	Clay	5.48	Boulders, Gravel, Conglomerate	N/A	15.8
GW016328	35.4	Clay	0.91	Basalt, Pink Oxide	9.76	24.4

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Bore ID	Depth of Bore (m)	Dominant Soil Type	Depth to Bedrock (m)	Bedrock Type	Basalt Thickness (m)	Depth to WBZ* (m)
GW035302	57.9	Clay	14.02	Basalt, Shale	>40.54	12.10
GW029002	33.2	Loam, Clay, Gravel	Not Encountered	N/A	N/A	16.80
GW045598	18.0	Not Recorded	Not Recorded	Not Recorded	Not Recorded	Not Recorded
GW045596	12.0	Not Recorded	Not Recorded	Not Recorded	Not Recorded	Not Recorded

*WBZ = Water Bearing Zone

Groundwater has been encountered at the subject site at a depth of 63m. The depth of excavation on site will be managed to ensure that groundwater reserves are not intercepted by excavation activities on site. It is noted that excavation of materials at extreme depth is increasingly expensive as a result of the increased costs associated with transport of materials onto the site and removal of materials off site.

5.9.2.1 Potential Impacts

The potential impacts of the development upon groundwater reserves are minimal. Water for dust suppression will be sourced from surface water reserves (a sediment dam on site) and therefore there will be no increase in groundwater extraction. Further, no de-watering will occur in association with the quarry, as the development will not excavate to the groundwater table.

The subject site is underpinned by basalt bedrock, which forms a largely impervious layer to prevent surface water – groundwater interactions. Therefore, the potential impact upon groundwater through seepage of surface water from the subject site is minimal.

The storage and/or use of hazardous materials which may be used on site will occur in accordance with *National Code of Practice for the Storage and Handling of Workplace Dangerous Goods (2001).* The appropriate storage and handling will ensure such materials do not pose an unacceptable risk in respect to the pollution of groundwater.

5.9.2.2 Management and Mitigation Measures

The following mitigation measures should be adopted onsite to ensure protection of groundwater quality:

- Inclusion of groundwater management as part of an OEMP prepared for the site;
- Maintain the quarry floor and extraction areas above the groundwater table;

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- If groundwater is proposed to be used separately to this application, the relevant permit and provision for use shall be obtained;
- If groundwater is unexpectedly intercepted during excavations, cease work and consult with relevant authorities (DPI Water) to identify appropriate mitigation measures.

5.9.2.3 Assessment of Impacts

An assessment of the quarry proposal indicates that there is little or no potential for impact on groundwater. The quarry would not intercept an aquifer and would not impact on any significant recharge area for local aquifers. Overall, the potential impacts of the development upon groundwater reserves are considered to be minimal.

5.9.3 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDE's) are defined as ecosystems which have their species composition and their natural ecological processes determined by groundwater (ARMCANZ & ANZECC, 1996). A search of the Atlas of Groundwater Dependent Ecosystems (GDE) (Australian Government Bureau of Meteorology) identified aquatic and terrestrial GDE's predicted to occur within the vicinity of the proposed development. The results of this search are outlined in Figure 25, Figure 26 (below).

No Aquatic Groundwater Dependent Ecosystems (GDE's) were identified within the proposed development site. The closest potential GDE is in the Namoi River, approximately 7.8 kilometres south-west of the subject site and downslope of Wave Hill Quarry. The Namoi River is mapped as having a high potential of supporting an aquatic GDE, based on the results of national assessment.

The development footprint is mapped as having a low potential of supporting a Terrestrial GDE, based on the results of regional studies. However, examination of the features of the site indicate that this prediction is not correct, given the shallow soil, thick basalt bedrock, and very deep (>60m) groundwater. Therefore, it is considered that the subject site does not support a Terrestrial GDE.

The available setback from surface water and potential GDE's is substantial, providing a sufficient barrier from the Quarry. The provision of suitable drainage and sediment controls will prevent erosion and ensure runoff does not contaminate offsite areas, including waterways and GDE's.

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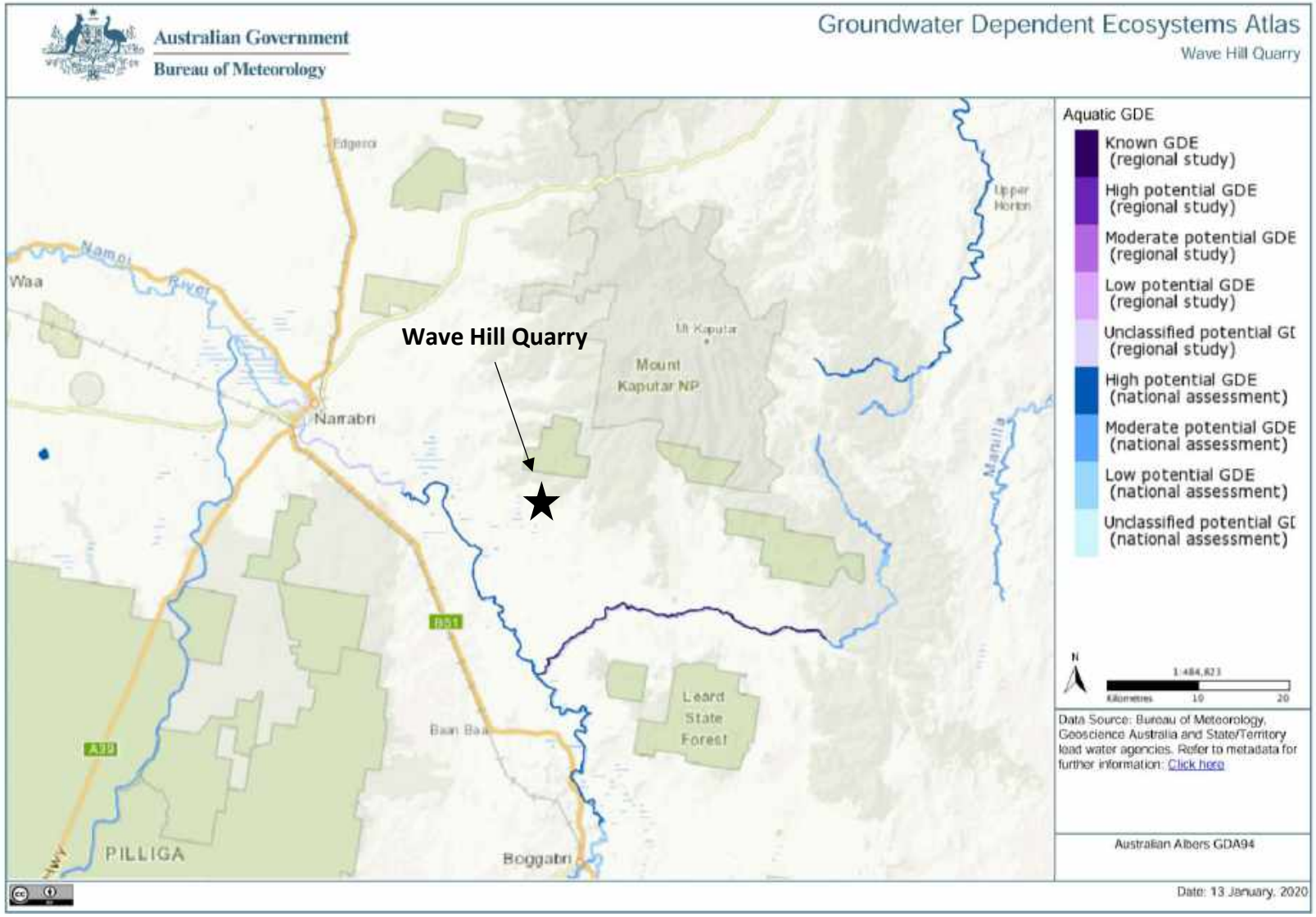

Figure 25: Aquatic Groundwater Dependent Ecosystems Near Wave Hill Quarry

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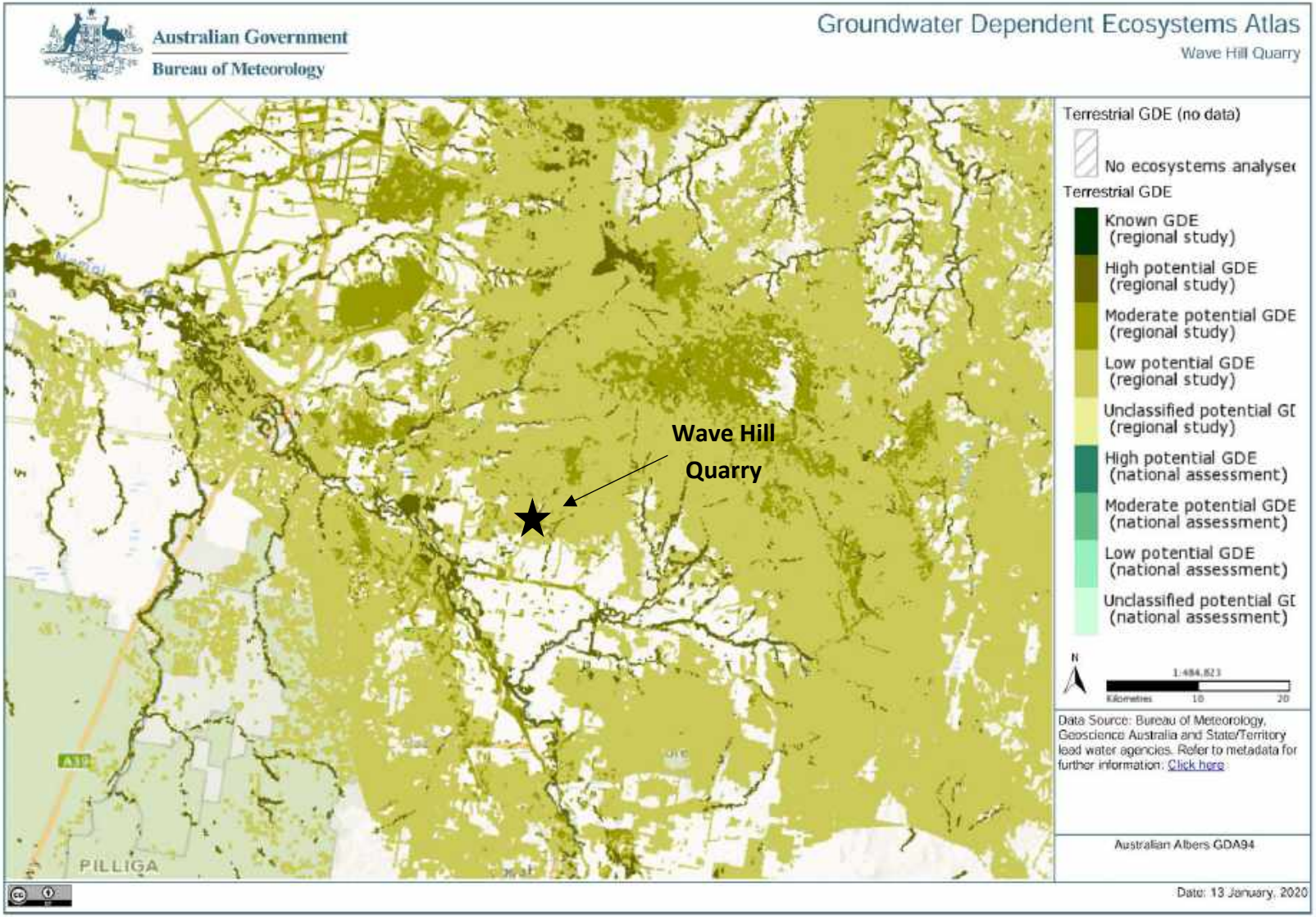

Figure 26: Terrestrial Groundwater Dependent Ecosystems Near Wave Hill Quarry

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5.10 Biodiversity

The subject site lies on the foot slopes of the Nandewar Range, a mountain range which forms part of the Great Dividing Range. Vegetation in the study area forms a continuous link north to Mount Kaputar National Park and to a large area of vegetation that covers the Nandewar Ranges. Mount Kaputar National Park comprises the largest area of remnant vegetation in the Nandewar Region and is regarded as significant for its geological, landscape and biological values. This proposal is unlikely to result in any impacts on wildlife movement given that no vegetation clearance will take place.

Within the subject site, vegetation is confined to a small patch of scrubby regrowth on the edge of the active quarry, as shown in Figure 27, and sparsely distributed shrubs throughout the less disturbed areas of the site where soil has been retained. This vegetation was assessed as highly disturbed and in low condition, having low structure and function attributes. No mature trees were recorded and some immature trees are dead. A number of weed species are also present throughout the quarry site.

Figure 27: Scrubby regrowth present east of the extraction footprint

Advitech Pty Ltd (trading as Advitech Environmental) was engaged to undertake a preliminary flora and fauna assessment of the vegetation to the north of the existing quarry

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in 2019. This study assessed the environmental and economic viability of expanding the Wave Hill quarry footprint, as initially intended. Study findings informed the Applicant's decision to continue operations within the existing footprint without expanding the quarry northwards. The site assessment was carried out on the 5th, 6th and 7th of March 2019 and the results of the inspection are briefly summarised below.

5.10.1 Flora

Vegetation in the study area to the north of the subject site is consistent with dry vine thicket forest. Vegetation has been previously disturbed, evident by areas of regrowth forest and old fence lines associated with historic pastoral use of the property. Species composition is consistent with 'PCT 147 – Mock Olive – Wilga – Peach Bush – Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion'. Species recorded in the canopy layer in the contiguous vegetation to the north of the site include She-oak (*Casuarina cristata*), White Cypress Pine (*Callytris glaucophylla*), and White wood (*Atalaya hemiglauca*). The understorey layer includes species such as Budda (*Eremophila mitchellii*), and Fragrant Saltbush (*Rhagodia parabolica*). Grasses such as Purple Wiregrass (*Aristida ramose*) and White Speargrass (*Aristida leptopoda*) are found in the herb layer. Exotic species such as Prickly pear (*Opuntia* sp.), Maltese Cockspur (*Centaurea melitensis*) and *Tribulus terrestris* were also recorded.

The condition of vegetation to the north of the subject site is variable. Some areas are in poor condition, occurring as monotypic stands of White Cypress Pine (*C. glaucophylla*), while others are in moderate to good condition with up to 35 native species recorded and emergent trees observed. Generally, vegetation condition improves further north with vegetation assessed as being in good to very good condition. Thirty-nine species were recorded in areas of higher quality vegetation, with a significant amount of dead wood and a well-developed canopy layer, dominated by White Box (*Eucalyptus albens*), recorded.

Figure 28 and Figure 29 show the vegetation recorded north of Wave Hill Quarry.

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Figure 28: PCT 147 in poor condition, consisting of *Callitris* regrowth, adjacent to and north of the subject site

Figure 29: PCT 147 - Thicket with Eucalypt canopy, in good to very good condition, north of the subject site.

5.10.2 Fauna

Several bird species were observed in the vicinity of the subject site during the site inspection by Advitech. Feral Goat (*Capra aegagrus hircus*) and Eastern Grey Kangaroo (*Macropus giganteus*) were also observed. A single threatened species, the cave dwelling

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Large-eared Pied Bat (*Chalinolobus dwyeri*) was recorded during the site assessment. Potential breeding habitat (caves and sandstone outcrops) was identified for this species on the hill north of the subject site.

Table 19 lists the species recorded in the study area during the site assessment, as well as their status under the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Table 19: Fauna Species Recorded Near Wave Hill Quarry

	Scientific Name	Common Name	BC Act	EPBC Act
BIRDS				
Family Artamidae	*Artamus cyanopterus*	Dusky woodswallow		
	Cracticus nigrogularis	Pied Butcherbird		
	Gymnorhina tibicen	Australian Magpie		
Family Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher		
Family Cacatuidae	*Cacatua sanguinea*	Little Corella		
	Eolophus roseicapilla	Gallah		
Family Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike		
Family Columbidae	*Geopelia placida*	Peaceful Dove		
	Phaps chalcoptera	Common bronzewing		
Family Corvidae	*Corvus coronoides*	Australian Raven		
Family Falconidae	*Falco cenchroides*	Australian Kestrel		
Family Meliphagidae	*Acanthagenys rufogularis*	Spiny-checked Honeyeater		
Family Psittaculidae	*Northiella haematogaster*	Blue Bonnet		
Family Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail		
Family Strigidae	*Ninox boobook*	Southern Boobook		
MAMMALS				
Family Bovidae	*Capra aegagrus hircus*	Goat		
Family Macropodidae	*Marcopus giganteus*	Eastern Grey Kangaroo		
Family Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V

5.10.3 Potential Impacts

It is noted that the proposal does not involve extension of the existing quarry footprint. Higher extraction rates will be achieved by intensifying extractive activities conducted within the existing footprint. The development will therefore not result in any new land

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disturbance or clearing, and vegetation in the study area will not be subject to any new types of impacts relative to the existing development.

An 'Assessment of Significance' under the EPBC Act and a 'Test of Significance' under the BC Act have been conducted and are presented in Appendix 7 and Appendix 8 respectively. These assessments consider potential threatened species, populations and ecological communities which may be present within the locality of the development site, and assess the potential impacts of the development upon these species. The results of the assessments are that the development is unlikely to impact upon threatened species/populations/communities.

Overall, the proposed development will not result in additional land clearing or disturbance and is not considered to pose a risk to threatened species, populations or communities. Therefore, the impacts of the development upon biodiversity values of the locality are minimal.

5.11 Archaeological Heritage

5.11.1 Non-Indigenous Heritage

A search of the NSW and Commonwealth heritage registers and *Narrabri Local Environmental Plan 2012* revealed that no non-indigenous heritage items have been found near the development site. Furthermore, a search for heritage sites using the EPBC Act Protected Matters Report found no World Heritage or National Heritage listed sites on the property or surrounding properties. A search of the NSW State Heritage Register found no heritage listed sites on the property or surrounding properties. Finally, Narrabri Shire Council Local Environmental Plan showed that no heritage sites on the property or surrounding properties.

The footprint of the proposal consists of an active quarry and it is therefore considered unlikely that heritage items will be impacted as part of the proposal.

5.11.2 Indigenous Heritage

Advitech was engaged to undertake an Aboriginal Due Diligence Assessment in 2019 to inform the intended expansion of the quarry footprint at that time. The assessment included a desktop review of historic information and a field assessment undertaken on the 10th of January 2019, and it provides detailed information on indigenous heritage in the northern vicinity of the proposed development. The results of the assessment are summarised below.

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Wave Hill Quarry is located approximately 3km south of boundary of the Deriah Aboriginal Area, a reserve co-managed by the National Parks and Wildlife Service and the local Aboriginal community which contains numerous Aboriginal sites. Many of the local Aboriginal people identify as being part of the Kamilaroi nation. The Kamilaroi Local Aboriginal Land Council members are the Aboriginal custodians of the study area. It must also be considered that Aboriginal cultures were not static and that clan and tribal boundaries, language groups and dialects most likely changed over many thousands of years.

There is limited information available regarding the pre-European lifestyle and customs of the Kamilaroi peoples. It is known that the area was once dominated by woodlands which were used for hunting, camping and culture. Basalt outcrops in the locality made excellent stone axes and grinding tools, whilst sandstone outcrops were used to sharpen tools and grind ochre or grain.

5.11.2.1Aboriginal Due Diligence Assessment

The due diligence process involved an assessment of landscape and visual inspection of the area north of the quarry site for artefacts or signs of aboriginal presence. The study area was surveyed via pedestrian survey. The area has been subject to land clearing but remains relatively undisturbed in comparison to the existing development.

In accordance with the *National Parks and Wildlife Act 1974*, Aboriginal objects include:

- physical objects, such as stone tools, Aboriginal-built fences and stockyards, scarred trees and the remains of fringe camps;
- material deposited on the land, such as middens;
- the ancestral remains of Aboriginal people.

No Potential Archaeological Deposits (PADs) or sites or site complexes of archaeological sensitivity were noted during the survey. One stone artefact was identified during the due diligence assessment. The artefact is a mudstone flake measuring approximately 3cm X 2cm which has evidence of retouch work along its proximal left edge. Aboriginal sites recorded during due diligence assessments are labelled according to the project proponent, related project, site name, and then followed by a digit representing the consecutive ACH site number- so in this case, sites were listed as SMK Consultants (SMK) / Inland Rail Project (IRP) / Wave Hill Quarry (WHQ)/ Site number (e.g. SMK/IRP/WHQ/1). The location of the site within the study area, as mapped by Advitech, is shown in Figure 30.

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Figure 30: Location of Site SMK/IRP/WHQ/1 (Source: Advitech)

A search of the NSW AHIMS register reveals a single recorded Aboriginal site within Lot 89 in DP 821255. There are no recorded Aboriginal site or places within the adjoining lot; Lot 77 in DP 754937. An extensive AHIMS register search of Lot 89 in DP821255 indicates that the recorded artifact in Lot 89/DP821255 corresponds to the mudstone flake encountered by Advitech, as described above. A copy of the AHIMS register searches are included in Appendix 14.

Given that the scope of the current proposal is limited to the footprint of the existing development and that this has already been excavated and/or extensively disturbed, it is extremely unlikely that Aboriginal artefacts would be present within the quarry footprint. The quarry was subjected to an archaeological assessment as part of the 2013 development application to Council (Suzanne R Hudson Consulting, 2011). This report was lodged with the development application to Council. No artefacts were found within the approved footprint. Similarly, the identified stone artefact and any other potential artefacts located to the north of the approved quarry area, are not considered at risk from impact or harm. The northern boundary of the existing development is clearly delineated by markers, which would prevent the inadvertent extension of the quarry site outside of the approved project footprint and into areas which potentially contain Aboriginal items. This measure is

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considered appropriate to avoid impact upon cultural heritage values and conserve the items present.

While it is highly unlikely that artefacts of Aboriginal cultural heritage may be discovered on site during the course of quarry activities, an Unanticipated Finds Protocol should be implemented in accordance with the Office of Environment and Heritage's requirements with regards to the protection of items of Aboriginal cultural heritage on development sites. The protocol outlines the steps to be taken in the event that Aboriginal objects are uncovered during quarrying activities on site, and is outlined below.

Steps to be undertaken if a site or object of Aboriginal origin is identified involve:

- *If any object is found suspected to be of Aboriginal origin, work in that location must cease.*
- *Notify Office of Environment and Heritage on 131 555*
- *The site must be inspected by a person suitably experienced in identifying Aboriginal cultural material.*
- *Work may continue at a suitably distant location, not closer than 50m to the potential Aboriginal object.*
- *In the event that an object of Aboriginal origin is identified, appropriate action should be undertaken by the Proponent for the preservation of this site, or alternatively retain the services of an archaeologist to apply for an AHIP.*
- *If bones are uncovered, NSW Police should be immediately notified.*

The adoption of the above protocol, as outlined by OEH guidelines, will ensure that the risk of harm to indigenous artefacts on site is minimised as far as practicable, such that the development does not pose a risk to indigenous heritage.

5.12 Natural Hazards

5.12.1 Bushfire Hazard

5.12.1.1 Introduction

Wave Hill Quarry is located within the jurisdiction of the Narrabri/Moree Bush Fire Management Committee (BFMC), and therefore is covered by the Narrabri/Moree Bush Fire Management Plan (BFMP).

The bushfire season in the BFMC generally runs from October through to March, yet drought conditions may mean that periods of fire danger may extend beyond this timeframe. The Narrabri/Moree BFMC area has on average 230 bushfires a year, of which an average of 10 can be considered to be major fires. The main sources of fire ignition include:

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- Lightning strikes;
- Arson, suspected arson and escapes from illegal hazard reduction burns;
- Escapes from legal burning off and unextinguished campfires; and
- Farm machinery (i.e. during harvest periods).

5.12.1.2 Description of Subject Site

Wave Hill Quarry is situated on a cleared section of a ridge that was previously grazed. Much of the land surrounding the property has been logged and grazed and now contains regrowth timber comprising species such as White Cypress (*Callitris glaucophylla*), Wilga (*Geijera parviflora*) and scrubby acacia species.

The vegetation has been classified according to "Planning for Bush Fire Protection" (RFS, 2019) as:

- Grassland (managed land) on the quarry site and downslope lands, and
- Woodland (regrowth) on higher slopes above the quarry site.

Significantly, the adjoining land downslope to the east, south and west are substantially cleared and actively managed for agricultural activities. This land is categorised as managed land and does not pose a bushfire threat to the proposed development.

5.12.1.3 Bushfire Prone Land Assessment

Bushfire Prone Land is land that has been identified by local council as capable of supporting a bushfire or being subject to bush fire attack. The NSW Planning Portal was accessed in January 2020 to assess whether Wave Hill is located in Bushfire Prone Land. Results of the search indicate that the subject site and the property are located within Category 1 Bushfire Prone Land (see Figure 31).

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Figure 31: Distribution of Bushfire Prone Land on the Property (NSW Planning Portal)

5.12.1.4 RFS Bushfire Planning Objectives

Fire protection objectives considered with regards to the development site are outlined in the Rural Fire Service (RFS) guideline "Planning for Bush Fire Protection" (PBP) (RFS 2019).

The PBP states that in order for an industrial development to comply with the PBP, it must:

- Satisfy the aims and objectives outlined in Chapter 1 of the PBP;
- Consider any issues listed for the specific purpose;
- Propose an appropriate combination of Bushfire Protection Measures (BPM).

The proposal would be classed as 'mining (underground and open cut) and petroleum production' as per the industrial facility categories set out in the PBP.

Aims and Objectives of the PBP

The aims and objectives of PBP, as outlined in Chapter 1, are as listed and addressed below.

- **Afford occupants of any building adequate protection from exposure to a bushfire;**

The proposed development does not consist of a dwelling or any permanent building. The development is not expected to offer protection for people from a passing fire front although a buffer of 10m will be observed between any structures present or erected

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onsite, and bushfire prone vegetation. Workers and employees are also not expected to defend the facility from fire and would be evacuated should a bushfire threaten the site.

This objective is satisfied.

- **Provide for a defendable space to be located around buildings;**

An Asset Protection Zone (APZ) of 10m will be maintained around all temporary buildings on site which will act as defendable space for all buildings. Access to the quarry is by roads suitable for heavy vehicles. These roads can be used by fire services to attend to fire at the facility.

This objective is satisfied.

- **Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;**

A minimum APZ of 10m will be maintained between all potential fire hazards and on site temporary buildings. It is noted that the quarry site is kept clear of vegetative growth and therefore the majority of the subject site will not support flammable materials. Activities which have potential to generate fire on site (such as blasting) will be conducted with safe buffer distances from any surrounding buildings or potentially flammable materials.

This objective is satisfied.

- **Ensure that safe operational access and egress for emergency service personnel and residents is available;**

As the quarry development provides for large truck movements, there is adequate access to proposed assets for fire fighting operations. There is no residential use of the land.

This objective is satisfied.

- **Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in the Asset Protection Zone (APZ); and**

A minimum APZ of 10m will be observed between fire supporting vegetation adjacent to the quarry site and buildings and flammable materials associated with the quarry site. The majority of the site will remain free of vegetation. Sufficient heavy machinery is available on-site to manage buffer zones in a fuel-reduced condition.

This objective is satisfied.

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- **Ensure that utility services are adequate to meet the needs of fire fighters (and others assisting is bushfire fighting).**

Utility services such as water supply exist in the form of a sediment dam within the property. In addition, a water cart/truck equipped with a hose is available to assist in extinguishing any fire ignited and to ensure that there is sufficient water availability on site for firefighting.

This objective is satisfied.

Issues Listed for Mining Activities

The PBP requires that, where mining and associated activities are carried out on bushfire prone land, the following measures be implemented:

- Consideration is given to any hazards and risks associated with bush fire and measures are implemented to control and manage any identified hazards and risks;
- As a minimum, an APZ of 10m should also be provided around any infrastructure associated with mining and petroleum production; and
- A Bush Fire Emergency Management and Operations Plan should be prepared to cover any mining activities and petroleum production undertaken on BFPL, with consideration to the same provisions detailed in section 8.3.5 for wind and solar farms.

Comment

Extensive consideration has been given to hazards and risks associated with bushfire throughout this section. A range of bush fire protection measures, listed below, will be implemented throughout the project life cycle to manage identified risks.

An APZ of at least 10m will be implemented around any temporary buildings, equipment and other infrastructure associated with the proposal. In reality, a much greater APZ is already available onsite (minimum 20m), such that minimum recommended distances are exceeded.

Given the location of the development on an existing quarry footprint and the available separation distance between the proposed operations and fire hazards such as native vegetation, it is considered that a Bush Fire Emergency Management and Operations Plan is not required. The measures listed in the section 'proposed bushfire protection measures' below are considered sufficient to minimise bushfire hazard onsite. However, should such a plan be requested, it would be prepared subsequent to development consent.

5.12.1.5 Potential Ignition Sources

Quarry operations will include a suite of activities which may act as potential sources of ignition, such as blasting, drilling, and use of machinery which may generate hot surfaces. To minimise the risk of fires being ignited as a result of quarry operations, excavation sites will be kept clear of vegetation and other potentially flammable materials. This will ensure

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that any potential sparks generated on site will not catch onto materials which may lead to fire spreading into the surrounding region.

5.12.1.6 Storage of Fuels and Hazardous Materials

Fuel and other flammable substances that are stored on site will be stored in accordance with relevant Australian Standards, and will be located at a distance from any potential ignition sources (such as explosives) or fire fuel loads (such as vegetation).

It is noted that explosives used for blasting will not be stored on site. Instead, explosives will be transported onto the site on the day of use by contractors.

5.12.1.7 Proposed Bushfire Protection Measures

The following safeguards and mitigation strategies will be implemented on site to minimise the bushfire hazard at Wave Hill Quarry:

- Incorporating firebreaks, including a perimeter road, around the quarry site;
- Ensuring any buildings (including temporary buildings) are set back at least 10m from any potential fuel sources (such as surrounding vegetation);
- Keeping the quarry site clear of potential fuel sources (such as vegetation), particularly in close proximity to quarry activities which may act as a source of ignition;
- Maintaining appropriate fire-fighting equipment at the site, ensuring fixed plant and mobile equipment are fitted with fire-fighting equipment including fire extinguishers, fire blankets, knapsack spray pumps and rake-hoes;
- Checking the underside of vehicles periodically to ensure they are kept free of vegetation debris that could dry out and ignite;
- Storing flammable materials such as waste hydrocarbons away from ignition sources;
- Refuelling only to occur in cleared areas of the project site;
- Engines in all vehicles to be turned off during refuelling;
- No smoking policy to be enforced in designated areas of the project site; and
- Ensuring a water cart/truck is equipped with a hose to assist in extinguishing any fire ignited and that there is sufficient water availability on site for firefighting.

Water requirements for the project will be sourced from water captured in a harvestable rights dam, which also acts as a sediment pond. This water resource will also be made available for fire-fighting purposes.

5.12.1.8 Operational Access for Fire Fighting

The site access is bitumen sealed to enable all weather condition access and is and suitable for heavy vehicles. The site is accessible from the south via Wave Hill Road, which traverses

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cleared agricultural land to the south of the development site. Therefore, the site is unlikely to be cut off in the event of a fire, ensuring practical access for fire fighting purposes.

5.12.1.9 Emergency and Evacuation Planning

In the event of a fire, the site would be evacuated. Evacuation would occur via the site access route which leads onto Wave Hill Road. It is noted that neither the site access nor Wave Hill Road are fringed by dense vegetation and therefore would not be cut off in the event of a fire.

5.12.1.10 Assessment of Impacts

The proposed operations are unlikely to increase the number and type of ignition sources in the local area relative to existing conditions. Nevertheless, the proposed management and mitigation measures would ensure that an acceptable bushfire hazard is maintained within the project site.

5.12.2 Flood Hazard Areas

The proposed development site is not located within a flood area. The subject site is located on a hill, approximately 65m above the elevation of the nearest water body. The site is therefore well above the 1% AEP flood height as a result of the local topography. The quarry site is further enclosed within a series of diversion banks and controlled drainage lines to further minimise the potential impacts of stormwater runoff.

5.12.3 Geological Instability

The land is not naturally subject to geological hazards such as volcanism, earthquake, or soil instability such as subsidence slip or mass movement. However, there is a potential that geological instability may be induced on the quarry site as part of quarry operations (such as through exposure of weak/erodible surfaces or creation of unstable quarry walls with steep slopes). This may lead to the occurrence of geological hazards on site (such as rock fall or failure of the quarry face).

To minimise the risk of geological hazards on site, the quarry site is operated to a high standard, adopting best management practices to ensure that safety standards are maintained on site. Quarry operations are guided by an overarching Mine Safety Management System, which identifies a series of site-specific Principle Hazards associated with the mine site, and outlines a suite of management methods to minimise the risk of each hazard. The Mine Safety Management System is implemented by the Mine Operator.

In the event of approval, the Mine Safety Management System will be upgraded as required to reflect any changes in activities or processes on site. It is considered that implementation

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of a comprehensive and site-specific Mine Safety Management System is sufficient to minimise the risks posed by geological instability at the Wave Hill Quarry.

5.13 Traffic

Wave Hill Quarry is accessible via Wave Hill Road. This is a mostly bitumen sealed road, with a 1.5km section of gravelled road, which is maintained by Narrabri Shire Council. The road services the neighbouring farming community in addition to the Boral Quarry. The road is trafficable in all weather conditions apart from times of extreme flood events.

The access to Wave Hill Quarry from Wave Hill Road is shown in Figure 32. The available sight distances along Wavehill Road (in excess of 150 metres to the east and west) are considered sufficient to provide for safe access to Wave Hill.

Figure 32: Entrance to Wave Hill Quarry from Wave Hill Road

5.13.1 Existing and Proposed Traffic Levels

A Traffic Impact Assessment has been prepared in accordance with the RTA's Guide to Traffic Generating Developments (2002). A copy of the full assessment is presented in Appendix 9. The following summarises the findings of this assessment.

The current traffic route extends along Wave Hill Road, Maules Creek Road and the Old Gunnedah Road, with much of the existing traffic then travelling to the eastern outskirts of Narrabri where JCLS has a landscaping business, or to various locations throughout the region, depending on the location of construction sites.

Based on the current annual extraction limit of 200,000 tonnes, it is estimated that the current proposal would result in an Average Annual Daily Traffic (AADT) of 34 one-way truck movements (17 trucks) per day. Should the current proposal be approved, and the maximum allowable tonnage of raw material (500,000 tonnes) be extracted and hauled from the quarry site on an annual basis, calculations indicate that AADT would be in the

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order of 66 one-way truck movements per day. The increase in traffic is not proportional to raw material quantities, as it is intended to use larger trucks to haul materials supplied to the Inland Rail Project. Under the current development approval, truck and dog units with a capacity of 38 tonnes are utilised. If this proposal is approved, truck and dog units would continue to be utilised to supply smaller projects in the region, while road trains with a capacity of 60 tonnes would be used to supply the Inland Rail Project.

Under the this proposal, daily tonnage will be a maximum of 2,000 tonne per day. This is equivalent to the current maximum daily crushing capacity onsite and therefore peak daily production will remain unchanged relative to existing operations. Given the use of larger trucks to haul materials to the Inland Rail Project, traffic generated on peak days would decrease by up to 62%, from 53 dog and truck movements to 33 road trains, in the event that all materials were transported by road trains.

Table 20 presents data pertaining to traffic levels under the existing and proposed developments. Table 21 shows existing and predicted traffic movements generated on a peak production day.

Table 20: Existing and Proposed Average Heavy Traffic Movements

Truck size	Load Weight	Existing Average Movements per day	Proposed Average Movements per day
Annual Extractions		200,000 tonnes	500,000 tonnes
Working days available		307	307
Truck and Dog	38-tonnes	17	17
Road Train	60-tonnes	0	16
Daily Tonnage moved		646	1629
AADT		34	66
Movement per hour (11-hour day)		3.1	6

Table 21: Peak Truck Movements for 2,000 tonnes per day

Truck size	Load Weight	Existing Average Movements per day	Proposed Average Movements per day
Daily peak despatch		2,000 tonnes	2,000 tonnes
Truck and Dog	38-tonnes	53	6
Road Train	60-tonnes	0	30
AADT		106	72
Movement per hour (11-hour day)		9.6	6.5

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5.13.2 Potential Impacts

Increased traffic generation has potential to increase the rate of wear of public roads utilised as freight routes in association with the development. Road trains supplying the Inland Rail Project will utilise Wave Hill road, Maules Creek road, Turrawan road and the Kamilaroi Highway to reach the Newell Highway.

The changes in traffic from Wave Hill Quarry, described in Section 5.13.1, is predicted to be relatively short-term (2-3 years) and primarily associated with increased regional demand for construction materials, as a result of the construction of the Inland Rail Project. In the long term, the Inland Rail Project will provide a major freight route for produce generated from within the region

Following the completion of the construction of the Inland Rail Project, it is predicted that the production rates of Wave Hill Quarry will drop once again to match current levels for construction materials for the surrounding region.

Traffic generated by the proposal also has the potential to impact on road traffic noise and safety. Potential noise impacts have been discussed in Section 5.8 and are not predicted to be significant.

Given that the current proposal will likely result in a reduced number of trucks on the local road networks, it is considered that the project may have a positive impact on road safety in the short-term.

5.13.3 Management and Mitigation Measures

In accordance with Section 7.11 of the *Environmental Planning and Assessment Act 1979* (previously Section 94), the Proponent will continue to provide fair and reasonable monetary contributions to Narrabri Shire Council, to assist in the maintenance costs of the freight routes to be utilised by the development. Such measures will ensure that the roads are able to be adequately maintained in the event of an increase in heavy vehicle traffic volumes.

The previous development approval for Wave Hill Quarry resulted in an agreement between the Proponent and local Authorities to upgrade the Wave Hill Road, the main haul road to the quarry. This was originally a gravel road. The last remaining gravel section of the road extends over 1.5km and is to be upgraded and bitumen sealed prior to Wave Hill Quarry obtaining approval to increase annual throughput to a 500,000-tonne annual limit.

Council and Transport NSW are at present upgrading road sections to create an alternative heavy traffic route which would provide access to the Newell Highway whilst avoiding a

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section of residential area and a school zone within the township of Narrabri. This will result in a long-term benefit to the town to reduce the travel of trucks within the town area. The works in progress include replacement of Tarriaro Bridge over the Namoi River, widening of Turrawan Road and reconstruction of the Turrawan-Kamilaroi Highway intersection to add left and right turning lanes.

To protect regional amenity values, transport activities associated with Wave Hill Quarry will be limited to operating hours as specified in Section 3.2.6.

These measures are considered sufficient to protect the quality of the road network.

5.13.4 Assessment of Impacts

It has been concluded that the proposal to increase the current annual extraction limit would result in a moderate increase in traffic generation from the Wave Hill Quarry. In part, this would be offset by an increase in truck size by the potential use of 11 Axle Rigid truck and 2-Dog trailer and standard Type 1 road trains to haul the additional gravel from Wave Hill via Turrawan Road. As a result of this, a major part of the additional gravel haulage will occur via a new route to avoid any increase in truck movements through residential and commercial sectors of Narrabri town, other than along the Newell Highway.

It is predicted that the traffic increase resulting from the proposal will be temporary in nature and primarily associated with construction of the Inland Rail Project. Following the completion of the project, it is predicted that traffic volumes generated by Wave Hill Quarry will return to their current levels, which reflects the steady demand for construction materials within the locality.

In the long term, the Inland Rail Project will decrease the overall strain on the public road network by providing an alternative freight route to industries throughout the region.

Overall, the increased level of heavy traffic generated by the proposed development is not considered to pose a significant risk to the amenity, safety, functionality, or accessibility of the wider region. Furthermore, the Proponent will contribute to road maintenance costs, through Section 94 Contributions and a Voluntary Planning Agreement, to ensure that there are no adverse impacts to the public road network as a result of increased traffic levels. The long-term secondary impacts of the development upon the public road network are neutral to positive, resulting from a decrease in heavy traffic in the locality as more freight is transported by rail.

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5.14 Waste, Chemicals and Hazardous Materials

5.14.1 Waste Generation

Waste management currently undertaken at the facility is considered to be appropriate. The Quarry operator maintains labelled bins for each waste stream on site for all rubbish generated by employees. The bins are regularly emptied by a local waste contractor. In addition, a number of waste management measures are implemented on site as part of the Quarry operations; these are outlined in the Onsite Environmental Management Plan, included as Appendix 12.

Whilst all regular servicing of mobile equipment would be undertaken offsite, small volumes of hydrocarbons would be generated as a result of non-scheduled maintenance needs. These hydrocarbons would be stored within a bunded container and generally removed from site either by a service contractor.

5.14.2 Mitigation Measures

5.14.2.1 Waste Classification and Disposal

Table 22 provides a summary of the waste types, controls and safeguards that would be applied to waste generated on the project site. Table 22 also identifies contingency management in the event of incidents which have the potential to result in pollution to the surrounding environment.

Table 22: Waste Controls, Safeguards and Contingency Management

Waste Type	Storage	Disposal	Contingency
General solid waste (putrescible)	Covered bins will be located within the general area of the quarry office and amenities. Where bins would be located in open areas, they would be fitted with animal-proof lids.	Bins would be collected, and the contents disposed of at a licensed waste disposal facility.	In the event waste volumes exceed that able to be managed by local waste collection service, Quarry Management would arrange for private delivery of waste to licensed landfill facility.
General solid waste (recyclables)	Covered bins located within the general area of the quarry infrastructure for the collection of recyclable materials.	Bins would be collected and transported to Narrabri Shire Council Waste Management Facility for recycling.	
General solid waste (non-putrescible)	Bin and designated adjoining area within	Bins would be collected, and the	

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Waste Type	Storage	Disposal	Contingency
	general processing, stockpiling and office area.	contents disposed of at Narrabri Shire Council Waste Management Facility	
Waste oils and greases	Placed within bunded storage area.	Collected as required by a licensed waste contractor and transported to an appropriately licensed facility for recycling.	Any leakage, spillage or ground contamination would follow the spill management procedure included below.
Batteries	Used batteries would be placed within a covered and marked used battery storage area until removed from site.	Used batteries would be collected on a regular basis by an appropriate contractor and recycled.	The Quarry Management would arrange for private delivery if collection service unavailable.
Tyres	Tyres would be securely stored until removed from site.	Tyres would be removed from site for re-use elsewhere or recycling in accordance with the Resource Recovery Exemption (RRE) and Resource Recovery Order (RRO) for types issued under Part 9 of POEO (Waste) Regulation.	N/A
Scrap steel/metal	Stored in a specified area, as required.	Collected on a regular basis by a licenced scrap metal recycler.	The Quarry Management would arrange for private delivery if collection service unavailable.
Screened waste	Temporarily stockpiled within the extraction area (Location shown in Site Plan in Appendix 1).	As sufficient volumes stockpiled, these would be returned to the quarry as backfill and incorporated into the final landform.	In the event of runoff from these stockpiles creating a sedimentation hazard, additional bunds and other controls would be implemented in accordance with the Blue Book.

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Only small quantities of oils and lubricants would be stored on the project site. Refuelling of equipment would be by a service truck brought to the project site as required with refuelling undertaken away from natural or artificial drainage lines. In the event of a hydrocarbon leak or spill, the Quarry Operator would implement the following spill management procedure:

1. Source Control: isolate the source of spill or leak and stop the leak by either maintenance or placing the item within or over the fuel/oil storage area.
2. Recovery: recover as much as possible at the source by pumping free hydrocarbon from the surface and excavating hydrocarbon-contaminated materials. Contaminated materials would be stockpiled on site under cover and on an impermeable surface, eg. a high-density polyethylene sheet. This material would later be bioremediated onsite and/or transported to an approved waste facility.
3. Remediation: transport the contaminated materials to a designated area within the project site (away from natural or created drainage) for onsite bioremediation or to a facility licensed to accept and treat hydrocarbon contaminated material.

5.14.2.2 Waste Handling and Management

Waste will be classified and segregated on site, with each waste stream having a determined storage location within the development footprint. Waste stockpiles will be clearly labelled for easy identification, thus ensuring that all waste is clearly defined and isolated from other waste types. Contaminated and non-contaminated waste will be separated by an appropriate distance to minimise the risk of cross-contamination. Stockpiles will be regularly inspected to ensure that waste is properly segregated.

The following mitigations measures will be implemented to minimise on site and off site pollution:

- Waste storage containers and areas will be provided at safe and convenient locations;
- Each container will be identified with the type of wastes which may be disposed of in each container. Each container or area will be designed to prevent the escape of materials;
- Recycling bins are emptied when full and materials which may cause land contaminations are not disposed of on site;
- Stockpiles will be separated from sensitive environmental receptors by an appropriate buffer and where necessary will be bunded to reduce sediment laden stormwater runoff;
- Tyre stockpiles will not exceed 50 tonnes at any one time and will be located in a clearly defined area away from the tipping face;

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- Bunding will be constructed of material which is impervious to the wastes stored;
- Bunds will be kept in good condition (e.g. no cracks, gaps or leaks);
- Roofed storage facilities will be provided where possible;
- Stormwater captured within bunding will be removed as soon as practicable and disposed of as contaminated water (if required); and
- Empty hydrocarbon and chemical containers will be stored with closures in place on a hardstand or within a bunded area.

Records of classified waste generated at the site, treatment and disposal methods, approved contractors used for transporting and disposing of waste and the location of the facility for accepting the waste will be documented and retained. Written records of waste sampling and classification results shall also be retained, in accordance with EPA's Waste Classification Guidelines (2014). Records will include details such as information on the nature of the waste (classification, name and address of its origin and quantity), and copies of waste dockets/receipts for the waste facility (date, time of delivery, name and address of the facility, its ABN and a contact person).

The Proponent is aware of the relevant legislative requirements for disposal of the waste, including any relevant Resource Recovery Exemptions, as gazetted by EPA from time to time.

5.14.2.3 Waste Transport

Waste transported to a lawful facility will be adequately covered to ensure that it does not fall or spill onto the road, and create dust or litter, or damage to other vehicles.

The following measures will be implemented to ensure that any waste leaving the site is transported and disposed of lawfully and in a way that does not pose a risk to human health or the environment:

- Waste will be covered during transportation unless the waste consists solely of waste tyres or scrap metal;
- The vehicle used to transport the waste must be maintained so as to avoid the waste spilling, leaking or otherwise escaping from the vehicle;
- Containers used to transport waste should be checked to ensure they are safely secured to the vehicle; and
- For higher risk wastes (i.e. trackable waste), an EPL would be obtained prior to transportation.

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5.14.2.4 Waste Tracking

Any wastes deemed to be wastes that need to be tracked are to be lawfully transported and disposed of at a licenced facility that is approved to accept the waste, and waste tracking records are to be produced and maintained. The Applicant is responsible for ensuring that hazardous waste is characterised, transported and tracked in accordance with Part 4 of the *Protection of the Environment (Waste) Regulation 2014*.

5.14.2.5 NSW Waste Avoidance and Resource Recovery Strategy 2014-21

The proposal was considered against the following targets of the NSW Waste Avoidance and Resource Recovery Strategy 2014-21 (EPA 2014):

1. Avoid and reduce waste generation
2. Increase recycling
3. Divert more waste from landfill
4. Manage problem wastes better
5. Reduce litter
6. Reduce illegal dumping

The proposal has identified the quarry generated wastes and provided for appropriate methods of managing these using the waste hierarchy to avoid and reduce, reuse or recycle if possible. Items that cannot by safely recycled will be disposed of at a licenced waste facility.

5.14.3 Assessment of Impacts

Waste generated by onsite extraction and related activities would be managed appropriately and, assuming adherence to the management, contingency and monitoring measures nominated in Table 22, should not pose significant risk of pollution to the surrounding environment.

It is therefore assessed that the development, as proposed, provides for appropriate waste management which reduces the risk of pollution or contamination to acceptably low levels. It is recommended, however, that a Waste Management Plan is prepared to further describe waste management procedures, protocols, monitoring and response to pollution incidents. The Waste Management Plan should be prepared in conjunction with a Pollution Incident Response Management Plan as required for the Environment Protection Licence.

5.15 Biosecurity

The following provides a Biosecurity Risk Assessment and Management Plan as requested by the NSW Department of Primary Industries – Agriculture. The assessment outlines the likely plant, animal and community risks associated with the proposed development and

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assesses the risk in accordance with AS/NZS 4360:2004 taking into consideration the likelihood and potential consequence(s) of the environmental impacts.

5.15.1 Defining Risk

Risk is the chance of something happening that will have an impact upon the objectives of a task, which in this case is the development and operation of the quarry without increasing the biosecurity risk posed to plants, animals and the community. Risk is measured in terms of consequence and likelihood, which are then evaluated in a risk matrix.

5.15.2 Sources of Risk

The primary source of biosecurity risk associated relates to the stockpiling or transportation of contaminants on vehicles, people, equipment or materials onto and off the Quarry site. The specific risks, as relevant to plants, animals and the community relate predominantly to the following:

- Introduction and spread of disease onto or from the Quarry site which could affect plant, animal or human health.
- Introduction, propagation and spread of weed species by vectors including vehicles and personnel moving on and off the Quarry site.

It is noted that the Quarry site would not involve the storage or cultivation of materials which could constitute potential food sources for pest animal species. Further, the site would be heavily disturbed as a result of vegetation clearing and ongoing human activity (including mechanical activities) which would result in the site not offering suitable habitat for pest animal species. Therefore, the risk of pest animal species being present at the subject site, or the risk of the development increasing the number of pest animal species, is negligible. As such, a pest animal management strategy is not necessary.

5.15.3 Risk Assessment

The allocation of a consequence rating was based on the definitions contained in Table A. The likelihood or probability of each impact occurring was then rated according to the definitions contained within Table B.

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Table A
Qualitative Consequence Rating

Level	Severity Level	Area of Consequence				
		Animal Health and Production	Plant Health and Production	Human Health, Safety & Well-being	Economic	Environmental
1	Insignificant	No loss.	No loss.	No injuries.	No economic loss.	No environmental impact.
2	Minor	Limited illness / injuries and / or deaths on single enterprise.	Limited damage / loss on single enterprise.	Minor injuries, no public health risk, short term well being impact.	Few businesses locally affected or single / few properties.	Minor / recoverable short-term isolated / localised environmental impact.
3	Moderate	Some illness / injuries / deaths on multiple properties across a locality.	Some damage / loss on single property – multiple paddocks.	Limited public health risk and / or injuries requiring medical and mental health treatment.	Widespread industry impact, multiple industries / properties per district.	Moderate, medium term, medium spread environmental impact.
4	Major	Considerable illness / injuries / deaths on multiple properties across a region.	Considerable damage / loss on multiple properties across a region.	Major public health risk and / or major injuries / well being impact.	High economic / trade risk to region and / or state.	Serious, long term widespread environmental impact.
5	Severe	Significant illness / injuries / deaths on multiple regions.	Considerable damage / loss across multiple regions.	Significant public health risk and / or human deaths / long lasting well being issues.	Major national economic implications.	Irreversible environmental impact.

Table B
Qualitative Likelihood Rating

Level	Descriptor	Description
A	Almost Certain	May occur several times over short period or continuously.
B	Likely	May occur monthly to several times a year.
C	Possible	Might occur once in a period of one to three years.
D	Unlikely	Could occur over time (every five to ten years).
E	Rare	May occur in exceptional circumstances.

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A risk ranking (low, medium, high or very high) was assigned to each potential impact based on the matric presented in Table C.

Table C
Risk Rating Matrix

Likelihood		Consequences				
		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A	Almost Certain	M	M	H	X	X
B	Likely	L	M	H	H	X
C	Possible	L	L	M	H	H
D	Unlikely	N	L	M	M	H
E	Rare	N	N	L	M	H

The five risk rankings are defined as follows.

Negligible (N):	Acceptable risk.
Low (L):	Ongoing monitoring. Manage by routine procedures, unlikely to need specific application of resources.
Medium (M):	Active management. Manage by specific monitoring or response procedures, with management responsibility specified.
High (H):	Intervention required. Urgent management attention needed, action plans and management responsibility specified.
Extreme (X):	Urgent attention required. Immediate action needed, action plans and management responsibility specified.

For each of the sources of risk identified, Table 23 identifies specific risks associated with each of the risk sources and identifies the management measures proposed to eliminate or reduce these risks and assess the residual risk.

Table 163: Biosecurity Risk Ranking

Risk Source	Specific Risk	Risk Management Measures	Likelihood	Consequence	Residual Risk
Transport of contaminants on vehicles, people, equipment or materials onto and off the Quarry site.	Introduction of disease onto or from the Quarry site.	Implement "come clean – go clean" principles for all vehicles / personnel moving onto and off the Quarry site, including: - Changing / cleaning footwear - Maintaining personal hygiene. - Cleaning of vehicle and equipment.	E	3	L
	Introduction, propagation and spread of	Weed spraying will be undertaken where there are signs of weeds.	D	2	L

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Risk Source	Specific Risk	Risk Management Measures	Likelihood	Consequence	Residual Risk
	weed species.				
Dispersal of dust, organic matter or other particulate matter from stockpiles.	Transfer of weed species propagules onto and beyond the Quarry site.	Water would be used to suppress any dust / particulate matter dispersion.	D	2	L

5.15.4 Summary of Biosecurity Risk

On consideration of the sources of risk and proposed management and mitigation measures to be imposed by the Quarry management, the proposal presents a negligible to low risk of specific biosecurity related impacts on plants, animals and the community. These risks would be effectively managed by the proposed monitoring, management and contingency measures proposed. On the basis of this reduced risk level it is not necessary for a biosecurity management plan to be prepared.

5.16 Land Contamination

The current quarry footprint was utilised for agricultural purposes prior to the establishment of Wave Hill Quarry in the late 1980's. The quarry footprint was assessed for evidence of contamination in 2011, in association with the previous development application (DA 60-2013) to expand the quarry's production capacity to 200,000 tonnes. At this time, the only potential contaminants identified on site were associated with herbicides (used for weed control), veterinary chemicals (associated with treatment of cattle on grazing lands), and fuel and oil (associated with machinery on site). No visible 'burnt' or bare patches of ground were identified, and it was determined that the risk of contamination being present on site was low. Overall, it was concluded that contamination was not present on site, and, as a result, was suitable for the proposed use as a quarry site.

In the intervening time period since this assessment, activities on site have been associated with quarry operations, including drilling, stockpiling and removal of quarry materials. The present proposal does not involve a change of land use. The existing site is considered suitable for continued use of extractive activities. Accordingly, it was determined that no further investigation into land contamination was required and that the site should remain classified as acceptable for use for the purposes of extractive industry.

5.17 Social Impacts

Quarries are permitted with consent within RU1 zoned land under the *Narrabri Local Environment Plan 2012*. The subject site and surrounding properties are zoned RU1, and

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therefore the operation of a quarry is consistent with the zoning of the locality. Upon approval of the proposed development, the layout and use of the lot will remain similar to current conditions.

Identification of the scope of the potential social impact of the proposed development has been undertaken with regards to scoping methodology outlined in the Social Impact Assessment Guideline (2017) (SIA Guideline), published by the Department of Planning and Environment.

The SIA Guideline proposes the use of a scoping checklist to identify the range of potential social impacts of a development. This checklist is to be considered, with each impact identified with regards to whether this impact is 'likely', 'unlikely' or 'not applicable' to the proposed development (without mitigation measures). The SIA Guidelines outlines the definition and required use of each of these three categories as part of the assessment of the scoping checklist, as follows:

- **Likely:** that is, there is a real chance or possibility that the adverse impact will occur.
- **Unlikely:** in which case, the applicant must explain why, for example, if the impact has been avoided.
- **Not Applicable (N/A):** in which case the applicant must explain why the matter is not relevant to the project.

The proposed development has the potential to produce a range of adverse social impacts in the absence of mitigation measures. These impacts relate to:

- Acoustic
- Health
- Safety
- Air
- Land, Water

The social impact assessment checklist, and associated assessment with regards to the potential impact of the proposed development, are presented in Table 24.

A LUCRA assessment has been completed to assess the risk of land use conflict as a result of the proposed quarry. A copy of this assessment is presented in Appendix 6. The LUCRA identified a suite of management methods which should be adopted to minimise the risk of adverse social impacts upon the surrounding locality. Potential causes of land use conflict and associated management methods include:

- Increased quarry dust and noise during operation, associated with intensification of extractive activities and haul truck movements: This can be addressed through available separation distances and the implementation of site management plans.

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- Traffic Noise along Wave Hill Road: The development will need to manage impacts of noise along the haulage route through a truck drive code of conduct protocol. This is deemed to be manageable.
- Health and safety: This may be protected by implementing a comprehensive Mine Safety Management System, and ensuring that all personnel on site are aware of, and comply with, the requirements of the Management System.
- Environmental protection issues: These can be addressed through appropriate site assessment, offsetting and rehabilitation measures, stormwater management and sediment and erosion controls.

With the implementation of appropriate mitigation measures, it is considered that the proposal will not produce significant negative social impacts within the region. Any negative impacts which may occur are considered to be temporary and of minor consequence.

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Table 24: Checklist of Matters of Potential Social Impact Significance

Matters		Key Links to Social Impacts	Risk of Impact Without Mitigation	Nature of Impact	Explanation
Amenity	Acoustic	Way of life; Surroundings	Likely	Negative	Noise generated by machinery, heavy vehicle movements or quarry activities may impact on neighbouring properties, particularly rural residences.
	Visual		Unlikely	Negative	Quarry site will be visible from Wave Hill Road. However the site is already present and there will be no change to the site extent of the footprint.
	Odour		N/A		Development will not produce strong odour.
	Microclimate		N/A		Development will not significantly impact local microclimate.
Access	Access to property	Way of life; Access to infrastructure, services and facilities; Personal and property rights	N/A		Development will not impact access to neighbouring properties.
	Utilities and public transport		N/A		School bus routes operate in districts which utilise public roads. School buses will not be impacted by development. No other public transport occurs within the region.
	Road		Likely	Negative	There is no construction phase associated with this proposal. The development will continue to operate under management protocols for road transport of materials. To date, ongoing consultation has taken place with adjacent residents, and this measure will continue to be implemented.
	Rail		Likely	Positive	The proposed development will support the construction of the Inland Rail project.
Built environment	Public domain	Community; Access to infrastructure, services and facilities; Surroundings; Personal and property rights	N/A		The development will be confined to private property.
	Public infrastructure		N/A		The development will not impact upon public infrastructure other than roads.
	Other built assets		N/A		The development will not impact upon public infrastructure.

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Matters		Key Links to Social Impacts	Risk of Impact Without Mitigation	Nature of Impact	Explanation
Heritage	Natural	Way of life; Community; Culture; Surroundings	N/A		The subject site does not possess significant natural heritage values.
	Cultural		N/A		The subject site does not possess European cultural heritage values.
	Aboriginal cultural		Unlikely	Negative	The majority of the site footprint has been subject to extensive disturbance from the existing development. It is considered unlikely that intensification of extractive activities will increase the likelihood of causing impact or harm to Aboriginal cultural heritage values.
	Built		N/A		The site does not possess built heritage values.
Community	Health	Health and wellbeing; Surroundings; Way of life; Access to infrastructure, services and facilities; Community; Culture; Personal and property rights	Likely	Negative	There is a potential for workers to be injured on site during quarry operations.
	Safety		Likely	Negative	There is a potential for workers to be injured on site during quarry operations.
	Services and facilities		N/A		The development does not offer or impact public services or facilities.
	Cohesion, capital and resilience		Likely	Positive	The proposal will provide additional employment and training opportunities for local communities, which will support the resilience and capability of the local workforce.
	Housing		N/A		The proposed development will not impact upon housing quality or supply.
Economic	Natural resource use	Way of life; Surroundings; Personal and property rights	Likely	Positive	The quarry will utilise available natural resources in a sustainable fashion to support improvements to regional infrastructure through construction of the Inland Rail Project.
	Livelihood		Likely	Positive	The quarry will provide employment and training opportunities for local populations.
	Opportunity cost		N/A		The development will not negatively impact upon the productivity of surrounding region.
Air	Particulate	Surroundings	Likely	Negative	Dust generated by machinery, heavy vehicle movements or quarry

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Matters		Key Links to Social Impacts	Risk of Impact Without Mitigation	Nature of Impact	Explanation
	matter, gases, atmospheric emissions				activities may impact on neighbouring properties, particularly rural residences.
Biodiversity	Native vegetation and fauna		Unlikely	Negative	The majority of the footprint of the proposal has been subject to clearing and development. No additional clearing will take place as part of the current proposal.
Land	Stability/ structure, soil chemistry, land capability, topography		N/A	Negative	Quarry operations will not cause additional soil disturbance.
Water	Quality, availability, hydrological flows		Likely	Negative	Erosion from site has the potential to result in sedimentation of waterways, thus decreasing water quality. Dust mitigation measures will also require use of water for dust suppression activities.

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5.18 Economic Impacts

The proposed development involves capital expenditure in the order of $150,000. Much of this cost is related to the environmental impact statement preparation. Some minor operational costs will be necessary when the approval is obtained. This would relate to site rehabilitation and the upgrade of some environmental mitigation measures, such as the consolidation of stockpiles to the east of the proposal, for example. Most of the site infrastructure is already in place, including the sediment pond system, roads, and machinery, with little or no additional expenditure required.

The modification of operations at Wave Hill quarry is not considered likely to stimulate additional employment at the quarry, however it will result in a modest increase of demand for local haulage contractors over a period of 2-3 years.

The close proximity of Wave Hill to the Inland Rail route may also decrease the construction costs of the Inland Rail by minimising costs associated with haulage and will contribute to minimising the impact of the construction period of Inland Rail upon the wider regional road network. This will contribute to the overall economic benefits of the Inland Rail Project for the taxpayer.

5.19 Cumulative Impacts

The potential environmental impacts from the establishment, operation and rehabilitation of the proposed Quarry have been detailed in their relevant sections throughout this report.

Potential cumulative impacts are those which are generated by the combined impacts on the local environment as a consequence of the project, together with other developments of a similar nature (both existing and proposed). For the purposes of this EIS, the assessment of cumulative impacts considers the impacts of existing and proposed extractive industry development in the local area.

Boral quarry is located approximately 1km west of Wave Hill Quarry on Wave Hill Road. It operates under EPL 3778 and has an annual extraction limit of 100,000 tonnes. Minor acceptable cumulative impacts from both quarries may arise from the effects of noise, dust and traffic on sensitive receivers.

The noise levels generated from the Wave Hill quarry have been considered in combination with potential noise levels generated by Boral Quarry in Section 5.8. Cumulative noise levels resulting from operational activities and traffic generated by the developments were deemed to meet the required criteria under worst case conditions where the noise is moving toward the receptor. Cumulative noise impacts resulting from blasting related activities can be avoided by consultation between both quarry managers.

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Predicted cumulative air quality impacts resulting from the proposal in combination with extractive activities at Boral Quarry are described in detail in an Air Quality Impact Assessment (Appendix 4) and are summarised in Section 5.7. Modelling results indicate that no additional exceedances of the NSW EPA assessment criteria for PM_{10}, $PM_{2.5}$, TSP or deposited dust are likely to occur at identified sensitive receptors in the vicinity of Wave Hill Quarry as a result of the proposal.

Traffic levels predicted to be generated by the operation of Wave Hill Quarry under an increased annual extraction limit were considered in combination with potential road traffic associated with Boral Quarry. It was concluded that there would be no significant adverse impacts to heavy vehicle traffic levels as a result of the proposal, given that traffic associated with Boral Quarry would remain similar to current levels, whereas traffic generated by Wave Hill Quarry has the potential to be reduced (on peak production days for example). It is estimated that in the worst case scenario, whereby 500,00 tonnes of raw material are extracted over a period of one-year, the increase in traffic associated with the proposal is moderate, with the number of number of one-way truck movements increasing from 34 to 66 trucks per day, on average. This is not considered to have the potential to significantly impact community amenity, given that trucks supplying the Inland Rail Project will follow a new upgraded haulage route and will avoid the township of Narrabri.

Cumulative visual impacts are not expected to occur as there will be no significant changes to the existing development. No new structures will be erected, and the extractive footprint of the Wave Hill quarry will remain unchanged.

Cumulative social impacts may also include positives such as additional expenditure of wages and requirements for services in the local area.

Review of the NSW Department of Planning Major Projects register indicates that no other significant projects are publicly proposed for this area at this time other than the Inland Rail upgrade. The identified sensitive receptors are not expected to incur any cumulative adverse impacts from this upgrade, given the significant separation distance (over 25km) between the 2 developments.

Overall, the EIS has demonstrated that impacts associated with the proposed development can be appropriately mitigated to ensure that compliance with regulatory limits will be achieved.

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6 Summary of Mitigation Measures

The outcome of this Environmental Impact Statement is a list of recommendations, which are to be observed during the planning and operation of the proposal. The proposed mitigation measures will also incorporate any additional controls detailed in the Noise Impact Assessment, Air Quality Impact Assessment, Rehabilitation Plan and Soil and Water Management Plan included in the Appendices of this EIS. It is noted that a number of these mitigation measures are currently implemented as part of the existing development.

The following table provides a summary of the recommended mitigation measures for the establishment and operation of the proposed quarry.

Table 25: List of Proposed Mitigation Measures

Issue	Mitigation Measures
General	▪ Review and update of the Onsite Environmental Management Plan (OEMP) ▪ Review and update, if required, of the established complaints processing mechanism. Ensure that a timely response is issued to any community and stakeholder enquiries regarding noise, vibration and traffic impacts associated with the proposed quarry.
Visual Amenity	▪ Retain and protect vegetation located outside of the identified extraction zone. ▪ Rehabilitate and revegetate the site with appropriate species.
Air Quality / Dust Impacts	▪ Implement control and mitigation measures recommended in the Air Quality Impact Assessment and Soil and Water Management Plan. ▪ Always cover loads when transporting aggregate from the site. ▪ Implement vehicle speed restrictions (recommended 40km/hr). ▪ Implement progressive revegetation and/or mulching to ensure soil stabilisation across the site. ▪ Minimise areas of disturbance. ▪ Keep front-end loader bucket low when handling and transporting materials. ▪ Clean up fines from around crusher operations to avoid disturbance from either loader operations or wind-blown dust ▪ Regularly inspect and maintain all construction equipment to reduce potential for excessive emissions. ▪ In the event of increased dust production, increased dust suppression management measures, including by increasing watering rates, decreasing processing rates, slowing truck speeds

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	and ensuring that dust housing protections remain in place. ▪ Initiate Shut down procedures during periods of excessive dust generation or upon receipt of complaint and investigate and initiate additional controls.
Noise	▪ Implement control and mitigation measures recommended in the Noise Impact Assessment ▪ Operating hours in accordance with the development consent conditions. ▪ Carefully check all plant and equipment to ensure that they are correctly tuned and well maintained to meet manufacturers specifications. ▪ Where practical, operate machines at low speed or power and switch off when not in use. ▪ Regularly inspect all plant and equipment to ensure compliance with industry best practice regarding noise levels and carry out repairs or modifications where necessary. ▪ Machinery to be operated in accordance with the manufacturer's direction. ▪ Monitor noise levels as and when required. ▪ Conduct environmental noise awareness inductions for all contractor employees and subcontractors. ▪ Conduct ongoing on the job training for each specific job task. ▪ Liaise with affected residents about when noisy works are likely to occur (e.g.: blasting operations). ▪ Undertake noisy works during standard and/or less sensitive hours where possible. ▪ Consult with the community and advise of expected increased traffic movements, times, and length of the proposed operation.
Water Quality	▪ Implement erosion and sediment control measures in the OEMP and the Soil and Water Management Plan. ▪ Implement temporary erosion and sediment control structures such as straw bales and silt fences to minimise the potential for sediment laden runoff to enter watercourses. ▪ Collect runoff from working areas in sediment ponds. ▪ Progressively stabilise and revegetate disturbed areas. ▪ Regularly monitor and maintain all erosion, sedimentation and pollution control devices, particularly after any significant rainfall event, to ensure effective operation, especially until disturbed areas are stabilised and/or properly vegetated. ▪ Water quality of surface runoff leaving the site should be

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	occasionally monitored by visual inspection to ensure that the water discharged is not overly sediment laden, which would indicate an issue with the treatment system. ▪ Well defined truck haulage routes to reduce the area requiring regular dust suppression demand (reduce water usage and dust impacts). ▪ Water levels in the sediment basins to be regularly monitored, and water use adjusted to suit the various levels. ▪ In the event of a chemical or sediment escape from site it would be cleaned up to a state which is no less than its condition prior to discharge. ▪ Education of site personnel for the implementation of sediment and erosion control plans. ▪ Use drains and diversion banks to direct clean stormwater away from disturbed areas, working areas or stockpiles. ▪ Ensure storage of and use of hazardous materials (fuels) is in accordance with *National Code of Practice for the Storage and Handling of Workplace Dangerous Goods (2001).* ▪ Maintain table drains to dissipate flow of rainfall runoff along drain and road areas.
Rehabilitation	▪ Rehabilitate the site in accordance with the Rehabilitation Plan and the development consent conditions. ▪ Revegetate disturbed areas within the project site in accordance with the Rehabilitation Plan and the development consent conditions. ▪ All site rehabilitation works shall be designed to ensure the maximum revegetation cover is achieved and shall be maintained to ensure optimum establishment and growth. ▪ All noxious weed species, environmental weeds and Weeds of National Significance are to be managed across the site (including during progressive rehabilitation). It is recommended to implement a Weed Management Plan on a continuous basis to prevent the need for a reactive weed management strategy. ▪ Soil containing high quantities of weed seeds and/or weed seed banks should be disposed of either at an appropriate waste management facility, or in an area separated from remnant vegetation communities ▪ Only endemic topsoil will ensure the endemic soil seed banks are restored to the site increasing the potential for successful rehabilitation of pre-development vegetation.

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	▪ An assessment of potentially contaminated soils is to be carried out prior to the removal of any infrastructure from the site.
Topsoil Management	▪ Maintain soil stockpiles appropriately to protect resource with a "rough" surface condition to reduce erosion hazard, improve drainage and promote revegetation. ▪ Stockpiles will not exceed 3m in height and will be constructed with a slope of <2:1(H:V) and the stockpile surface left roughened. ▪ Where stockpiles are inactive for extended periods of time stockpiles will be fertilised and seeded to maintain soil structure, organic matter and microbial activity and to prevent erosion. ▪ Silt fences shall be installed/maintained around stockpiles to control potential loss of stockpiled soil.
Biodiversity	▪ Rehabilitate the site upon cessation of extractive activities, in accordance with the site rehabilitation plan. ▪ A protection zone should be established around areas of vegetation to be retained close to quarrying activities. ▪ The site should be maintained to reduce the fuel load adjacent to retained vegetation. ▪ Implement weed management strategies through the onsite OEMP minimise risk of weed establishment and proliferation. ▪ Control existing weeds that are present onsite and listed under the *Biosecurity Act 2015*. ▪ Ensure that machinery brought onto and off the site is free from propagules. ▪ Revegetation of previously cleared and quarried areas should utilise local species.

Cultural Heritage	▪ In the event that any Aboriginal artefacts, items or sites of cultural heritage are found during quarry operations, the following management procedures will be carried out:
	  ▪ Work will cease in the immediate area until OEH are advised and the site/artefact/relic is assessed.
	  ▪ A requirement to immediately stop all works if human remains are found during the quarry operations to prevent any further impacts to the remains. The NSW Police, the OEH and the Aboriginal Community will be notified.
	  ▪ Consultation will be carried out as appropriate in accordance with the following documents:
	  ▪ Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010;

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	▪ The Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW 2010. ▪ Ensure that project staff and contractors and their employees are advised of their legal responsibilities under the *National Parks and Wildlife Act 1974* and the *Heritage Act 1977.*
Hazards and Risks	▪ Ensure all activities are carried out in accordance with *NSW Work Health Safety Regulation 2011*. ▪ Appointed contractors would need to be appropriately accredited, and undertake their work in accordance with an accepted WH&S Management Plan. ▪ Ensure all staff, sub-contractors and visitors to the site are appropriately inducted and made aware of hazards and emergency hazard procedures. ▪ Ensure all fuels are correctly stored, isolated away from vegetation and combustible sources. ▪ Ensure the fire extinguishers are regularly maintained and located around buildings and mobile machinery. ▪ Ensure all trafficked areas, access tracks and road verges are cleared of vegetation build up. ▪ Incorporate fire breaks, including a perimeter road, around the quarry site. ▪ Ensure any buildings, including temporary buildings, are set back at least 10m from any potential fuel sources. ▪ Checking the underside of vehicles periodically to ensure they are kept free of vegetation debris that could dry out and ignite. ▪ Ensure a water cart/truck is equipped with a hose to assist in extinguishing any fired ignited and that there is sufficient water availability onsite for fire fighting. ▪ Review and update, if required, hazard and risk management and contingency measures in the OEMP.
Hazardous Materials	▪ Diesel (Class C1) and lubricating oils and greases (Class C2) will not be stored adjacent to any other hazardous materials.
Traffic and Transport	▪ Implement mitigation measures included in the Traffic Impact Assessment and Noise Impact Assessment. ▪ Operating hours in accordance with the development consent conditions. ▪ Ensure that the remaining gravelled section of Wave Hill Road is bitumen sealed prior to commencing operations. ▪ Provide adequate traffic management, including temporary speed restrictions, precautionary signs, illuminated warning

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	devices, manual traffic control and provision of temporary barriers and markers when necessary. ▪ Monitor traffic amounts and driver performance.
Greenhouse Gas	▪ Biodiesel for machinery and equipment will be used where possible. ▪ All machines will be regularly maintained in accordance with the manufacturer's specifications. ▪ Ongoing driver education will be carried out to minimise greenhouse gas emissions arising from undesirable driver performance. ▪ Use modern, well-maintained machinery and vehicles where practicably possible.
Waste Management	▪ Waste materials would be placed into individual bins or skips that are clearly labelled, so that waste materials may be kept segregated during collection and storage. ▪ Transport of waste material off-site, whether for reuse, recycling or disposal, would be conducted by a licensed waste contractor where required by legislation. ▪ Implement a spill management procedure (described in Section 5.14.2) in the event of leakage, spillage or ground contamination. ▪ Stockpiles will be separated from sensitive environmental receptors by an appropriate buffer. ▪ Tyre stockpiles will not exceed 50 tonnes at any one time and will be located in a clearly defined area. ▪ Bunding will be constructed of material which is impervious to the wastes stored. ▪ Bunds will be kept in good condition (e.g. no cracks, gaps or leaks) ▪ In the event of runoff from stockpiles creating a sedimentation hazard, additional bunds and controls will be implemented in accordance with "Managing Urban Stormwater – Soils and Construction" V1 ("The Blue Book"). ▪ Roofed storage facilities will be provided where possible. ▪ Stormwater captured within bunding will be removed as soon as practicable and disposed of as contaminated water (if required) ▪ Empty hydrocarbon and chemical containers will be stored with closures in place on a hardstand or within a bunded area. ▪ Waste will be covered during transportation unless the waste consists solely of waste tyres or scrap metal. ▪ The vehicle used to transport the waste must be maintained so as

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	to avoid the waste spilling, leaking or otherwise escaping from the vehicle. ▪ Containers used to transport waste should be checked to ensure they are safely secured to the vehicle. ▪ For higher risk wastes (i.e. trackable waste), an EPL would be obtained prior to transportation.
Machinery	▪ Care taken when refuelling machinery ▪ Waste lubricating oil removed from site
Utilities	▪ Call Dial Before You Dig on 1100

An Onsite Environmental Management Plan (OEMP) has been prepared for operation of the existing Quarry. The plan forms part of the standard approach required for the operation of the site in order to establish and monitor objectives of the operation. This should be reviewed and updated prior to the intensification of extractive activities at Wave Hill Quarry, should the proposal be approved.

Relevant monitoring programs are included in the OEMP relating to specific performance criteria. These criteria should include the following aspects of the operation:

- Operation schedule and production;
- Noise emission criteria;
- Dust emission criteria;
- Water quality;
- Complaints receival and mitigation actions; and
- General environmental compliance.

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7 Justification for the Proposal

Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) requires a detailed justification of the proposal and suitability of the site for the proposed expansion of Wave Hill Quarry. Mineral resource extraction can benefit and affect communities in different ways during the mining lifecycle. The sustainable management of mineral resources must consider and balance varying impacts to produce sustainable economic, social and environmental outcomes. The following justification therefore considers the potential biophysical, economic and social impacts and compliance with the principles of ecologically sustainable development (ESD).

7.1 Biophysical

Wave Hill Quarry is an existing quarry which is currently approved to extract up to 200,000 tonne of gravel per annum. The goal of the proposed amendment to the annual extraction limit is to enable supply of materials to the Inland Rail Project, whilst continuing to meet the local demand of the mining and construction industries in the Narrabri Shire region.

Inland Rail has advised that the section of the rail corridor between Narrabri and the QLD Border requires large amounts for gravel materials. ARTC noted that insufficient quarries were located in the region to supply their project. Initial estimates involve approximately 300,000 tonnes of material between Narrabri and Bellata. This may be the limit of material to be supplied from Wave Hill due to other competing quarry operations able to supply material at a lower cost.

Loading points have not yet been identified by ARTC for the Inland Rail Project, however the quarry is relatively close to the railway development. This proximity renders Wave Hill quarry suitable in that it minimises the potential impact of the proposed development on the surrounding locality, by minimising the impacts of the development on the public road network.

Wave Hill Quarry is therefore suitable for the development of the proposed quarry on biophysical grounds, as the site is capable of producing ballast and gravel material to satisfy construction requirements of the ARTC as an initial project and potentially other projects in the region.

7.2 Economic

Operation of the quarry would involve a capital investment in the order of $150,000.. However, the costs associated with the extraction and processing of 300,000 tonnes of

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material between Narrabri and Bellata for example, are expected to cost up to $3.5 million. This level of expenditure within the region is significant as a proportion of this money will be spent on services and supplies from local suppliers.

The proposal would not result in direct employment of additional staff as the work undertaken to operate the quarry is considered as an existing activity. In the short to medium term, increased quarry throughput would result in an increased requirement for the transport of raw materials to the Inland Rail Project depot. This would result in a modest increase of demand for local haulage contractors over a period of 2-3 years while quarry materials are supplied to the Inland Rail Project, thereby contributing to increased job security for affected contractors.

Approval of amended annual extraction limits at Wave Hill Quarry will also assist in enabling completion of the Inland Rail Project. The Inland Rail Project is a significant project, aimed at connecting Brisbane and Melbourne ports through a 1,700km inland rail corridor.

Inland Rail has indicated that construction of the rail corridor will produce significant economic benefits for the wider region. It is anticipated that the Inland Rail Project will:

- Cost $10bn over 10 years, and will produce a long-term economic benefit to cost ratio of 2.62;
- Increase Australia's GDP by $16bn during its construction and first 50 years of operation;
- Create 16,000 new jobs at the peak of construction, and an average of 700 additional jobs per year over the entire period;
- Reduce inter-capital rail freight costs between Melbourne and Brisbane by $10/tonne; and
- Significantly improve the overall efficiency and safety of the freight network between Melbourne and Brisbane.

The close proximity of the subject site to the proposed rail corridor will contribute to reducing the construction costs of the Inland Rail Project, increasing the efficiency of the project and therefore improving the overall economic benefits of the project for the taxpayer.

The proposal is therefore justifiable on economic grounds, as it will deliver significant economic benefit to the local region, in addition to improving the economic efficiency and benefits of the Inland Rail Project.

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7.3 Social

By contributing to the construction of the Inland Rail Project, operation of the quarry would indirectly contribute to the range of social benefits imparted by the Inland Rail, including job creation, improved connections within the national freight network, the provision of better access to and from local/regional markets, improved road safety and reduced local traffic.

The haulage route from Wave Hill would result in increased traffic along Wavehill Road through to Turrawan Road and the Kamilaroi Highway. This is the recommended haul route after discussions with Council with the aim of reducing truck movements through central Narrabri business area. Residents along Wavehill and Maules Creek road are already subject to some inconvenience as a result of the two quarries operating in the same area. The decision by Council to avoid any increase in truck movements through mainly Barwan Street in Narrabri, will aim to have a positive impact for a larger population within the Shire. In compensation to residents already impacted by trucks along the existing haul route, Council has conditioned existing approvals so that these roads are upgraded to ensure road safety is maintained, potential truck noise is reduced by requiring a sealed road and road dust is eliminated by the sealed road.

7.4 Environmental

This assessment has provided thorough consideration of the potential impacts of the proposed development upon environmental values within the region. It is considered that, in the event that:

- Mitigation measures outlined in Section 6 of this report are implemented;
- Recommendations outlined in the specialist reports in Appendix 4 – Appendix 10 are implemented;
- Site management is outlined and recorded with the guidance of an Environmental Management Plan implemented on site; and
- The site is rehabilitated following decommissioning of the quarry site in accordance with Appendix 11;

Then the environmental values of the locality will be protected from adverse impacts as a result of the continued operation of the quarry.

7.5 Ecologically Sustainable Development

Ecologically Sustainable Development' (ESD) is defined as:

> *"Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased (DPM 1990)."*

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ESD is integrated into NSW environmental legislation and government policy. Schedule 2 of the EPA Regulation lists four guiding principles to assist in achieving ESD. They are:

- *The precautionary principle:* if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- *Inter-generational equity:* the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
- *Conservation of biological diversity and ecological integrity:* conservation of biological diversity and ecological integrity should be a fundamental consideration.
- *Improved valuation and pricing of environmental resources:* environmental factors should be included in the valuation of assets and services, such as polluter pays, full life cycle costing, and utilising incentive structures / market mechanisms to meet environmental goals.

7.5.1 Precautionary Principle

Schedule 2 of the EPA Regulation notes that application of the precautionary principle in public and private decision making processes should be guided by:

i. Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
ii. An assessment of the risk-weighted consequences of various options.

The proposal will be developed in accordance with relevant Guidelines. Providing the Quarry is operated as described in this EIS, the development can continue operate as a sustainable short-term activity. No substantial threats of serious or irreversible environmental harm were identified. In addition, environmental monitoring will be used to confirm that the Quarry is operating in an environmentally sustainable way. Once the available resource is extracted and/or the demand for material has ceased the Quarry will be shut-down and the site rehabilitated.

7.5.2 Intergenerational Equity

It is not expected that the proposal will have any significant adverse environmental effects due to the suitability of the site and the proposed high standards of design, management and site rehabilitation. Hence the proposed quarry provides for 'intergenerational equity'.

Biological Diversity and Ecological Integrity

The site footprint currently consists of an operational quarry, therefore the proposal will not result in any additional vegetation clearing or habitat modification. It is intended to rehabilitate the site to a condition that would be suitable for agriculture, which will

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constitute an improvement on habitat values presently on site. Consequently, there should be no loss to existing biological diversity in the locality.

7.5.3 Valuation and Pricing of Environmental Resources

Protection of amenity and natural resources has been considered throughout the quarry planning phase. The environmental controls which are already in place, and which will continue to be implemented, add significant cost to the proposed development. The development has therefore been developed in accordance with the polluter pays principle, in that environmental management and mitigation measures associated with the development have been funded by the Proponent.

In conclusion, the proposed quarry can be justified on biophysical, economic, social and environmental grounds in compliance with the principles of ecologically sustainable development.

7.5.4 Analysis of Alternatives

The proponent wishes to capitalise on the demand for hard rock materials within the region as a result of the Inland Rail Project and of ongoing regional demand for construction materials. The proponent does not have an alternative site for this proposal. The proponent will therefore not develop an alternative site if the proposed Quarry is not approved.

7.5.5 Consequences of Not Carrying Out the Development

If this proposal does not proceed, the ballast materials required by ARTC for the construction of the Inland Rail Project would need to be sourced from other existing or new basalt quarries within the region. It is noted that there are few approved quarries within the district which are capable of providing materials to the Inland Rail Project.

If an alternate local resource cannot be accessed, ARTC would need to import material from outside of the local area. This would involve additional traffic on public roads, which would be avoided if the proposal were to proceed. The local area would also not benefit from investment and employment opportunities associated with the proposed Quarry development.

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8 Conclusion

This report has been prepared by SMK Consultants on behalf of Johnstone Concrete and Landscape Supplies Pty Ltd ("the Applicant") to assess the potential operations and potential impacts of a proposed extension to the annual extraction limit of the existing "Wave Hill" quarry. The development is located at 975 Wave Hill Road, Tarriaro, NSW 2390, more formally described as Lot 77 in Deposited Plan 754937 and Lot 89 in Deposited Plan 821255.

The development application seeks approval for the following aspects of development:

- Development Approval for Regional Development – Extractive Industry from the Joint Regional Planning Panel (JRPP) under the *State Environmental Planning Policy (State and Regional Development) 2011.*

This report demonstrates that the development proposal is consistent with relevant environmental planning instruments and meets the planning intent for the zoning of the *Narrabri Local Environmental Plan 2012*.

Additionally, as detailed within this report and the attached documentation, it is noted that the development application:

- is consistent with the relevant regulatory provisions;
- satisfies the relevant requirements of the State Environmental Planning Policies;
- is consistent with the provisions of the Regional Plan;
- adequately addresses and can appropriately manage potential off-site impacts associated with the quarry operation, including potential for noise emissions;

The land is well located in terms of a shortest haulage route to the proposed Inland Railway alignment from existing hard-rock quarries in the region. A suite of environmental mitigation measures has been presented to mitigate against potential impacts to surrounding natural or built environments. Adoption of these mitigation measures need to form part of management protocols and procedures to ensure that the quarry can operate within acceptable thresholds to avoid unacceptable disturbance of local amenity and the environment. Upon completion of the quarry, the site will be rehabilitated.

Overall, proposal is considered to meet current Extractive Industry Guidelines, statutory policy and best practice. In view of the above, the proposed development is capable of approval, subject to reasonable and relevant conditions of development.

If approval is granted, a separate application will be made to the NSW EPA for an Environment Protection Licence for "Carrying out scheduled activities – Extractive Activities

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– Land-based extractive activity" in accordance with the *Protection of the Environment Operations Act 1997*.

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Appendix 1: Site Plans

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Figure 1: Initial Site Layout plan approved for Wavehill Quarry

Figure 2: Proposed Development Layout

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Figure 3: Layout of Fixed Plant Equipment at Wave Hill Quarry

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Appendix 2: Secretary's Environmental Assessment Requirements

SMK
CONSULTANTS

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Planning Secretary's Environmental Assessment Requirements

Section 4.12(8) of the *Environmental Planning and Assessment Act 1979* and Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*

Designated Development

EAR Number	EAR 1237
Proposal	Expansion of a hard rock quarry to extract and process a maximum of 500,000 tonnes per annum over a 30 year period, from a total resource of up to 4 million tonnes.
Location	Wavehill Road Narrabri (Lot 89 DP 821255)
Applicant	Johnstone Concrete and Landscape Supplies Pty Ltd
Date of Issue	11 July 2018
Date of Expiry	11 July 2020
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • an executive summary; • 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; - identification of the resource, including the amount, type, composition; - the layout of the proposed works and components (including any existing infrastructure that would be used for the development); - a detailed description of proposed extraction methods; - 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; - a detailed rehabilitation plan for the site; - any likely interactions between the development and any existing/approved developments and land uses in the area, paying particular attention to potential land use conflicts with nearby residential development; - a list of any other approvals that must be obtained before the development may commence; - the permissibility of the development, including identification of the land use zoning of the site; - 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; - a summary of all proposed environmental management and monitoring measures for the development, including detailed procedures to ensure that extraction does not exceed 500,000 tonnes per year, or 4 million tonnes over the life of the development; • a conclusion justifying why the development should be approved, taking into consideration: – alternatives; – the suitability of the site; – the biophysical, economic and social impacts of the project, having regard to the principles of ecologically sustainable development; and – whether the project is consistent with the objects of the Environmental Planning and Assessment Act 1979; and • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading.
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. 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.

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: • **Noise** – including a quantitative assessment of potential: - construction and operational noise and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline, NSW Noise Policy for Industry and NSW Road Noise Policy* respectively; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures; • **Blasting & Vibration** – - proposed hours, frequency, methods and impacts; 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, buildings, livestock, infrastructure and significant natural features; • **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*. 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; • **Water** – including: - a detailed site water balance and an assessment of any volumetric water licensing requirements, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals required under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP) - 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; - an assessment of activities that could cause erosion or sedimentation issues, and the proposed measures to prevent or control these impacts; - an assessment of any likely flooding impacts of the development; - an assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; and - a detailed description of the proposed water management system, water monitoring program and other measures to mitigate surface and groundwater impacts; • **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, populations and ecological communities and groundwater dependent ecosystems undertaken in accordance with Sections 7.2 and 7.7 of the *Biodiversity Conservation Act 2016*; and - 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. • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including a surface survey undertaken by a qualified archaeologist and 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; 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 relevant policies and guidelines listed in Attachment 1; • **Traffic &Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - 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; - 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, including future options for legal access to Lot 88 DP821255; • **Land Resources**– including an assessment of: - invasive species; - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long-term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - 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*; • **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; • **Hazards** – including an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks and the transport, storage, handling and use of any hazardous or dangerous goods; • **Visual** – including an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, including with respect to any new landforms; • **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; • **Cumulative impacts** – an assessment of the likely cumulative impacts of the proposed development in combination with other established quarries in the locality, having particular regard to air quality, noise and blasting and traffic impacts; and • **Rehabilitation** – including: - a detailed description of the proposed rehabilitation measures that would be undertaken throughout the development and during quarry closure; - 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, recognising that a rehabilitation bond will likely be required as a condition of any future development consent.
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. During the preparation of the EIS you must also consult the Department's EIS Guideline – Extractive Industries – Quarries. This guideline is available at http://www.planning.nsw.gov.au/~/media/Files/DPE/Guidelines/extractive-industries-quarries-eis-guideline-1996-10.ashx. In addition, the EIS must assess the development against the *Narrabri LEP 2012* and any relevant development control plans/strategies.

ATTACHMENT 1

The following guidelines may assist in the preparation of the Environmental Impact Statement. This list is not exhaustive and not all of these guidelines may be relevant to your proposal.

Many of these documents can be found on the following websites:
http://www.planning.nsw.gov.au
http://www.bookshop.nsw.gov.au
http://www.publications.gov.au

Environmental Planning Instruments, Policies, Guidelines & Plans

Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	Narrabri Local Environmental Plan 2012
Risk Assessment	
	AS/NZS 4360:2004 Risk Management (Standards Australia)
	HB 203: 203:2006 Environmental Risk Management – Principles & Process (Standards Australia)
Land	
	State Environmental Planning Policy No. 55 – Remediation of Land
	Agricultural Land Classification (DPI)
	Rural Land Capability Mapping (OEH)
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
	Guidelines for Consultants Reporting on Contaminated Sites (EPA)
	Agricultural Issues for Extractive Industry Development (DPI)
Water	
Groundwater	NSW Aquifer Interference Policy 2012 (NOW)
	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW State Rivers and Estuary Policy (NOW)
	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (DECC)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities (NOW)
Flooding	Floodplain Development Manual (OEH)
	Floodplain Risk Management Guideline (OEH)
Biodiversity	
	Biodiversity Assessment Method (OEH 2017)

	Guidance and Criteria to assist a decision maker to determine a serious and irreversible impact (OEH 2017)
	Ancillary rules: Biodiversity conservation actions
	Ancillary rules: Reasonable steps to seek like-for-like biodiversity credits for the purpose of applying variation rules
	NSW Guide to Surveying Threatened Plants (OEH 2016)
	Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECC 2009)
	Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004)
	Threatened Species Assessment Guideline – The Assessment of Significance (DECC 2007)
	OEH principles for the use of biodiversity offsets in NSW
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Guide to investigation, assessing and reporting on Aboriginal cultural heritage in NSW (OEH) 2011
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
Noise & Blasting	
	NSW Noise Policy for Industry (EPA)
	Interim Construction Noise Guideline (EPA)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Air	
	Protection of the Environment Operations (Clean Air) Regulation 2002
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Assessment and Management of Odour from Stationary Sources in NSW (DEC)
	National Greenhouse Accounts Factors (Commonwealth)
Transport	
	Guide to Traffic Generating Development (RTA)
	Road Design Guide (RMS) & relevant Austroads Standards
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
	Planning for Bush Fire Protection 2006 (RFS)
	Guide for Bush Fire Prone Area Land Mapping (RFS)
Resource	
	Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves 2012 (JORC)
Waste	
	Waste Classification Guidelines (EPA)
	Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes 1999 (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)

ATTACHMENT 2

AGENCIES' CORRESPONDENCE

NARRABRI SHIRE COUNCIL ABN 95 717 801 656

46-48 Maitland Street
PO Box 261
NARRABRI NSW 2390

P: (02) 6799 6866 F: (02) 6799 6888
E: council@narrabri.nsw.gov.au
W: www.narrabri.nsw.gov.au

Narrabri SHIRE
Heart of the North West

Our Reference:	417479
Your Reference:	417479
Contact Name:	Cara Stoltenberg
Telephone:	(02) 6799 6855

26 June 2018

Jack Murphy
Environmental Assessment Officer
Resource Assessments
Planning Services
GPO Box 39
SYDNEY NSW 2001

Dear Mr Murphy,

Re: EAR 1237 – Wave Hill Quarry Proposed Expansion

Thank you for the opportunity to comment on the requirements for the preparation of an Environmental Impact Statement (EIS) for the proposed expansion of the Wave Hill Quarry located within the Narrabri Shire Local Government Area. Please find following the Council's comments:

1. **Environmental Planning and Assessment Act 1979**

   The proposed development is identified as integrated development for the purposes of section 4.46 of the *Environmental Planning and Assessment Act 1979* and requires an amended Environmental Protection Licence pursuant to the provisions of the *Protection of the Environment Operations Act 1997*. It is requested that the proponent include provisions for the appropriate approvals pathway for integrated development when completing the EIS.

   Council adopted a new Section 94 Contributions Plan entitled "Narrabri Shire Section 94 Contribution's Plan 2016" (the plan) at their meeting held on Tuesday 21 February 2017. A copy of the plan can be obtained by contacting Council. The plan is requested to be addressed with regards to the proposed expansion in the EIS documentation.

2. **Traffic Impacts**

   The proposed development will have a significant expansion in regards to the volume of material being extracted from the site. This will have a significant impact to the volume of traffic (in particular heavy vehicle numbers) on the surrounding public road network. The proponent is requested to undertake a detailed traffic study and provide a Traffic Impact Assessment report for the heavy vehicle route required to deliver quarry material to the Inland Rail development.

3. **Rehabilitation/Remediation Post Development**

   The development is proposed to have a life of thirty (30) years. It is considered that rehabilitation of the site should be addressed as part of the EIS to demonstrate the site can be made suitable for return to agricultural land use, including addressing any potential contamination that may have occurred throughout the operation of the development.

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4. **Impacts on Existing Residential Receptors**

The site is located less than 1500 metres away from another quarry operated by Boral. The proponent is requested to assess cumulative noise, air and blasting impacts at the receptor location positioned between these two sites in particular, as well as the other two (2) receptors identified.

It is requested that a Visual Impact Assessment be undertaken for the proposed expansion to determine the visual impacts for surrounding receptors (including residences, roads, other significant receptors).

5. **Bushfire**

The site is currently mapped as being bushfire prone, the expansion of the current operations have the potential to create a bushfire risk both through activities on site and change in land management practices, particularly in the area retained for ecological purposes. It should also be noted that the NSW Rural Fire Services' *Guideline for Council to Bushfire Prone Area Land Mapping* has introduced a new Category 3 into the Bush Fire Prone Land System. Category 3 includes grasslands. It is requested that the proponent liase with the New South Wales (NSW) Rural Fire Service (RFS) regarding any requirements they may deem appropriate when developing the EIS.

Council appreciates the opportunity to have input into the requirements for the EIS for the proposed quarry expansion, and requests a pre-development application meeting be held between Council and the proponent to further assist in the discussion of key points raised within this letter.

I trust this information is to your satisfaction. If you require any further clarification please do not hesitate to contact Mrs Cara Stoltenberg, Town Planner, of Council's Development and Economic Growth Department on (02) 67996855 or caras@narrabri.nsw.gov.au.

Yours faithfully,

Daniel Boyce
ACTING DIRECTOR DEVELOPMENT AND ECONOMIC GROWTH

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

With regard to the above application.
The proposed development relates to subject land Lot 89 DP821255 and Lot 77 DP75937, with Lot 89 being the most impacted parcel.

Lot 89 adjoins Crown Perpetual Lease 109315 by Kristian John Bogdanoff, with residence on site. The proposed works stop short about 100m from the lease boundary and about 300m from the residence. It is requested that the EIS addresses in detail the mitigation measures proposed in regards to dust/noise and vibration from blast/hammering for the residence. It is requested that direct consultation also be made with the leaseholder, Mr Kristian John Bogdanoff.

Lot 88 DP 821255 is enclosed within Lot 89 DP821255. Lot 88 is Crown Land, reserved R160042 for Government Purposes with legal access via easement registered on title of Lot 89 DP821255. The current footprint of the quarry site, as well as the proposed expansion will make the future use of this right of carriageway impossible. Future options for legal access to Lot 88 are required to be provided.

A registered trigonometrical site (TS6953) is located within Lot 88 DP 821255. Consultation with Office of the Registrar General is required to address any impacts that may occur to this site.

The above mentioned lease has also been identified for possible addition to Forestry NSW estate. It is therefore also requested that consultation also be undertaken with Forestry NSW.

If you require any further information in regards to this matter, please contact our office on 1300 886 235 or email tamworth.crownlands@crownland.nsw.gov.au

Kind regards
--
Leanne Dunstan | Senior Natural Resource Management Officer
NSW Department of Industry | Crown Lands and Water
Level 2 | Noel Park House | 155-157 Marius Street | TAMWORTH NSW 2340
P O Box 2185 | DANGAR NSW 2309
T: 1300 886 235 | F: 02 4925 3517
E: tamworth.crownlands@crownland.nsw.gov.au
W: www.industry.nsw.gov.au
Please Note: Our Office opening hours are 9.00am to 12.00pm Monday to Friday and outside of these hours by appointment only

Document Set ID: 1738646
Version: 1, Version Date: 04/06/2020

INT18/104926

26/06/2018

Jack Murphy
GPO Box 39
Sydney NSW 2001
jack.murphy@planning.nsw.gov.au

Dear Mr Murphy

SEAR's Request – "Wavehill; Quarry Extionson – Narrabri Shire

Thank you for the opportunity to provide Secretary Environmental Assessment Requirements (SEAR) for the above proposal as per your correspondence dated 14 June 2018.

The NSW Department of Primary Industries (NSW DPI) Agriculture is committed to the protection and growth of agricultural industries, and the land and resources upon which these industries depend. Important issues for extractive industries are the potential impact on limited agricultural resources and the ability to rehabilitate the land to enable agricultural pursuits post extraction if directed.

NSW DPI Agriculture provides issues to be covered in the SEARs (Attachment 1) and a range of publications to assist consent authorities, community and proponents in addressing the recommended SEARs (Attachment 2).

Should you require clarification on any of the information contained in this response, please contact Resource management Officer Andrew Scott on (02) 6763 1142.

Yours sincerely

Lilian Parker
Manager Agricultural Land Use Planning

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Version: 1, Version Date: 04/06/2020

Attachment 1: SEARs Recommendations

Issue and desired outcome	Detail / Requirement
Site Suitable for development	• Include a map to scale showing the above operational and infrastructure details including separation distances from sensitive receptors.
Consideration for impacts to agricultural resources and land	• Describe the current and potential *Important Agriculture Land* on the proposed development site and surrounding locality including the land capability and agricultural productivity. • Demonstrate that all significant impacts on current and potential agricultural developments and resources can be reasonably avoided or adequately mitigated. • Consider possible cumulative effects to agricultural enterprises and landholders. • Detail the expected life span of the proposed development
Suitable and secure water supply	• Estimated water demand and water availability should be clearly outlined in the proposal. • Outline any impacts to water use for agriculture and mitigation measures if required.
Biosecurity Standards met	• Include a weed risk assessment outlining the likely plant risks. • Develop a weed response plan to deal with identified risks as well as contingency plans for any failures. Including monitoring and mitigation measures (particularly for any soil stockpiles to be used for future rehabilitation) and adjacent roadsides (to avoid spreading weeds off site). • Develop a Pest animal management strategy for possible problem species with emphasis on coordinated group control with neighbours.
Visual amenity achieved	• Amenity impacts are assessed and any necessary response to mitigate visual impacts is described and illustrated.
Land stewardship met	• Develop Rehabilitation and Decommissioning/Closure Plans that describes the design criteria of the final land use and landform along with the expected timeline for the rehabilitation program. • Outline monitoring and mitigation measures to be adopted for rehabilitation remedial actions.
Adequate Consultation with surrounding rural community to prevent future land use conflict	• Consult with the owners / managers of affected and adjoining neighbours and agricultural operations in a timely and appropriate manner about; the proposal, the likely impacts and suitable mitigation measures. • Consultation program needs to consider and avoid key periods for Agricultural activities such as Harvest, Sowing, Sales and Holiday periods. • Establish a complaints register that includes reporting and investigating procedures and timelines, and liaison with Council in relation to complaint issues.

Attachment 2: Guidelines to assist development of plans and their assessment

Title	Location
Land Use Conflict Risk Assessment Guide	www.dpi.nsw.gov.au/content/agriculture/resources/lup/development-assessment/lucra
Agricultural Issues for Extractive industry Development	http://www.dpi.nsw.gov.au/content/agriculture/resources/lup/development-assessment/extractive-industries

Mr Jack Murphy
Resource Assessments
Dept of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Email: jack.murphy@planning.nsw.gov.au

Notice Number	1566352
Date	28-Jun-2018

Dear Mr Murphy

RE: REQUEST FOR REQUIREMENTS - EAR 1237 - PROPOSED EXPANSION OF WAVEHILL QUARRY - JOHNSTON CONCRETE AND LANDSCAPE SUPPLIES

I refer to your request for the Environment Protection Authority's ("**EPA**") requirements for the environmental assessment ("**EA**") in regard to the above proposal received by EPA on 20 June 2018.

The EPA has considered the details of the proposal as provided by Department of Planning and Environment and has identified the information it requires to consider its general terms of approval in **Attachment A**. In summary, the EPA's key information requirements for the proposal include an adequate assessment of:

1. Noise - Proximity to sensitive receptors and impact of any sources associated with the project.

2. Air - Dust generation and management of potential impacts on adjacent rural residences during the construction and operational phases.

3. Water - Water management systems and the implementation of adequate erosion and sediment controls to control runoff from the quarry.

In carrying out the assessment, the proponent should refer to the relevant guidelines as listed in **Attachment B** and any relevant industry codes of practice and best practice management guidelines.

Based on the information provided to the EPA, the applicant will require a variation to its environment protection licence to increase the annual production tonnage, should approval be gramted.

The applicant will need to make a separate application to the EPA for this licence variation. General information on licence requirements can be obtained from Environment Line on 131555 or on the EPA website at http://www.epa.nsw.gov.au/licensing/licencePOEO.htm

To assist the EPA in assessing the Environmental Impact Statement ("**EIS**") it is requested that the EIS follow the format of the Department of Planning EIS guidelines and addresses the EPA's specific EIS requirements outlined in the attachments.

If the necessary information is not adequately provided in the EIS then delays in the development application process may occur.

Please note that this response does not cover biodiversity or Aboriginal cultural heritage issues, which are the responsibility of the Office of Environment and Heritage.

The Proponent should be made aware that any commitments made in the EA may be formalised as approval conditions and may also be placed as formal licence conditions.

The Proponent should be made aware that, consistent with provisions under Part 9.4 of the *Protection of the Environment Operations Act 1997* ("**the Act**") the EPA may require the provision of a financial assurance and/or assurances. The amount and form of the assurance(s) would be determined by the EPA and required as a condition of an Environment Protection Licence ("**EPL**").

In addition, as a requirement of EPL 20139, the Proponent must prepare, test and implement a Pollution Incident Response Management Plan and/or Plans in accordance with Section 153A of the Act. This document may need to be updated, should approval be granted.

The EPA requests that the applicant provide one (1) electronic copy of the EA when lodging its application with the EPA. These documents should be sent to the EPA's Armidale office by email to: armidale@epa.nsw.gov.au.

If you have any queries regarding this matter please contact Simon Lund on (02) 6773 7000.

Yours sincerely

.....

Rebecca Scrivener

Acting Head Regional Operations Unit

North - Armidale

(by Delegation)

ATTACHMENT A: Environmental Assessment Requirements for "Wavehill" Quarry Extension

1 Environmental impacts of the project

1.1. Impacts related to the following environmental issues need to be assessed, quantified and reported on:

- Air Issues
  - air quality including dust generation
- Noise and vibration
- Waste including hazardous materials and radiation
  - General waste – disposal options
  - Hazardous materials and radiation
- Water and Soils
  - Sediment and Erosion controls

The Environmental Impact Statement ("**EIS**") should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant guidelines mentioned. A full list of guidelines is at **Attachment B**.

2 Licensing requirements

2.1. The development is a scheduled activity under the *Protection of the Environment Operations Act 1997* (POEO Act) and will therefore require an Environment Protection Licence (EPL) if approval is granted. The EIS should address the requirements of Section 45 of the POEO Act determining the extent of each impact and providing sufficient information to enable the EPA to determine appropriate limits for the EPL.

2.2. Should project approval be granted, the proponent will need to make an application to the EPA for its EPL for the proposed facility prior to undertaking any on site works. Additional information is available through the *EPA Guide to Licensing* document (www.epa.nsw.gov.au/licensing/licenceguide.htm).

SPECIFIC ISSUES

3 Air issues

3.1. The EIS must include an air quality impact assessment (AQIA), prepared in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA, 2016) .

The AQIA should:

3.2. Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human heath and amenity.

3.3. Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:
- proposal location;
- characteristics of the receiving environment; and

- type and quantity of pollutants emitted.

3.4. Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to:
- meteorology and climate;
- topography;
- surrounding land-use; receptors; and
- ambient air quality.

3.5. Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided.

3.6. Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.

3.7. Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.

3.8. Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2005) http://www.epa.nsw.gov.au/resources/air/ammodelling05361.pdf.

3.9. Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations (POEO) Act (1997)* and the *POEO (Clean Air) Regulation (2002)*. Particular consideration should be given to section 129 of the POEO Act concerning control of "offensive odour".

3.10. Detail emission control techniques/practices that will be employed by the proposal.

4 Noise and Vibration

In relation to noise, the following matters should be addressed as part of the Environmental Assessment.

General

4.1. Construction noise associated with the proposed development should be assessed using the *Interim Construction Noise Guideline (*DECC, 2009). http://www.epa.nsw.gov.au/noise/constructnoise.htm

4.2. Vibration from all activities (including construction and operation) to be undertaken on the premises should be assessed using the guidelines contained in the *Assessing Vibration: a technical guideline* (DEC, 2006). http://www.epa.nsw.gov.au/noise/vibrationguide.htm

4.3. If blasting is required for any reasons during the construction or operational stage of the proposed development, blast impacts should be demonstrated to be capable of complying with the guidelines contained in *Australian and New Zealand Environment Council – Technical basis for guidelines to*

minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990). http://www.epa.nsw.gov.au/noise/blasting.htm

Industry

4.4. Operational noise from all industrial activities (including private haul roads and private railway lines) to be undertaken on the premises should be assessed using the guidelines contained in the *NSW Noise Policy for Industry* (EPA, 2017) and *Industrial Noise Policy Application Notes.* http://www.epa.nsw.gov.au/noise/industrial.htm

Road

4.5. Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the *Environmental Criteria for Road Traffic Noise* (EPA, 1999). http://www.epa.nsw.gov.au/noise/traffic.htm

5 Waste, chemicals and hazardous materials and radiation

5.1. Identify, characterise and classify all waste that will be generated onsite through excavation, demolition or construction activities, including proposed quantities of the waste.
Note: All waste must be classified in accordance with the *EPA's Waste Classification Guidelines* available at: http://www.epa.nsw.gov.au/wasteregulation/classify-waste.htm

5.2. Identify, characterise and classify all waste that is proposed to be disposed of to an offsite location, including proposed quantities of the waste and the disposal locations for the waste. This includes waste that is intended for re-use or recycling.
Note: All waste must be classified in accordance with the *EPA's Classification Guidelines* available at: http://www.epa.nsw.gov.au/wasteregulation/classify-waste.htm.

5.3. Include a commitment to retaining all sampling and classification results for the life of the project to demonstrate compliance with *EPA's Waste Classification Guidelines* available at: http://www.epa.nsw.gov.au/wasteregulation/classify-waste.htm.

5.4.Provide details of how waste will be handled and managed onsite to minimise pollution, including:

a) Stockpile location and management
- Labelling of stockpiles for identification, ensuring that all waste is clearly identified and stockpiled separately from other types of material (especially the separation of any contaminated and non-contaminated waste).
- Proposed height limits for all waste to reduce the potential for dust and odour.
- Procedures for minimising the movement of waste around the site and double handling.
- Measures to minimise leaching from stockpiles into the surrounding environment, such as sediment fencing, geofabric liners etc.

5.6. Provide details of how the waste will be handled and managed during transport to a lawful facility. If the waste possesses hazardous characteristics, the Proponent must provide details of how the waste will be treated or immobilised to render it suitable for transport and disposal.

5.7. Include details of all procedures and protocols to be implemented to ensure that any waste leaving the site is transported and disposed of lawfully and does not pose a risk to human health or the environment.

5.8. Include a statement demonstrating that the Proponent is aware of the EPA's requirements with respect to notification and tracking of waste.

5.9. Include a statement demonstrating that the Proponent is aware of the relevant legislative requirements for disposal of the waste, including any relevant Resource Recovery Exemptions, as gazetted by the EPA from time to time.

5.10. Outline contingency plans for any event that affects operations at the site that may result in environmental harm, including: excessive stockpiling of waste, volume of leachate generated exceeds the storage capacity available on-site etc.

6 Water and soils

6.1 Soils

The EA should include:

6.1.1. An assessment of potential impacts on soil and land resources should be undertaken, being guided by *Soil and Landscape Issues in Environmental Impact Assessment* (DLWC 2000). The nature and extent of any significant impacts should be identified. Particular attention should be given to:

a. Soil erosion and sediment transport - in accordance with *Managing urban stormwater: soils and construction,* vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008).

b. Mass movement (landslides) – in accordance with *Landslide risk management* guidelines presented in Australian Geomechanics Society (2007).

c. Urban and regional salinity – guidance given in the Local Government Salinity Initiative booklets which includes *Site Investigations for Urban Salinity* (DLWC, 2002).

6.1.2. A description of the mitigation and management options that will be used to prevent, control, abate or minimise identified soil and land resource impacts associated with the project. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented. Where required, add any specific assessment requirements relevant to the project.

6.2 Water

No proposal should breach clause 120 of the *Protection of the Environment Operations Act 1997* (i.e. pollution of waters is prohibited unless undertaken in accordance with relevant regulations).

Describe Proposal

6.2.1. Describe the proposal including position of any intakes and discharges, volumes, water quality and frequency of all water discharges.

6.2.2. Demonstrate that all practical options to avoid discharge have been implemented and environmental impact minimised where discharge is necessary.

6.2.3. Where relevant include a water balance for the development including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.

6.2.4. Provide details of Erosion, sediment and leachate control including measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site during works. The EIS should show the location of each measure to be implemented. The Proponent should consider measures such as:

- Sediment traps
- Diversion banks
- Sediment fences
- Bunds (earth, hay, mulch)
- Geofabric liners
- Other control measures as appropriate

5.5. The Proponent should also provide details of:

- how leachate from stockpiled waste material will be kept separate from stormwater runoff;
- treatment of leachate through a wastewater treatment plant (if applicable); and
- any proposed transport and disposal of leachate off-site.

Background Conditions

6.3.1. Describe existing surface and groundwater quality. An assessment needs to be undertaken for any water resource likely to be affected by the proposal.

Impact Assessment

6.4.1. Describe how stormwater will be managed both during and after construction.

6.4.2. Discharges from the site must be characterised with respect to their location, frequency, volume and likely water quality.

6.4.3. Outline sediment and erosion control measures directed at minimising disturbance of land, minimising water flow through the site and filtering, trapping or detaining sediment. Also include measures to maintain and monitor controls as well as rehabilitation strategies.

6.4.4. Provide details of how stormwater and runoff will be managed to minimise pollution, including measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site during construction and operation phases of the project. The EA should show the location of each measure to be implemented. The proponent should consider the guidelines *Managing urban stormwater: soils and construction,* vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC2008) as well as control measures such as:

- Sediment traps
- Diversion banks
- Sediment fences
- Bunds (earth, hay, mulch)
- Geofabric liners
- Other control measures as appropriate.

6.4.1. Describe the nature and degree of impact that any proposed discharges will have on the receiving environment.

Depending on the nature, scale and/or risk of the proposal, this could include specific requirements to consider impacts on, for example:

- water circulation, current patterns, water chemistry and other appropriate characteristics such as clarity, temperature, nutrient and toxicants
- changes to hydrology (including drainage patterns, surface runoff yield, flow regimes, and groundwater)
- disturbance of acid sulphate soils and potential acid sulphate soils
- stream bank stability and impacts on macro invertebrates

Depending on the nature, scale and/or risk of the proposal, modelling, monitoring, or both, may need to be undertaken to assess the potential impact of discharges on the receiving environment. If modelling is required to assess the potential impact of any discharge(s), this could include, for example:

- a range of scenarios that encompass any variations in discharge quality and quantity as well as the relevant range of environmental conditions of the receiving waters. The scenarios could describe a set of worst-case conditions and typical conditions to ensure that both acute and chronic impacts are assessed,
- assumptions used in the modelling, including identification and discussion of the limitations and assumptions to ensure full consideration of all factors, including uncertainty in predictions.

6.4.2. Assess impacts against the relevant ambient water quality outcomes.

Demonstrate how the proposal will be designed and operated to:

- protect the Water Quality Objectives for receiving waters where they are currently being achieved; and
- contribute towards achievement of the Water Quality Objectives over time where they are not currently being achieved.

6.4.3. Where a discharge is proposed that includes a mixing zone, the proposal should demonstrate how wastewater discharged to waterways will ensure the ANZECC (2000) water quality criteria for relevant chemical and non-chemical parameters are met at the edge of the initial mixing zone of the discharge, and that any impacts in the initial mixing zone are demonstrated to be reversible.

6.4.4. Assess impacts on groundwater and groundwater dependent ecosystems.

Monitoring

6.5.1. Describe how predicted impacts will be monitored and assessed over time.

For relatively large and/or high risk developments, proponents should develop a water quality and aquatic ecosystem monitoring program to monitor the responses for each component or process that affects the Water Quality Objectives that includes, for example:

- adequate data for evaluating compliance with water quality standards and/or Water Quality Objectives,
- measurement of pollutants identified or expected to be present in any discharge.

Water quality monitoring should be undertaken in accordance with the *Approved Methods for the Sampling and Analysis of Water Pollutant in NSW* (2004) (http://www.epa.nsw.gov.au/resources/legislation/approvedmethods-water.pdf).

Attachment B – Guidance Material

Title	Web Address
Contaminated Land Management Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+140+1997+cd+0+N
Environmentally Hazardous Chemicals Act 1985	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+14+1985+cd+0+N
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Licensing	
EPA Guide to Licensing	www.epa.nsw.gov.au/licensing/licenceguide.htm
Air Issues	
Approved methods for modelling and assessment of air pollutants in NSW (2005)	http://www.epa.nsw.gov.au/resources/air/ammodelling05361.pdf
POEO (Clean Air) Regulation 2010	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N
Noise and Vibration	
Interim Construction Noise Guideline (DECC, 2009)	http://www.epa.nsw.gov.au/noise/constructnoise.htm
Assessing Vibration: a technical guideline (DEC, 2006)	http://www.epa.nsw.gov.au/noise/vibrationguide.htm
Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990)	http://www.epa.nsw.gov.au/noise/blasting.htm
Industrial Noise Policy (EPA)	http://www.epa.nsw.gov.au/noise/industrial.htm
Industrial Noise Policy Application Notes	http://www.epa.nsw.gov.au/noise/applicnotesindustnoise.htm
Environmental Criteria for Road Traffic Noise (EPA, 1999)	http://www.epa.nsw.gov.au/noise/traffic.htm
Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (DECC, 2007)	http://www.epa.nsw.gov.au/noise/railinfranoise.htm
Environmental assessment requirements for rail traffic-generating	http://www.epa.nsw.gov.au/noise/railnoise.htm

developments	
Waste, Chemicals and Hazardous Materials and Radiation	
Waste	
Environmental Guidelines: Solid Waste Landfills (EPA, 1996)	http://www.epa.nsw.gov.au/resources/waste/envguidlns/solidlandfill.pdf
Draft Environmental Guidelines - Industrial Waste Landfilling (April 1998)	http://www.epa.nsw.gov.au/resources/waste/envguidlns/industrialfill.pdf
Waste Classification Guidelines (DECC, 2008)	http://www.epa.nsw.gov.au/waste/envguidlns/index.htm
EPA Resource recovery exemption	http://www.epa.nsw.gov.au/waste/RRecoveryExemptions.htm
Chemicals subject to Chemical Control Orders	
Chemical Control Orders (regulated through the EHC Act)	http://www.epa.nsw.gov.au/pesticides/CCOs.htm
National Protocol - Approval/Licensing of Trials of Technologies for the Treatment/Disposal of Schedule X Wastes - July 1994	Available in libraries
National Protocol for Approval/Licensing of Commercial Scale Facilities for the Treatment/Disposal of Schedule X Wastes - July 1994	Available in libraries
Water and Soils	
Acid sulphate soils	
Coastal acid sulfate soils guidance material	http://www.environment.nsw.gov.au/acidsulfatesoil/
Acid Sulfate Soils Planning Maps	http://www.environment.nsw.gov.au/acidsulfatesoil/riskmaps.htm
Contaminated Sites Assessment and Remediation	
Managing land contamination: Planning Guidelines – SEPP 55 Remediation of Land	http://www.planning.nsw.gov.au/assessingdev/pdf/gu_contam.pdf
Guidelines for Consultants Reporting on Contaminated Sites (EPA, 2000)	http://www.epa.nsw.gov.au/resources/clm/20110650consultantsglines.pdf
Guidelines for the NSW Site Auditor Scheme - 2nd edition (DEC, 2006)	http://www.epa.nsw.gov.au/resources/clm/auditorglines06121.pdf
Sampling Design Guidelines (EPA, 1995)	Available by request from EPA's Environment Line
National Environment Protection (Assessment of Site Contamination) Measure 1999 (or update)	http://www.scew.gov.au/nepms/assessment-site-contamination

Soils – general	
Managing land and soil	http://www.environment.nsw.gov.au/soils/landandsoil.htm
Managing urban stormwater for the protection of soils	http://www.environment.nsw.gov.au/stormwater/publications.htm
Landslide risk management guidelines	http://www.australiangeomechanics.org/resources/downloads/
Site Investigations for Urban Salinity (DLWC, 2002)	http://www.environment.nsw.gov.au/resources/salinity/booklet3siteinvestigationsforurbansalinity.pdf
Local Government Salinity Initiative Booklets	http://www.environment.nsw.gov.au/salinity/solutions/urban.htm
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	http://environment.gov.au/water/policy-programs/nwqms/index.html
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	Contact the EPA on 131555
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

Planning & Environment
Resources & Geoscience

22nd June 2018

Jack Murphy
Environmental Assessment Officer
Resource Assessments | Planning Services
Department of Planning & Environment
GPO Box 39
Sydney NSW 2001

Emailed: jack.murphy@planning.nsw.gov.au

Your Reference: SEARs 1237
Our Reference: DOC18/408466

Dear Mr Murphy,

Re: Request for Secretary's Environmental Assessment Requirements - Wavehill Quarry located at 975 Wavehill Road, Tarriaro - Narrabri LGA- (SEARs 1237)

Thank you for the opportunity to provide advice on the subject proposal. This is a response from NSW Department of Planning & Environment – Division of Resources & Geoscience, Geological Survey of New South Wales (GSNSW).

The building and construction industries in NSW require the ongoing replacement of supplies as current sources are exhausted. The continued sustainable development of existing and new quarries will facilitate the ongoing supply of construction materials to support affordable housing and infrastructure development for the growth of NSW. The resource in the subject area represents an important source of hard rock aggregate for the Narrabri area.

It is in the best interests of both the proponent and the community to fully assess the resources which are to be extracted. This means that a thorough geological assessment should be undertaken to determine the nature, quality and extent of the resource. Failure to undertake such an assessment could lead to operational problems and possibly even failure of the proposal.

Hard rock aggregate (basalt) is not a prescribed mineral under the *Mining Act 1992*. Therefore, the Division has no statutory role in authorising or regulating the extraction of this commodity, apart from its role under the *Work Health and Safety Act 2011* and associated regulations and the *Work Health and Safety (Mine and Petroleum Sites) Act 2013* and associated regulations, for ensuring the safe operation of mines and quarries. However, the Division is the principal government authority responsible for assessing the State's resources of construction materials and for advising State and local government on their planning and management.

NSW Department of Planning and Environment
DIVISION of RESOURCES & GEOSCIENCE
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E: landuse.minerals@geoscience.nsw.gov.au
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All environmental reports (EIS or similar) accompanying Development Applications for extractive industry lodged under the *Environmental Planning & Assessment Act 1979* 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.**

The above information should be summarised in the EIS, with full documentation appended. If deemed commercial-in-confidence, the resource assessment summary included in the EIS should commit to providing DRG with full resource assessment documentation separately. 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.

DRG collects data on the quantity of construction materials produced annually throughout the State. Forms are sent to all operating quarries at the end of each financial year for this purpose. The statistical data collected is of great value to Government and industry in planning and resource management, particularly as a basis for analysing trends in production and for estimating future demand for particular commodities or in particular regions. Production data may be published in aggregated form, however production data for individual operations is kept strictly confidential.

In order to assist in the collection of construction material production data, the proponent should be required to provide annual production data for the subject site to the NSW Division of Resources and Geoscience as a condition of any new or amended development consent.

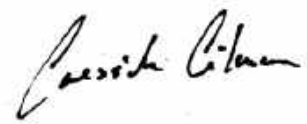
DRG request to be consulted in relation to the proposed location of any biodiversity offset areas (both on and off site) or any supplementary biodiversity measures to ensure there are no consequent reduction in access to prospective land for mineral exploration, or potential for sterilisation of mineral or extractive resources.

During the preparation of the EIS, DRE recommends that the proponent consult NSW Department of Planning & Environment's *'EIS Guideline - Extractive Industries – Quarries'*. This guideline is available from:

http://www.planning.nsw.gov.au/Assess-and-Regulate/Development-Assessment/~/media/4A89C0947A8C4D70A983F8EE1D7B9790.ashx

Queries regarding the above information, and future requests for advice in relation to this matter, should be directed to the Division of Resources & Geoscience - Land Use team at landuse.minerals@geoscience.nsw.gov.au.

Yours sincerely



Cressida Gilmore
Manager - Land Use

Encl. Attachments "A"

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ATTACHMENT A

NSW Department of Planning & Environment
RESOURCES & GEOSCIENCE DIVISION

ENVIRONMENTAL and WORK HEALTH & SAFETY ASSESSMENT REQUIREMENTS FOR CONSTRUCTION MATERIAL QUARRY PROPOSALS

It is in the best interests of both the proponent and the community to fully assess the resources which are to be extracted. This means that a thorough geological assessment should be undertaken to determine the nature, quality and extent of the resource. Failure to undertake such an assessment could lead to operational problems and possibly even failure of the proposal.

The following issues need to be addressed when preparing an environmental assessment (EA) or environmental impact statement (EIS) for a proposed construction materials (extractive materials) quarry:

Resource Assessment

1. A summary of the regional and local geology including information on the stratigraphic unit or units within which the resource is located.

2. 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). 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.

3. Characteristics of the material or materials to be produced:
   a) For structural clay/shale extraction proposals, ceramic properties such as plasticity, drying characteristics (e.g. dry green strength, linear drying shrinkage), and firing characteristics (e.g. shrinkage, water absorption, fired colour) should be described.
   b) For sand extraction proposals, properties such as composition, grainsize, grading, clay content and contaminants should be indicated. The inclusion of indicative grading curves for all anticipated products as well as the overall deposit is recommended.
   c) 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.
   d) For other proposals, properties relevant to the range of intended uses for the particular material should be indicated.

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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.

4. An assessment of the quality of the material and its suitability for the anticipated range of applications should be given.

5. 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.

6. If the proposal is an extension to an existing operation, details of history and past production should be provided.

7. 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.

8. Justification for the proposal in terms of the local and, if appropriate, the regional context.

9. Information on the location and size of markets to be supplied from the site.

10. Route(s) used to transport quarry products to market.

11. Disposal of waste products and the location and size of stockpiles.

12. Assessment of noise, vibration, dust and visual impacts, and proposed measures to minimise these impacts.

13. Proposed rehabilitation procedures during, and after completion of, extraction operations, and proposed final use of site.

14. Assessment of the ecological sustainability of the proposal.

Health and Safety Issues

In relation to the health and safety of mining and quarrying operations, the following must be addressed:

1. All mining operations are to comply with the following legislation:
    a. *Work Health and Safety Act 2011*
    b. *Work Health and Safety Regulation 2017*
    c. *Work Health and Safety (Mine and Petroleum Sites) Act 2013*
    d. *Work Health and Safety (Mine and Petroleum Sites) Regulation 2014*
    e. *Explosives Act 2003*
    f. *Explosives Regulation 2013*.

2. The mine holder must appoint a mine operator and notify the Department in writing as required by clause 7 of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* before commencing any mining operations.

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3. Other duties and notification and reporting requirements exist under the WHS laws and duty holders must ensure they understand and comply with these requirements.

Mineral Ownership

The *Mining Act 1992* applies to those commodities prescribed by the regulations of the Act (Schedule 2, *Mining Regulation 2016*). Most construction materials are not prescribed minerals under the *Mining Act 1992*. In general terms, this means these materials are owned by the Crown where they occur on Crown land and by the landowner in the case of freehold land. A Mining Title is not required for their extraction although a Crown Lands licence is required where they occur on Crown land.

Construction materials such as s*and (other than marine aggregate), loam, river gravel, and coarse aggregate materials such as basalt, sandstone, and granite* are not prescribed minerals under the *Mining Act 1992*. Therefore, the Division of Resources & Geoscience has no statutory responsibility for authorising or regulating the extraction of these commodities, apart from its role under the WHS laws with respect to the safe operation of mines and quarries. However, the Division is the principal government authority responsible for assessing the State's resources of construction materials and for advising State and local government on their planning and management.

Some commodities, notably *structural clay (ie clay for brick, tile and pipe manufacture), dimension stone (except for sandstone), quartzite, kaolin, limestone and marine aggregate* are prescribed minerals under the *Mining Act 1992*. Minerals which are prescribed as minerals under the terms of the Mining Act may, in some cases belong either to the Crown or to an individual, depending on a number of factors including the date on which the mineral was proclaimed and the date of alienation of the land.

The proponent needs to determine whether the material is privately owned or Crown mineral (publicly owned). If it is privately owned, then either a mining lease or mining (mineral owner) lease would be required. If it is a Crown mineral, an application for a mining lease will have to be lodged.

If you are unsure whether a mining title is required for your proposal you should contact NSW Department of Planning & Environment, Resources & Geoscience Division.

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DOC18/410800-2

Mr Jack Murphy
Environmental Assessment Officer
Resource Assessments
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001
jack.murphy@planning.nsw.gov.au

Dear Mr Murphy

Wavehill Quarry – EAR 1237

I refer to your email dated 14 June 2018 seeking input into the Department of Planning and Environment Environmental Assessment Requirements (EARs) for the preparation of an Environmental Impact Assessment (EIS) for Blayney Rock Quarry – EAR 1235.

OEH has considered your request and provides EARs for the proposed development in **Attachments A** and **B**.

OEH recommends the EIS needs to appropriately address the following:

1. Biodiversity and offsetting
2. Aboriginal cultural heritage
3. Historic heritage
4. Water and soils
5. Flooding

Please note that for projects **not** defined as pending or interim planning applications under Part 7 of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* the Biodiversity Assessment Method (BAM) **must** be used to assess impacts to biodiversity in accordance with the *Biodiversity Conservation Act 2016* (BC Act). For this project the BAM **must** be used.

If you have any questions regarding this matter further please contact Ellie Dean on 02 6883 5358 or email ellie.dean@environment.nsw.gov.au .

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Yours sincerely

SAMANTHA WYNN
Senior Team Leader Planning - North West
Regional Operations Division

21 June 2018

Contact officer: ELLIE DEAN
02 6883 5358

Attachment A - Environmental Assessment Requirements

Attachment B - Guidance Material

ATTACHMENT A

OEH's Recommended Environmental Assessment Requirements (EARs) for Wavehill Quarry

1. The Proposal

All components of the proposed development must be clearly described, including:

- the location of the proposed development and its context in the locality
- The rationale for the project.
- the size, scale and type of the proposed development
- the pre-construction, construction, operational, and, where relevant, decommissioning phases of the proposed development, and the methods proposed to implement these phases,
- plans and maps of the proposed development showing the locations of relevant phases and infrastructure
- the staging and timing of the proposed development
- the proposed development's relationship to any other proposals and developments

2. Environmental Impacts of the Proposal

The proponent must consider, assess, quantify and report on the likely environmental impacts of the proposal if applicable, particularly:

- Aboriginal cultural heritage
- Biodiversity
- OEH estate: land reserved or acquired under the *National Parks and Wildlife Act 1974*
- Flooding, floodplain issues and coastal erosion
- Historic heritage.
- Cumulative impacts

The Secretary's Environmental Assessment Requirements should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant guidelines mentioned. A full list of guidelines and reference material is presented in **Attachment 2**. Appropriate justification should be provided in instances where the matters below are not addressed.

3. Aboriginal Cultural Heritage

- The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the proposal. This may include the need for surface survey and test excavation. The identification of cultural heritage values must be conducted in accordance with the Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW (OEH 2010), and be guided by the *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (DECCW, 2011) and consultation with OEH regional branch officers.

- Where Aboriginal cultural heritage values or potential values are present, these are to be assessed and documented in an Aboriginal Cultural Heritage Assessment Report (ACHAR). An assessment under the Due Diligence process is not an Aboriginal Cultural Heritage Assessment Report. The ACHAR must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the ACHAR must

outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.

- Consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW) where an ACHAR is required. The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the ACHAR.

  Note: Consultation is not only required for an AHIP will be required, but also when test excavations are carried out under the Code of Practice. These may not always require an AHIP but will trigger the need for an ACHAR.

- Where harm to an Aboriginal object or declared Aboriginal place cannot be avoided, an Aboriginal Heritage Impact Permit (AHIP) will be required from OEH under the *National Parks and Wildlife Act 1974*. You must apply to OEH for an AHIP prior to commencing works that will directly or indirectly harm an Aboriginal object or a declared Aboriginal place.

  Note: Designated development where an AHIP is required should also be considered as an integrated development application (IDA). In these circumstances, OEH will issue General Terms of Approval (GTAs) to the consent authority to be included in conditions of development consent. OEH GTAs will address Aboriginal cultural heritage matters required to be addressed as part of an AHIP application. The matters outlined in the GTAs will be required to be assessed as part of an AHIP after development consent has been granted. OEH requires a valid development consent to accompany an AHIP application.

- The ACHAR must outline procedures to be followed if Aboriginal objects are found at any stage of the life of the development to formulate appropriate measures to manage unforeseen impacts.

- The ACHAR must outline procedures to be followed in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate protocols to manage the impacts to this material in accordance with the Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW (OEH 2010)

Project specific requirements

- If you do not know whether a proposal may harm Aboriginal objects or declared Aboriginal places, it may be appropriate to apply the due diligence procedure as prescribed under the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (OEH 2011). The due diligence must indicate whether further assessment under an Aboriginal Cultural Heritage Report (ACHAR) is required. An assessment under the Due Diligence process is not an ACHAR.

- The assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of surface surveys and test excavations are to be documented in the ACHAR.

4. Biodiversity

Biodiversity Assessment Methodology for the Biodiversity Offsets Scheme (BOS)

The EIS should include an assessment of the following:

a. The EIS must assess the impact of the proposed development on biodiversity values to determine if the proposed development is "likely to significantly affect threatened species" for the purposes of Section 7.2 of the Biodiversity Conservation Act 2016 (BC Act), as follows:

   a. The EIS must demonstrate and document how the proposed development exceeds, or does not exceed, the biodiversity offsets scheme threshold as set out in Section 7.4 of the BC Act 2016 and Clause 7.1 of the Biodiversity Conservation Regulation 2017 (BC Regulation) by determining whether the proposed development involves:

      i. **The clearing of native vegetation exceeds the thresholds** listed under Clause 7.23 of the BC Regulation, **or**

      ii. The clearing of native vegetation, or other action, **on land included on the Biodiversity Values Map** published under Clause 7.23 of the BC Regulation (this map includes areas of outstanding biodiversity value, as declared under Section 3.1 of the BC Act).

   b. If the proposal does not trigger any of the criteria in (a) above, then the EIS must determine whether the proposed development is likely to have a significant impact based on '*the test for determining whether proposed development likely to significant affect threatened species or ecological communities'* in Section 7.3 of the BC Act.

   c. Where there is reasonable doubt regarding potential impacts, or where information is not available, then a significant impact upon biodiversity should be considered likely when applying the test in Section 7.3 of the BC Act. Where it is concluded that there is no significant impact, the EIS must justify how the conclusion has been reached.

   d. If the development exceeds the thresholds in (a) or (b), then the EIS must be accompanied by a biodiversity development assessment report (BDAR) prepared in accordance with Part 6 of the BC Act. That is, the Biodiversity Assessment Methodology applies.

Required Information

Where development is considered "likely to significantly impact on threatened species" and a Biodiversity Development Assessment Report is required, the following requirements apply:

- Biodiversity impacts related to the proposal are to be assessed in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the *Biodiversity Conservation Act 2016* (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method.
- The BDAR must document the application of the avoid, minimise and offset hierarchy including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.
- The BDAR must include details of the measures proposed to address the offset obligation as follows:
  - The total number and classes of biodiversity credits required to be retired for the proposal.
  - The number and classes of like-for-like biodiversity credits proposed to be retired.
  - The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules.
  - Any proposal to fund a biodiversity conservation action.
  - Any proposal to make a payment to the Biodiversity Conservation Fund.

- If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.

The BDAR must be prepared by a person accredited to apply the Biodiversity Assessment Method under s6.10 of the *Biodiversity Conservation Act 2016*.

Where a BDAR is not required and a threatened species assessment is prepared to support a conclusion of "no significant impact", the EIS must include a field survey of the site, conducted and documented in accordance with the relevant guidelines including the Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECCW, 2009), Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft (DEC, 2004) and Guidelines for Threatened Species Assessment (Dept Planning, July 2005). The approach should also reference the field survey methods and assessment information on the OEH website including the Bionet Atlas, Threatened Species Profile and Bionet Vegetation Classification (see Attachment 2).

5. OEH Estate

Land reserved or acquired under the *National Parks and Wildlife Act 1974* (NPW Act)
If the proposed development is within, adjacent to, or in close proximity to, OEH-managed conservation estate (e.g. a national park, nature reserve, state conservation area, land which is declared wilderness under the *Wilderness Act 1987*), or is within, adjacent to, or in close proximity to, a watercourse that flows directly into OEH-managed conservation estate, then the EIS must address impacts upon such area/s.

Where OEH estate is likely to be impacted, the EIS should include:

- The following (as appropriate):
    - Evidence that the proponent has consulted with OEH on the legal permissibility of the proposal under the NPW Act.
    - In the case of proposals on land declared as wilderness under the *Wilderness Act 1987*, evidence that the proponent has consulted with OEH on the appropriateness of the proposal. That is, whether it is consistent with the objects of the *Wilderness Act 1987* (section 3) and the management principles for wilderness areas (section 9).
    - Alternative options that have been explored to avoid impacts on the OEH estate (on-park) and a clear justification of any on-park components of the proposal.
    - If on-park impacts are considered unavoidable, consideration of the issues, including details of any compensation proposal, consistent with the OEH *Revocation, Recategorisation and Road Adjustment Policy* (2012) for proposals that are located wholly or partly in a National Park or other land acquired or reserved under the *National Parks and Wildlife Act 1974*.

- Consideration of the matters identified in the *Guidelines for developments adjoining land managed by the Office of Environment & Heritage* (OEH 2013) where a proposal adjoins or is immediate vicinity of OEH estate, or is upstream of OEH estate, which include:
    - The nature of the impacts, including direct and indirect impacts
    - The extent of the direct and indirect impacts
    - The duration of the direct and indirect impacts
    - The objectives of the reservation of the land

- A description of the mitigation and management options that will be used to prevent, control, abate or minimise identified direct and indirect impacts associated with the proposal. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

6. Water

- The EIS must map features relevant to water, including:
    - Rivers, streams, estuaries (as described in s4.2 of the Biodiversity Assessment Method).
    - Wetlands (as described in s4.2 of the Biodiversity Assessment Method).
    - Groundwater.
    - Groundwater dependent ecosystems.

- The EIS must describe background conditions for any water resource likely to be affected by the proposal, including:
    - Existing surface and groundwater.
    - Hydrology
    - Water Quality Objectives (as endorsed by the NSW Government) including groundwater as appropriate that represent the community's uses and values for the receiving waters. Indicators and trigger values/criteria for the identified environmental values in accordance with the ANZECC (2000) *Guidelines for Fresh and Marine Water Quality* and / or local objectives, criteria or targets endorsed by the NSW Government
    - *Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions* (OEH/EPA, 2017).

- The EIS must assess the impacts of the proposal on water quality, including:
    - The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the proposal protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.
    - Identification of proposed monitoring of water quality.
    - Consistency with any relevant certified Coastal Management Program (or Coastal Zone Management Plan).

- The EIS must assess the impact of the proposal on hydrology, including:
    - Water balance including quantity, quality and source.
    - Effects upon rivers, wetlands, estuaries, marine waters and floodplain areas.
    - Effects upon water-dependent fauna and flora including groundwater dependent ecosystems.
    - Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).
    - Changes to environmental water availability, both regulated / licensed and unregulated / rules-based sources of such water.

Project specific requirements
Where the proposal is large or high risk with a heightened potential to impact on water quality and hydrology, the EIS should include the following:

- A description of existing water quality / hydrology based on suitable data (meaning data collection may be required) and must include:
    - Water chemistry.
    - A description of receiving water processes, circulation and mixing characteristics and hydrodynamic regimes.
    - Lake or estuary flushing characteristics.

- Sensitive ecosystems or species conservation values.
- Specific human uses and values (e.g. fishing, proximity to recreation areas).
- A description of any impacts from existing industry or activities on water quality.
- A description of the condition of the local catchment e.g. erosion, soils, vegetation cover.
- An outline of baseline groundwater information, including, for example, depth to water table, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment.
- Historic river flow data.

- An assessment of the impacts of the proposal on water quality and hydrology including:

  - Water circulation, current patterns, water chemistry and other appropriate characteristics such as clarity, temperature, nutrient and toxicants, and potential for erosion.
  - Changes to hydrology
  - Stream bank stability and impacts on macro invertebrates.
  - Water quality and hydrology modelling and / or monitoring, where necessary.

- Proposed water quality monitoring in accordance with the *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (DEC 2004). The water quality and aquatic ecosystem monitoring program must include:

  - Adequate data for evaluating maintenance, or progress towards achieving, the relevant Water Quality Objectives.
  - Measurement of pollutants identified or expected to be present.

7. Flooding

- The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:

  - Flood prone land (ie land susceptible to the probable maximum flood event).
  - Flood planning area, the area below the flood planning level.
  - Hydraulic categorisation (floodway and flood storage areas).
  - Flood hazard.

- The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 10% Annual Exceedance Probability (AEP), 1% AEP flood levels and the probable maximum flood, or an equivalent extreme event.

- The EIS must model the effect of the proposal (including fill) on the current flood behaviour for a range of design events as identified above, and the 0.5% AEP and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.

- All site drainage, stormwater quality devices and erosion / sedimentation control measures should be identified in the EIS and the onsite treatment of stormwater and effluent runoff and predicted stormwater discharge quality from the proposal should be detailed.

- Modelling in the EIS must consider and document:

  - Existing council flood studies in the area and examine consistency to the flood behaviour documented in these studies.
  - The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood (PMF), or an equivalent extreme flood.
  - Impacts of the proposal on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazard categories and hydraulic categories.

- Impacts of earthworks and stockpiles within the flood prone land up to the PMF level. The assessment should be based on understanding of cumulative flood impacts of construction and operational phases.
- Relevant provisions of the NSW Floodplain Development Manual 2005.

- The EIS must assess the impacts on the proposal on flood behaviour, including:

  - Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure.
  - Consistency with Council floodplain risk management plans.
  - Consistency with any Rural Floodplain Management Plans.
  - Compatibility with the flood hazard of the land.
  - Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.
  - Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.
  - Whether there will be a direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.
  - Appropriate mitigation measures to offset potential flood risk arising from the proposal. Any proposed mitigation work should be modelled and assessed on the overall catchment basis in order to ensure it fits its purpose and meets the criteria of the Council where it is located, and to ensure it has no adverse impact to surrounding areas.
  - Any impacts the proposal may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the NSW SES and Council.
  - Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the NSW SES and Council.
  - Emergency management, evacuation and access, and contingency measures for the proposal during both construction and operational phases considering the full range of flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the NSW SES.
  - Any impacts the proposal may have on the social and economic costs to the community as a consequence of flooding.

8. Historic Heritage

The EIS must provide a heritage assessment including but not limited to an assessment of impacts to State and local heritage including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, and trees. Where impacts to State or locally significant heritage items are identified, the assessment shall:

- outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996)

- be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria)

- include a statement of heritage impact for all heritage items (including significance assessment)

- consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant)

- where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical

archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.

ATTACHMENT B

Guidance Material

Title	Web address
Relevant Legislation	
Biodiversity Conservation Act 2016	https://www.legislation.nsw.gov.au/#/view/act/2016/63/full
Coastal Management Act 2016	https://www.legislation.nsw.gov.au/#/view/act/2016/20/full
Commonwealth *Environment Protection and 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
Marine Parks Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+64+1997+cd+0+N
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Wilderness Act 1987	http://www.legislation.nsw.gov.au/viewtop/inforce/act+196+1987+FIRST+0+N
Aboriginal Cultural Heritage	
Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/commconsultation/09781ACHconsultreq.pdf
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/10783FinalArchCoP.pdf
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011)	http://www.environment.nsw.gov.au/resources/cultureheritage/20110263ACHguide.pdf
Aboriginal Site Recording Form	http://www.environment.nsw.gov.au/resources/parks/SiteCardMainV1_1.pdf
Aboriginal Site Impact Recording Form	http://www.environment.nsw.gov.au/resources/cultureheritage/120558asirf.pdf
Aboriginal Heritage Information Management System (AHIMS) Registrar	http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm
Care Agreement Application form	http://www.environment.nsw.gov.au/resources/cultureheritage/20110914TransferObject.pdf
Biodiversity	
Biodiversity Values Map	https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap
Biodiversity Assessment Method (OEH, 2017)	http://www.environment.nsw.gov.au/resources/bcact/biodiversity-assessment-method-170206.pdf

Title	Web address
Guidance and Criteria to assist a decision maker to determine a serious and irreversible impact (OEH, 2017)	http://www.environment.nsw.gov.au/resources/bcact/guidance-decision-makers-determine-serious-irreversible-impact-170204.pdf
Ancillary rules: Biodiversity conservation actions	http://www.environment.nsw.gov.au/resources/bcact/ancillary-rules-biodiversity-actions-170496.pdf
Ancillary rules: Reasonable steps to seek like-for-like biodiversity credits for the purpose of applying the variation rules	http://www.environment.nsw.gov.au/resources/bcact/ancillary-rules-reasonable-steps-170498.pdf
Ancillary rules: Impacts on threatened species excluded from application of the variation rules	http://www.environment.nsw.gov.au/resources/bcact/ancillary-rules-impacts-on-threatened-entities-excluded-from-variation-170497.pdf
OEH Threatened Species Profiles	http://www.environment.nsw.gov.au/threatenedspeciesapp/
BioNet Atlas	http://www.environment.nsw.gov.au/wildlifeatlas/about.htm
BioNet Vegetation Classification	http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx
Threatened Species Profile	http://www.environment.nsw.gov.au/threatenedSpeciesApp/
NSW Guide to Surveying Threatened Plants (OEH, 2016)	http://www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-guide-to-surveying-threatened-plants
Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians (DECC, 2009)	www.environment.nsw.gov.au/resources/Threatenedspecies/09213amphibians.pdf
Threatened Species Assessment Guideline - The Assessment of Significance (DECC 2007)	www.environment.nsw.gov.au/resources/Threatenedspecies/tsaguide07393.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
Fisheries NSW policies and guidelines	http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation
OEH Estate	
Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water (DECCW, 2010)	http://www.environment.nsw.gov.au/protectedareas/developmntadjoiningdecc.htm
List of national parks	http://www.environment.nsw.gov.au/NationalParks/parksearchatoz.aspx
Revocation, recategorisation and road adjustment policy (OEH, 2012)	http://www.environment.nsw.gov.au/policies/RevocationOfLandPolicy.htm
List of aquatic reserves	www.dpi.nsw.gov.au/fisheries/habitat/protecting-habitats/mpa
List of marine parks	www.mpa.nsw.gov.au/contact.html
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	www.environment.gov.au/water/publications/quality/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1

Title	Web address
Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions	http://www.environment.nsw.gov.au/research-and-publications/publications-search/risk-based-framework-for-considering-waterway-health-outcomes-in-strategic-land-use-planning
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales (DEC 2004)	http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf
Flooding	
Floodplain Development Manual	http://www.environment.nsw.gov.au/floodplains/manual.htm
Floodplain Risk Management Guidelines	http://www.environment.nsw.gov.au/topics/water/coasts-and-floodplains/floodplains/floodplain-guidelines
NSW Climate Impact Profile	http://climatechange.environment.nsw.gov.au/
Climate Change Impacts and Risk Management	Climate Change Impacts and Risk Management: A Guide for Business and Government, AGIC Guidelines for Climate Change Adaptation
Coastal Erosion	
Reforms to coastal erosion management	http://www.environment.nsw.gov.au/coasts/coastalerosionmgmt.htm
Guidelines for Preparing Coastal Zone Management Plans	http://www.environment.nsw.gov.au/resources/coasts/130224CZMPGuide.pdf
Historic Heritage	
The Burra Charter (The Australia ICOMOS charter for places of cultural significance)	http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf
Statements of Heritage Impact 2002 (HO & DUAP)	http://www.environment.nsw.gov.au/resources/heritagebranch/heritage/hmstatementsofhi.pdf
NSW Heritage Manual (DUAP) (scroll through alphabetical list to 'N')	http://www.environment.nsw.gov.au/Heritage/publications/
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

NSW RURAL FIRE SERVICE

The Secretary
NSW Planning & Environment
GPO Box 39
Sydney NSW 2001

Your Ref: EAR 1237
Our Ref: D18/5965
DA18061813542 AB

ATTENTION: Jack Murphy

26 June 2018

Dear Mr Murphy

Agency Comment: Request for Environmental Assessment Requirements (SEARs 1237) – Expansion Wavehill Basalt Quarry Lot 89 DP 821255; Wavehill Road Tarriaro

I refer to NSW Planning and Environment correspondence dated 14 June 2018 seeking comment from the NSW Rural Fire Service on matters to be included in the Environmental Assessment Requirements for the above designated development proposal.

The subject land is mapped bush fire prone land by Narrabri Shire Council. The NSW Rural Fire Service considers that the environmental assessment for the development of a 'basalt quarry' should address the following bush fire criteria:

- *the aim and objectives of 'Planning for Bush Fire Protection 2006';*
- *identification of potential ignition sources during construction and operation of the development;*
- *storage of fuels and other hazardous materials (e.g., explosives for blasting);*
- *proposed bush fire protection measures for the development, including vegetation management and fire suppression capabilities;*
- *operational access for fire fighting appliances to the site; and*
- *emergency and evacuation planning.*

For any enquiries regarding this correspondence, please contact Alan Bawden on 6691 0400.

Yours sincerely

John Ball
Manager – Planning and Environment Services North

The RFS has made getting information easier. For general information on 'Planning for Bush Fire Protection, 2006', visit the RFS web page at www.rfs.nsw.gov.au and search under 'Planning for Bush Fire Protection, 2006'.

Postal address
Records
NSW Rural Fire Service
Locked Bag 17
GRANVILLE NSW 2142

Street address
NSW Rural Fire Service
Planning and Environment Services (North)
Suite 1, 129 West High Street
COFFS HARBOUR NSW 2450

T (02) 6691 0400
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Email: pes@rfs.nsw.gov.au

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

21 June 2018

SF2018/206089; WST11/00141/02

The Manager
Resource & Energy Assessments
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Mr Jack Murphy

Dear Mr Murphy

EAR ID No.1237: Lot 77 DP 754937 & Lot 89 DP 82155; 'Wavehill Quarry' 975 Wavehill Road, Tarriaro
Expansion of Wavehill Quarry
Request for input into Secretary's Environmental Assessment Requirements (SEARs)

Thank you for your email on 15 June 2018 requesting input into SEARs for the proposed expansion of Wavehill Quarry from Roads and Maritime Services.

I note the proposal involves an increase in production from 2,000 tonnes per annum to 5,000 tonnes per annum. The quarry operation includes transportation of extracted materials on public roads. As such, once completed, the Environmental Impact Statement (EIS) prepared in support of the proposal, in accordance with clause 16(2) of *State Environmental Planning Policy (Mining Petroleum Product and Extractive Industries) 2007,* will be referred to Roads and Maritime for comment.

Roads and Maritime has identified the following key issues that need to be included and addressed in the EIS 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:
    - Road transport volumes and types broken down into origin and destination, travel routes and peak hours for extension construction and operation of the quarry. The study is to provide details of projected transport operations including peak and average volumes of traffic and tonnage to be transported. Volumes will need to also include input related traffic generation (e.g. fuel deliveries, potable water deliveries, maintenance, services; etc) and impacts of related traffic generation on public roads and other road users. Specifically, the traffic study is to explain/justify how the proposed 150% expansion of operations will generate only 1-2 additional heavy vehicle movements per day.

- Internal parking facilities.
- Any oversize and over-mass vehicles and loads expected for the construction and operation of the project.
- Temporary and permanent staff numbers (including employees and contractors) during construction and operation of the project.
- The impact and cumulative impacts of quarry related traffic and measures employed to ensure efficiency and safety on the public road network during construction and operation of the project. In particular, an assessment of cumulative traffic impacts of the proposal and the nearby Boral Quarry.
- Any mitigating measures required to address expected traffic generation.
- 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, including vehicular access routes to the Kamilaroi Highway (HW29), are to be identified and in accordance with *Austroads Guide to Road Design* and Roads and Maritime Supplements.
- 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 provide comment and requests a copy of the SEARs be forwarded to Roads and Maritime at the same time they are sent to the applicant.

Should you require further information please contact the undersigned on 02 6861 1453.

Yours faithfully

Andrew McIntyre
Manager Land Use Assessment
Western Region

PO Box 1251, Tamworth NSW 2340
170 Peel Street
Tamworth, NSW 2340
www.waternsw.com.au
ABN 21 147 934 787

9 July 2018

Executive Director
Planning Services
Department of Planning and Environment
GPO Box 39
Sydney NSW 2000

Contact: Lachlan Browne
Phone: 02 6763 3917
Email: lachlan.browne@waternsw.com.au
Our ref: F2017/5119

Attn: Jack Murphy

Dear Mr Murphy,

Re:SEARs ID No.1237 – Extension of Wavehill Quarry
Lot 77 DP754937 & Lot 89 DP82155,
Wavehill Road, NARRABRI NSW 2390.

WaterNSW has reviewed the supporting documentation accompanying the request for Secretary's Environmental Assessment Requirements (SEARs) and provides the following comments below, and further detail in **Attachment A**.

It is recommended that the EIS be required to include:

Access to surface and groundwater resources

- 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.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- Assessment of the impact and approvals (Works and Use Approvals under the WMA 2000) required for the taking or storage of water.
- 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.
- A detailed and consolidated site water balance.

Impact on surface and groundwater resources

- Assessment of 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.
- Full technical details and data of all surface and groundwater modelling.
- Proposed surface and groundwater monitoring activities and methodologies.
- Proposed management and disposal of produced or incidental water

Flooding

WaterNSW is responsible for the management and licensing of flood work approvals.

If the proposal is for an earthwork, embankment or levee, wherever situated or proposed to be constructed that is reasonably likely to affect the flow of water to or from a river or lake then the assessment is required to address potential impacts detailed further in attachment A.

Please direct any questions or correspondence to myself via the contact details at the top of the first page.

Yours sincerely

Lachlan Browne
Water Regulation Officer
WaterNSW

ATTACHMENT A

WaterNSW General Assessment Requirements

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for this proposal.

For further information visit www.waternsw.com.au or www.industry.nsw.gov.au/water.

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Management Act 2000* (WMA 2000), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WMA 2000)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Basic landholder rights, including harvestable rights dams
- Aquifer interference activity approval and flood management work approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Maximum penalties of $2.2 million plus $264,000 for each day an offence continues apply under the *WMA 2000*

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Water Sharing Plans – these are considered regulations under the *WMA 2000*

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.

- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a "dealing" to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

An assessment framework for the NSW Aquifer Interference Policy can be found online at: https://www.industry.nsw.gov.au/__data/assets/pdf_file/0005/151772/NSW-Aquifer-Interference-Policy.pdf

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).

- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10 % of the average annual runoff from their property. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit: https://www.waternsw.com.au/customer-service/water-licensing/basic-water-rights/harvestable-rights-dams

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,

- existing surface water users, and
- planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Flooding

If the proposal is for an earthwork, embankment or levee, wherever situated or proposed to be constructed that is reasonably likely to affect the flow of water to or from a river or lake then the assessment is required to address potential impacts detailed below;

- the contents of any relevant floodplain management plan or any other relevant Government policy,
- the need to maintain the natural flood regimes in wetlands and related ecosystems and the preservation of any habitat, animals (including fish) or plants that benefit from periodic flooding,
- the effect or likely effect on water flows in downstream river sections,
- any geographical features, or other matters, of Aboriginal interest that may be affected by a controlled work,
- the effect or likely effect of a controlled work on the passage, flow and distribution of any flood waters,
- the effect or likely effect of a controlled work on existing dominant flood ways or exits from flood ways, rates of flow, flood water levels and the duration of inundation,
  the protection of the environment

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources including:

- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.
- A description of the water table and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.

- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
  - the effect of the proposal on the recharge to groundwater systems;
  - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
  - the effect on the function of GDEs (habitat, groundwater levels, connectivity).
- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.

- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.
- Works on waterfront land may be subject to Controlled Activity Approval (CAA) under the *Water Management Act 2000. This is managed by the Natural Access Resource Regulator.* Further information can be obtained from the Industry Water's website: https://www.industry.nsw.gov.au/water

Drill Pad, Well and Access Road Construction

- Any construction activity within 40m of a watercourse, should be designed by a suitably qualified person, consistent with the NSW *Guidelines for Controlled Activities on Waterfront Land* (July 2012).
- Construction of all wells must be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (3rd edition 2012) by a driller holding a bore drillers' licence valid in New South Wales.
- The length of time that a core hole is maintained as an open hole should be minimised.

Landform rehabilitation (including final void management)

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project;
- Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void (where relevant) on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent;
- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation; and
- The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.

Consultation and general enquiries

General licensing enquiries can be made to the Customer Helpdesk:
customer.help@waternsw.com.au or on 1300 662 077

Appendix 3: Resource Assessment

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Resource Assessment

1 Introduction

SMK Consultants have been engaged by Johnstone Concrete and Landscape Supplies Pty Ltd to undertake a Resource Assessment. This report will accompany an Environmental Impact Statement in support of an increased annual extraction limit of the existing "Wave Hill" quarry, located within Narrabri Shire Council in north-west NSW. The resource assessment has been undertaken based on an assessment of desktop resources, field investigations and laboratory testing of quarry materials.

The existing Wave Hill Quarry is a basalt quarry which currently supplies materials to construction and infrastructure projects throughout the region. The quarry currently has an approved annual extraction threshold of 200,000 tonnes and a footprint of approximately 24 hectares. It is noted that the quarry usually produces approximately 100,000 tonnes of material per year, with occasional production peaks up to approximately 150,000 tonnes in the event of large contracts. The current quarry production threshold is therefore suitable to meet background demand for construction materials within the region.

The proposal involves increasing the annual extraction threshold of the quarry to 500,000 tonnes per annum. The purpose of the proposal is to enable Wave Hill Quarry to supply additional materials to meet peak demand associated with construction of the Inland Rail Project by increasing the annual extraction limit.

The objectives of this Resource Assessment are as follows:

- Assess the quantity of available resource within the existing quarry footprint; and
- Assess the quality of available resource, with respect to its intended purpose for use by the Inland Rail Project.

2 Site Description

2.1 Location

Wave Hill Quarry is located within the North West Slopes and Plains of NSW, within the boundaries of the Gunnedah Basin. The site is on western foothills of the Nandewar Range, approximately 24 kilometres east of Narrabri. A locality plan of the property is presented in Figure 1.

2.2 Topography

The average slope across Wave Hill quarry, based on surveyed heights, is approximately 15 degrees. The quarry footprint has a median elevation of 325m AHD. Elevation across the site ranges from approximately 275m to 375m AHD. Figure 2 outlines the topography of the quarry footprint in the context of the surrounding landscape.

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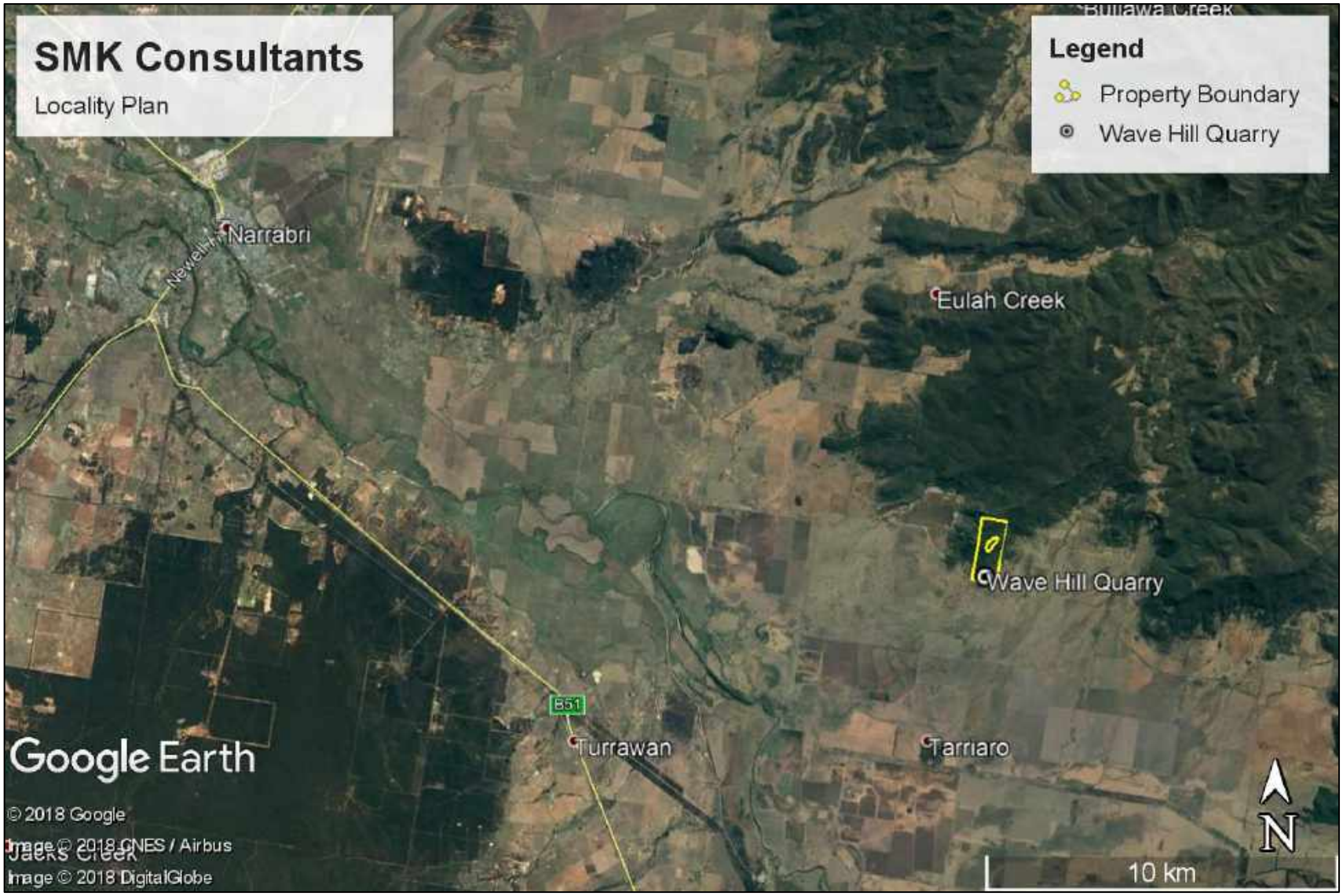

Figure 1: Wave Hill Locality Plan

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Figure 2: Topography of Landscape Near Wave Hill Quarry

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3 Desktop Resource Assessment

3.1 Geological Mapping

Geological mapping of the region surrounding the subject site has been accessed using the NSW Department of Planning and Environment (Resources and Geoscience)'s online mapping tool. The online mapping tool presents a 1:1,500,000 scale geological map that has been compiled from numerous geological maps and regional geological synthesis datasets from the Geological Survey of NSW and Geoscience Australia. The map represents a simplified, generalised description of geological characteristics of New South Wales. From this, the geology of the region surrounding the proposed development site is outlined in Figure 3. Table 1 provides a description of the geological formations present within the area.

Mapping indicates the subject site is directly underlain by Permian Mafic Volcanics, which include basaltic lava flows and tuffs, and that the surrounding locality includes a diverse array of igneous, sedimentary, alluvial and colluvial deposits. Field investigations (discussed further below) confirmed the geology of the area to be consistent with the desktop findings.

The age of the basaltic deposits at Wave Hill indicate that the formation of the basalt resource (dated 252-299 million years ago) significantly pre-dates the formation of the Nandewar Range (which formed approximately 17-21 million years ago). The basalts of Wave Hill are therefore associated with the Permian deposits of the Gunnedah Basin.

The present-day topography of the subject site, in which the basalt appears elevated and exposed, would have formed as a result of uplift of the Permian deposits. The hill persists today because the basalt is more resistant to weathering than the immediate surrounding landscape, and therefore has become progressively more exposed over time whilst the surrounding landscape has eroded at comparatively faster rates.

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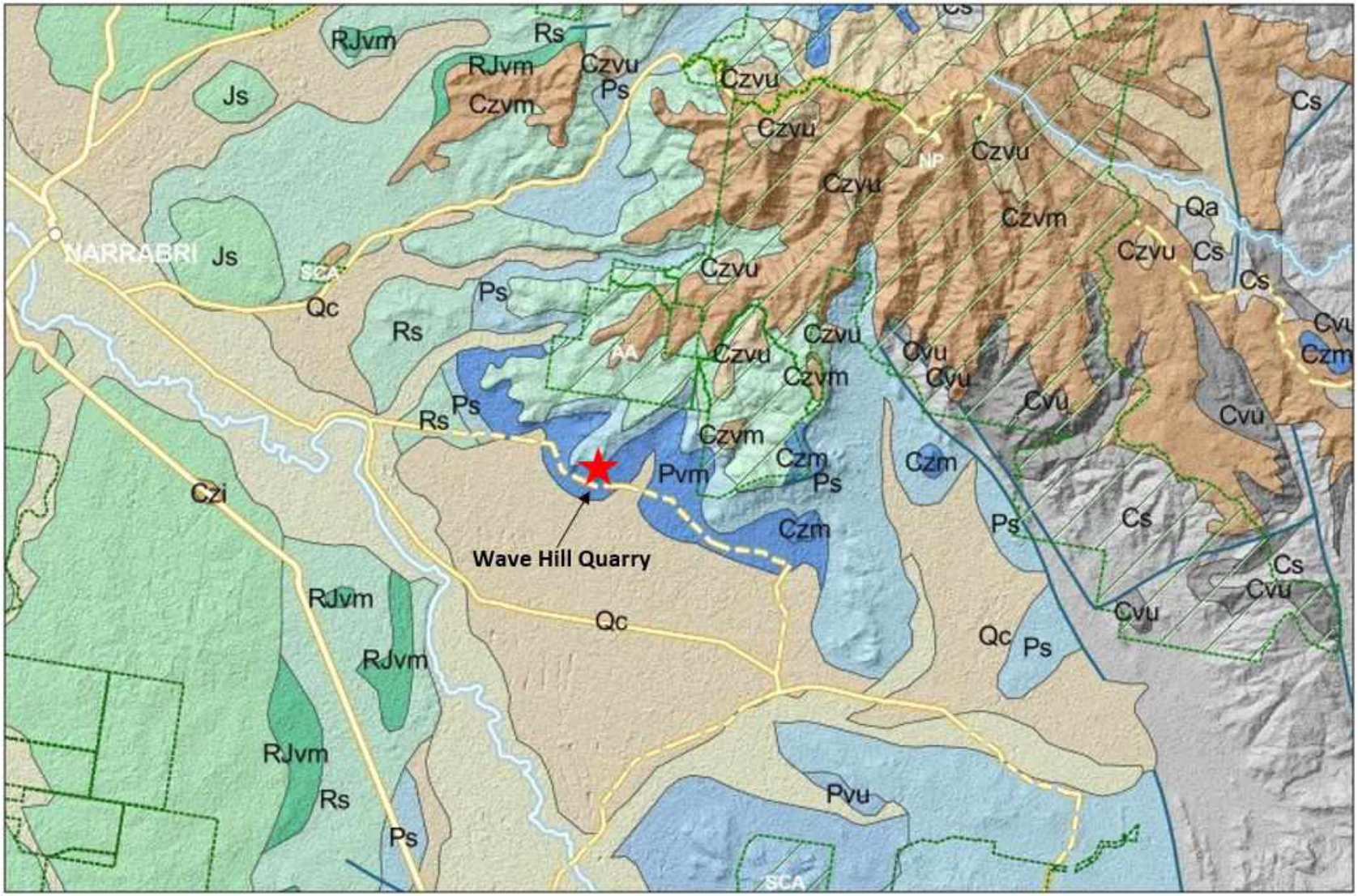

Figure 3: Geology of the Locality. Legend is Presented in Table 1

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Table 1: Legend for Figure 3

Abbreviation	Name	Age	Description
Pvm	Permian Mafic Volcanics	252-299 MYO	Basaltic lava flows and tuffs. Typically rich in plagioclase. Also some intercalated sedimentary rocks.
Czm	Cainozoic Mafic Intrusives	0-66 MYO	Intrusive mafic rocks associated with volcanoes. These rocks typically include iron-magnesium minerals like pyroxene.
Ps	Permian Sedimentary Rocks	252-299 MYO	Sandstone, siltstone and mudstone. Deposited in fluvial and floodplain systems, or in shallow marine environments. Also includes coal seams in some areas.
Pvu	Permian Silicic-Intermediate Volcanics	252-299 MYO	Latite and trachytic tuff with associated sandstone.
Rs	Triassic Sedimentary Rocks	201-252 MYO	Quartz-lithic to quartz-rich sandstone with conglomerate, mudstone and siltstone. Deposited in high energy braided river systems.
RJvm	Triassic-Jurassic mafic volcanics	145-252 MYO	Mafic rocks including dolerite, basalt, trachyte, tuff and breccia.
Js	Jurassic sedimentary Rocks	145-201 MYO	Sedimentary sequences dominated by sandstone with minor conglomerate units and claystone.
Qa	Quaternary Alluvial Deposits	0-2.5 MYO	Current and recent mud, silt, sand and gravel deposited by river (alluvial) systems.
Qc	Quaternary Colluvial Deposits	0-2.5 MYO	Colluvial deposits are unconsolidated sediments that are found downslope from hills. They form by erosion of hills and by creep or sheetwash.
Czvm	Cainozoic Mafic Volcanics	0-66 MYO	Mafic volcanic rocks are those that were erupted from widespread volcanic activity through the eastern part of the state over the last 65 million years. Basalt lava flows are typical examples.
Czvu	Cainozoic Silicic-Intermediate Volcanics	0-66 MYO	Rhyolite (quartz and feldspar rich) and dacite (feldspar rich) eruptive rocks.
Cvu	Carboniferous Silicic-Intermediate Volcanics	300-359 MYO	These rocks were erupted explosively from volcanoes. Ignimbrite sheets smother the ground from pyroclastic flows. These rocks are rich in quartz and feldspar.
Cs	Carboniferous Sedimentary Rocks	300-359 MYO	A wide range of sedimentary rocks, including feldspar-rich sandstone, siltstone, mudstone and conglomerate units.

3.2 Bore Log Data

A desktop assessment of publicly available bore logs in the locality was completed to assess the distribution of basalt deposits across the locality. The locations of bores assessed is indicated in Figure 4, whilst a summary of bore log data is presented in Table 2.

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Figure 4: Bore Log Locations in the Vicinity of Wave Hill

Table 2: Bore Log Record Summary

Bore ID	Bore Depth (m)	Depth to Bedrock (m)	Basalt Present?	Cumulative Basalt Thickness (m)
GW035583	32.9	18.89	Not Recorded	Not Recorded
GW970045	55.0	23	Yes	1
GW045595	24	Not Recorded	Not Recorded	Not Recorded
GW273204	36	34	Yes	2
GW045596	Not Recorded	Not Recorded	Not Recorded	Not Recorded
GW045598	Not Recorded	Not Recorded	Not Recorded	Not Recorded
GW029002	33.2	> 33.2	No	N/A
GW035302	57.9	14.02	Yes	40.54
GW016328	35.4	0.91	Yes	9.76
GW970345	68.0	1	Yes	64
GW011470	21.3	16.45	Not Recorded	Not Recorded
GW038580	Not Recorded	Not Recorded	Not Recorded	Not Recorded
GW038581	60.9	> 60.9	No	N/A
GW038609	18.2	Not Recorded	Not Recorded	Not Recorded

Results indicate that Wave Hill Quarry is placed atop a thick basalt outcrop; Bore site 'GW970345', located at the subject site, records a basalt thickness of over 64m.

It is noted that the bore log results are consistent with geological mapping results presented in Figure 33, which shows the subject site located atop of Permian Mafic Volcanics.

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In the wider landscape, the presence of basalt is sporadic. For instance, it is noted that the bore site 'GW016328' only recorded a basalt thickness of 9.76m. This site is located approximately 500m to the east of Wave Hill Quarry yet is at a lower elevation by approximately 50m to the quarry site. The presence or absence of basalt layers at a given location within the vicinity of the subject site would be the result of the historic processes of uplift, exposure and erosion of various layers which make up the boundaries of the Gunnedah Basin.

4 Site Investigation

Field inspection of the subject site indicates that Wave Hill Quarry is located on a hill comprised of basalt. The presence is basalt is evidenced by exposed basalt within the existing quarry footprint and exposed basalt cliff faces towards the top of the hill.

In November 2012, a survey was carried out of the existing quarry footprint to obtain an estimate of the potential basalt resources available onsite for extraction. The survey results are presented in Section 5.1. The volume of available extractive resources was calculated by multiplying the area of the footprint by its height, with no consideration of batter, benches or structural walls.

In October 2017, basalt samples sourced from the existing quarry site were sent to Boral Materials Technical Services Facility, a NATA accredited laboratory facility to assess the quality of the basalt resource on site. Results of this assessment are discussed in Section 5.1.2.

5 Summary of Results

5.1 Resource Extent

The basalt deposit underpinning the existing quarry site has a thickness of at least 64m, extending over 68m below the natural ground surface.

However, it is noted that there are practical and safety constraints associated with deep excavation of the quarry site. Typically, quarry faces are limited to a maximum height of 20m to protect workplace safety. Quarry operations therefore occur by excavating horizontally into the hill until the quarry face reaches a height of 20m, at which point new excavation begins to form a ledge above each face. The ledges also function to support machinery access to active working faces within the quarry. The worked quarry therefore eventually appears as a series of steps pushing into the hill face. These considerations further limit the potential productive depth of the quarry.

Therefore, the approximate maximum predicted depth below natural surface of the existing Wave Hill Quarry site is 20m.

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The total, current quarry footprint is approximately 24 hectares, however, a significant proportion of this area is devoted to non-extractive land uses (including sediment control works, internal roads, stockpile areas, on-site screening and crushing equipment and office premises).

Based on historical production volumes, it is estimated that approximately 1,620,000 tonnes of basalt have been removed from the quarry site since the quarry first commenced operations in 1997.

Results from the survey carried out in November 2012 indicated that a total of 3,818,949 tonnes of rock are located within the existing quarry footprint. This would entail cutting the floor level of the quarry down to the current weighbridge level (RL 315). The weighbridge level is similar to the floor level around the new crushing and screening plant. The Proponent has indicated that production rates have averaged at 100,000 tonne per year since 2012, therefore it is estimated that 750,000 tonne has been extracted from the quarry site since the survey was carried out (November 2012 – May 2020). Therefore, remaining available basalt resources within the quarry footprint, assuming the quarry floor is levelled to the current weighbridge level, are estimated to be 3,068,949 tonne.

Additional rock could then be extracted by gradually lowering the floor of the quarry to reach a total extraction limit of 4 million tonne over the lifetime of the quarry.

Discussions with the Proponent indicate that, should Johnstone Concrete and Landscape be awarded a contract to supply materials to the Inland rail Project, the rate of extraction would increase to 300,000 – 500,000 tonne per annum over a maximum period of 3 years. Following the completion of the Inland Rail Project contract, extractive rates would likely return to current production rates, which are approximately 100,000 tonnes per year.

In the context of the current proposal, the quarry has an estimated lifespan in the order of 15.5 years beyond the current date, based on the following assumptions;

- The Proponent will quarry a maximum of 4 million tonne over the lifetime of the project;
- The rate of extraction will average 500,000 tonne per annum over a period of 3 years while the quarry supplies the Inland Rail Project;
- The rate of extraction will average 200,000 tonne per annum during 'normal' quarry operations outside of the Inland Rail contract duration. (While this extraction rate is more likely to be 100,000 tonne per annum, a maximum potential extraction rate of 200,000 tonne per annum was conservatively used for these calculations).

It is noted that at current average extraction rates of 100,000 tonne per annum, the quarry has a lifetime of approximately 40 years.

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The lifespan of the quarry is therefore expected to be between 15.5 – 40 years, depending on actual rates of extraction over time and on whether or not the Wave Hill Quarry is awarded a contract to supply the Inland Rail Project.

5.2 Resource Quality

Preliminary testing of basalt extracted from the existing quarry site indicates that the basalt material is compliant with requirements for ballast material as specified by the ARTC, as indicated in Table 3. Therefore, the basalt resource within Wave Hill Quarry is suitable for use by the ARTC for the Inland Rail Project. A copy of the laboratory report is included as Appendix 1.

Table 3: Comparison of ARTC Ballast Requirements with Basalt from Wave Hill Quarry

Laboratory Test	Australian Standard	ARTC – ETA – 04-01 Ballast Specification	Site Sample
Compacted Bulk Density (kg/m^3)	AS 1141.4	Min. 1200	1500
Particle Density (kg/m^3)	AS 1141.6	Min. 2500	
% Passing Through Sieve Size: 63.0mm	AS 1141.11 and AS 1141.12	100	100
% Passing Through Sieve Size: 53.0mm	AS 1141.11 and AS 1141.12	85-100	100
% Passing Through Sieve Size: 37.5mm	AS 1141.11 and AS 1141.12	20-65	60
% Passing Through Sieve Size: 26.5mm	AS 1141.11 and AS 1141.12	0-20	18
% Passing Through Sieve Size: 19.0mm	AS 1141.11 and AS 1141.12	0-5	5
% Passing Through Sieve Size: 13.2mm	AS 1141.11 and AS 1141.12	0-2	2
% Passing Through Sieve Size: 9.50mm	AS 1141.11 and AS 1141.12	-	2
% Passing Through Sieve Size: 4.75mm	AS 1141.11 and AS 1141.12	0-1	1
% Passing Through Sieve Size: 1.18mm	AS 1141.11 and AS 1141.12	-	1
% Passing Through Sieve Size: 0.075mm	AS 1141.11 and AS 1141.12	0-1	1
Nominal Particle Size (mm)	AS 1141.11 and AS 1141.12	60	
Particle Shape (%)	AS1141.14	Max. 30	
Flakiness Index (%)	AS 1141.15	Max. 30	23
Aggregate Crushing Value (%)	AS1141.21	Max. 25	19.9
Wet Attrition Value (%)	AS1141.27	Max. 6*	8.3
Los Angeles Values	AS1141.23	Max. 25%	
Weak Particles (%)	AS 1141.32	Max. 5	Nil

*Material having a wet attrition value in excess of the requirements may be accepted provided the corresponding aggregate crushing values does not exceed the requirement and is endorsed by ARTC's GM Infrastructure & Asset Management or nominated representative.

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6 Conclusion

The materials identified at the proposed Quarry site meet ARTC specifications for rail ballast and would also be suitable for other hard rock requirements for rail foundations, State highway infrastructure projects and local road construction.

The infrastructure project identified by the Proponent would require up to 1.5 M tonne of hard rock material over a 3-year period. This resource assessment has indicated that this tonnage of material is available on this site. It is, however, noted that annual extraction will be capped to an upper limit of 500,000 tonne per annum, including material extracted to supply local projects.

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Appendix 1 – Ballast Test Results

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TEST REPORT

CLIENT: SOUTH QLD SOILS PTY LTD – (NARRABRI)
PROJECT: Testing of Ballast from Narrabri Quarry
TEST PROCEDURE: i) AS1141 – Methods of Sampling and Testing Aggregates
ii) RMS-Materials Test Methods Vol. 1
SPECIFICATION: John Holland – CRN CP 241 – Version 1.2 – May 2016

FILE NO: 632/17
REQUEST NO: 75355

Sample Description:			Ballast
Location:			Narrabri Quarry
Project No:			QA - 2017
Laboratory Sample No:			197386
Date Sampled:			26.9.17
Test Method	**Test**	**Specification**	**Results**
AS1141.11.1*	% Passing A.S.Sieve		
	63mm	100	
	53mm	85-100	100
	37.5mm	20-65	60
	26.5mm	0-20	18
	19.0mm	0-5	5
	13.2mm	0-2	2
	9.5mm	-	2
	6.7mm	-	2
	4.75mm	0-1	1
	2.36mm	-	1
	1.18mm	-	1
AS1141.12	Material finer than 75 micron (%)	0-1	1
AS1141.15	Flakiness Index (%)	Max. 30	23
AS1141.4	Uncompacted Bulk Density t/m³		1.32
	Compacted Bulk Density t/m³	Min. 1.4	1.50
RMS T262	Moisture Content (%)		1.0
AS1141.21	Aggregate Crushing Value (%) Fraction tested: -26.5+19.0mm	Class 'H' Max. 25 Class 'N' Max. 30 Class 'L' Max. 40	19.9
AS1141.27	Resistance to wear by attrition using Deval Machine Wet Attrition Value (%)	Class 'H' Max. 6 Class 'N' Max. 8 Class 'L' Max. 12	8.3
AS1141.32	Weak Particles (%) The % of original sample passing 2.36mm sieve = 1.1	Max. 5	Nil

*Sample washed over 75 micron sieve as per AS1141.11.1 Clause 5.6
Material sampled by client
L. New, File

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Approved Signatory: Kamal Ali
Date 31.10.17 Serial No. 162177

Accredited for compliance with ISO/IEC 17025

NATA Accredited Laboratory
Number: 547

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Ref: 2017 197387 Dust from Ballast Production Narrabri Quarry S179-1464 AS1289.4.4.1 ER
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TEST REPORT

CLIENT:	SOUTH QLD SOILS PTY LTD (NARRABRI)	FILE No:	632/17
PROJECT:	QA - 2017	REQUEST No. :	75355
MATERIAL:	Dust from Ballast Production - Narrabri Quarry	DATE SAMPLED:	26.9.17
		DATE TESTED:	28.10.17 to 30.10.17

Test Method AS1289.4.4.1	Results
Resistivity of Sands and Granular Material	**Client Sample No.** S179-1464 **Laboratory Sample No.** 197387
Mean ER (Ω.m)	**55** (test samples saturated according to test method)
Mean Density (t/m^3)	1.926
Amount of material +2.36mm (%)	0.0
Method used for moisture content determination	AS1289.2.1.1

Note : Sampled by client as per AS1141.3.1 Clause 9.4

LUKE NEW, FILE.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Approved Signatory _____ **Artemio Mendoza**
Date 30.10.17 Serial No. 162178

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Appendix 4: Air Quality Impact Assessment

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Report

Wave Hill Quarry

Air Quality Impact Assessment

Johnstone Concrete and Landscaping Supplies Pty Ltd

7 Feb, 2020

Rev 0 (Final)

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Report Details

Wave Hill Quarry - Air Quality Impact Assessment

Job #: J0191228, Folder #: F20924, Revision: 0 (Final), Date: 7 Feb, 2020

Filename: 20924 Wave Hill Quarry AQIA Rev0.docx

Prepared For

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History

Date	Revision	Comments
7 Feb, 2020	0	Final Issue for Client Review

Endorsements

Function	Signature	Name and Title	Date
Prepared by		Grant Brown Environmental Scientist (Air Quality)	7 Feb, 2020
Checked by	for	Dr Carl Fung Lead Consultant- Process Engineering and Sustainability (CAQP, *CASANZ*)	7 Feb, 2020
Authorised for Release by		Dr Rod Bennison Lead Environmental Scientist	7 Feb, 2020

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APPENDICES

Appendix I	Narrabri Airport Historical Wind Rose Data
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Appendix III	Contour Plots (Increment Only)

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1. INTRODUCTION

Advitech Pty Limited (trading as Advitech Environmental) was engaged by Johnston Concrete and Landscaping Supplies Pty Ltd on behalf of SMK Consultants to prepare an Air Quality Impact Assessment (AQIA). SMK Consultants is preparing an Environmental Impact Assessment (EIA) that will facilitate increased quarrying operations to be undertaken at the Wave Hill Quarry in the Narrabri Shire Council area in New South Wales (NSW) to support the Inland Rail project. The Wave Hill Quarry proposal is considered Designated Development under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). As such, this Air Quality Impact Assessment supports the EIA completed in accordance with the Planning Secretary's environmental assessment requirements (SEARs) (EAR 1237).

It should be noted that this report was prepared by Advitech Pty Limited for Johnstone Concrete and Landscaping Supplies Pty Ltd ('the customer') in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

2. BACKGROUND AND OBJECTIVES

2.1 Project Background and Site Description

Johnstone Concrete and Landscaping Supplies proposes to increase the annual extraction rate for the Wave Hill Quarry from 200,000 tonnes per annum to no more than 500,000 tonnes per annum to meet demand of the proposed Inland Rail project. No other alterations to the current operation or footprint of the Wave Hill Quarry are proposed.

The Wave Hill Quarry is located along Wave Hill Road, approximately 25 km west south east of the township of Narrabri NSW in the North West Slopes (a site map is provided in **Figure 1**). The quarry lies on Lot 89 DP 821255 within the Narrabri Shire Local Government Area comprising 123.3 hectares of undulating land. The property contains significant deposits of basalt and is one of several possible sources of material for the proposed Inland Rail project, mainly ballast.

Another quarry facility (referred to in this report as the 'Boral Quarry') located on Lot 1 DP 1225128 on Wave Hill Road, Narrabri, is located approximately 1.5 km west from the Wave Hill Quarry. To properly account for cumulative particulate impacts associated with the two closely situated quarrying facilities, Advitech has also modelled particulate emissions from the Boral Quarry.

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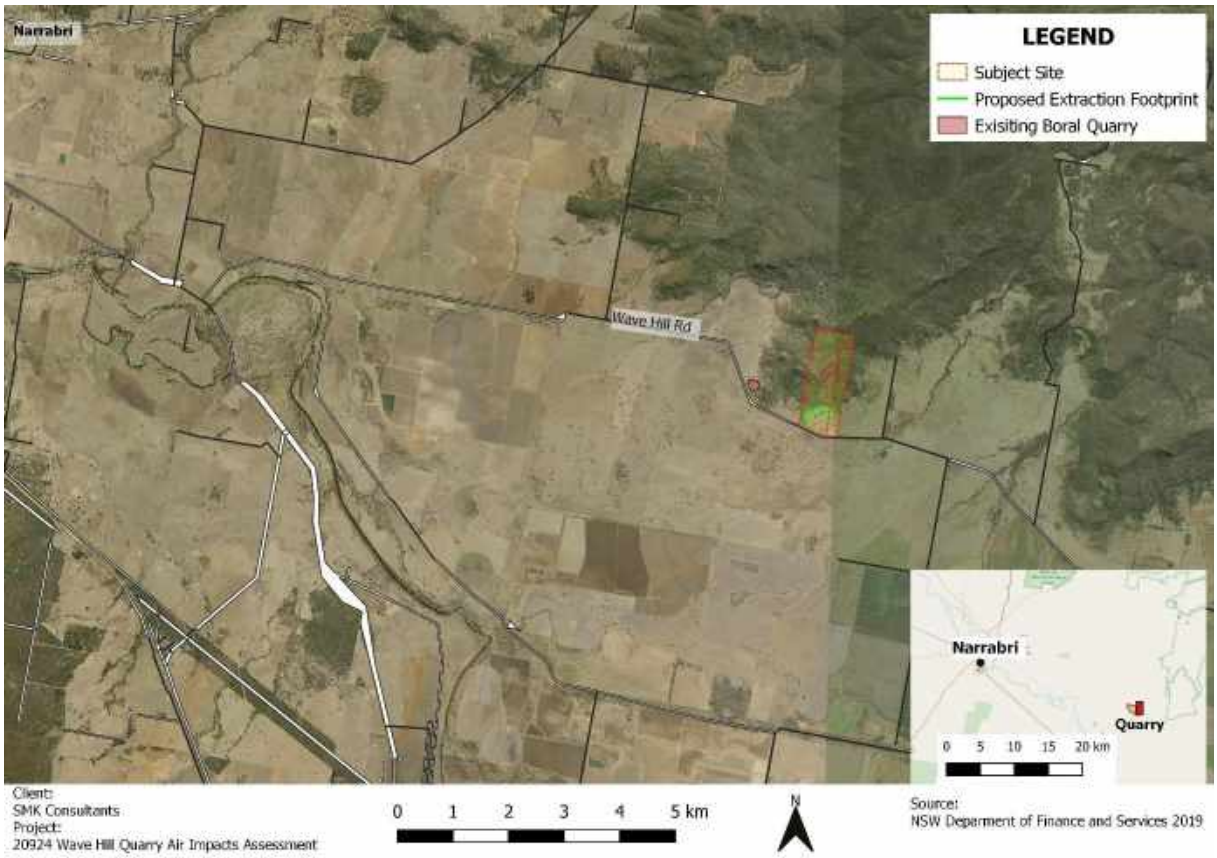

Figure 1: Site Location (Regional Context)

2.2 Project Description

The revised development proposal for the Wave Hill Quarry will change only the annual extraction limit. Site operations and equipment will remain the same. The site layout and indicative quarry extraction area is presented in **Figure 2**. A summary of the quarrying/extraction operations are as follows:

- The Wave Hill Quarry will extract up to 500,000 metric tonnes of material per annum;
- The extracted material will be delivered primarily to supply ballast materials for the Australian Government's Inland Rail project. Blue metal products will also be extracted from the quarry to supply the local council;
- The daily hours of operation will be 11 hours Monday to Saturday; and
- The quarry will be subject to typical daily and weekly extraction activities such as blasting, winning, crushing and stockpiling of material as well as removing prepared product and transportation.

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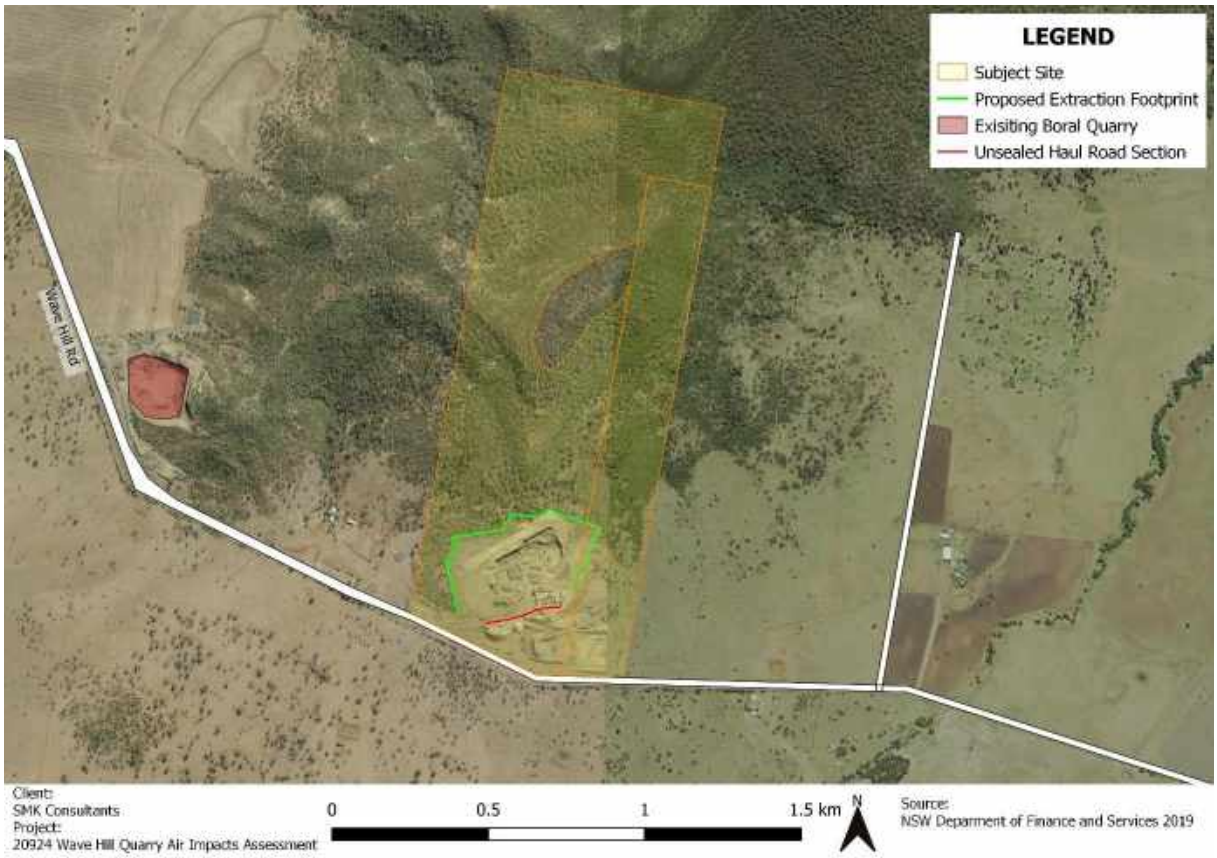

Figure 2: Wave Hill Quarry Layout (Source: SMK Consultants)

2.3 Secretary's Environmental Assessment Requirements

This report will be appended to an EIA which must comply with the requirements of Clauses 6 and 7 of the Environmental Planning and Assessment Regulation 2000, and which addresses environmental considerations identified in the SEARs relevant to air quality.

The SEARs notes the following requirement for an air quality assessment:

- *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. The assessment is to give particular attention to potential dust impacts on any nearby private receivers due to the operation of the quarry and/or road haulage.*

2.4 Sensitive Receivers

The nearest potentially affected residences are shown on **Figure 3**. The residences are located in Tarriaro NSW, along Wave Hill Road. **Table 1** provides the locations for each sensitive receiver.

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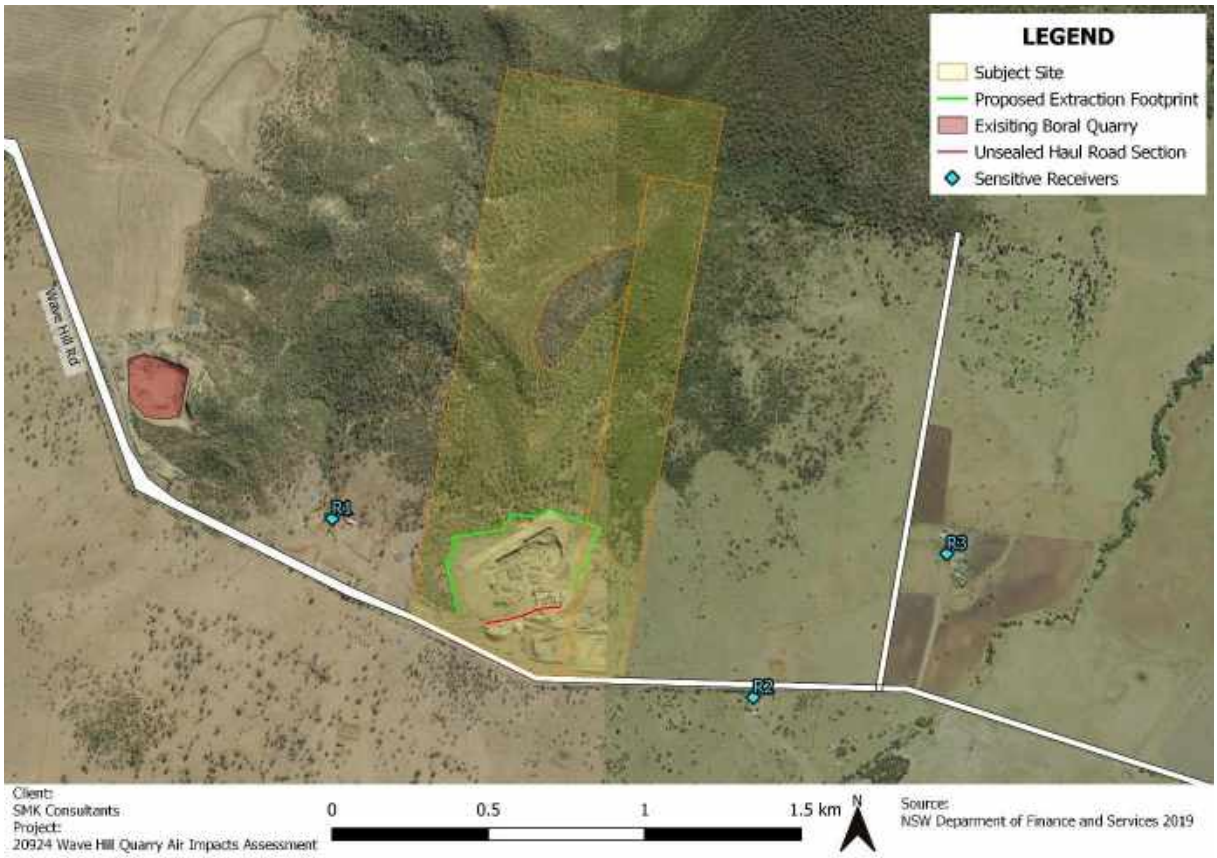

Figure 3: Sensitive Receiver Locations

Table 1: Sensitive Receiver Details

Receiver ID	Address	Easting UTM (m)[a]	Northing UTM (m)[a]	Receiver Type
R1	939 Wave Hill Road Tarriaro	211844	6631712	Private Residence
R2	1092 Wave Hill Road Tarriaro	213220	6631211	Private Residence
R3	1143 Wave Hill Road Tarriaro	213855	6631644	Private Residence

[a]-Universal Transverse Mercator (UTM) coordinate system based on the WGS84 datum.

3. AIR QUALITY GUIDELINES

The NSW Environment Protection Authority (EPA) specifies the impact assessment criteria in the publication Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, 2016 (NSW EPA, 2016). The relevant sections from this publication are reproduced below in **Table 2** which presents the ground level concentration (GLC) criteria for each applicable air pollutant.

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Table 2: NSW EPA Impact Assessment Criteria

Pollutant	NSW EPA Impact Criteria	Units	Averaging Time
TSP[a]	90	µg/m³	Annual
PM_{10}[b]	50	µg/m³	24 hours
	25	µg/m³	Annual
$PM_{2.5}$[b]	25	µg/m³	24 hours
	8	µg/m³	Annual
Deposited Dust[d]	2[e]	g/m²/month	Annual
	4[f]		

[a] Total suspended particulates
[b] Particulate materials with an aerodynamic diameter less than 10 µm
[c] Particulate materials with an aerodynamic diameter less than 2.5 µm
[d] Dust is assessed as insoluble solids defined by AS 3580.10.1-1991 (AM-19)
[e] Maximum increase in deposited dust level
[f] Maximum total deposited dust level

4. METEOROLOGICAL DATA

To determine the most representative 12 month calendar period, required for modelling air emissions from Wave Hill Quarry, historical Bureau of Meteorology (BoM) climate data at the Narrabri Airport Automatic Weather Station (AWS) (054038) was reviewed in **Table 3**. Historical BoM wind roses at Narrabri Airport from 2012 – 2017 have also been reviewed and are presented in **Appendix I**.

Table 3: Bureau of Meteorology (BoM) Climate Data History for Narrabri Airport (054038)

Year	Temperature (°C)				Rainfall (mm)	
	Maximum year average	Difference from long term average	Minimum year average	Difference from long term average	Yearly total	Percentage of long-term average
2012	26.2	-0.7	11.2	-1.0	445.4	82%
2013	27.3	0.4	11.8	-0.4	591.4	109%
2014	27.7	0.8	12.6	0.4	458.2	84%
2015	26.7	-0.2	12.3	0.1	584.2	107%
2016	26.7	-0.2	12.6	0.4	709	130%
2017	27.6	0.7	12.4	0.2	585.4	108%

A review of the BoM climate and wind rose data suggests the years with the least deviation from long term average climate statistics are years 2013, 2015 and 2017. As a result of the review of the climatic data (**Table 3**) and wind rose data (**Appendix I**), this report has adopted the 2013 year for air dispersion modelling purposes.

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4.1 CALMET

Air dispersion modelling requires the creation of a three-dimensional (3D) CALMET meteorological data file that represents the weather and climate for the region (domain) modelled. In brief, CALMET is a meteorological model that develops hourly (or sub-hourly) wind and other meteorological fields on a 3D gridded modelling domain. Associated two dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The final time varying wind field thus reflects the influences of local topography and land uses. Compilation of a 2013 three dimensional (3D) meteorological data file for the Narrabri area representative of the proposed site was obtained from the following data sources:

- Mesoscale Prognostic Weather Research and Forecasting (WRF) Model for 2013;
- Surface meteorological data from Narrabri AWS (054038);
- NSW DECC 2007 Land Use NSW; and
- Terrain data set with Shuttle Radar Topography Mission derived ˜30 m resolution topography data.

The Weather Research and Forecasting (WRF) Model is a next generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications. It features two dynamic cores, a data assimilation system, and software architecture supporting parallel computation and system extensibility. The model serves a wide range of meteorological applications across scales from tens of metres to thousands of kilometres.

The generated 3D meteorological file used in this report was developed using 'hybrid mode' in CALMET. Surface observations from the BoM AWS at Narrabri Airport (054038) were combined with prognostic WRF upper air data to compile a simulated three dimensional meteorological model.

The WRF wind field data was used as an initial guess in CALMET which was subsequently used to generate its wind. The initial wind field was then adjusted to account for the kinematic and thermal effects of terrain and land use on its wind.

Figure 4 shows the frequency of wind speed and direction for each season during the 2013 calendar year extracted from the CALMET generated file. The CALMET seasonal wind roses predict that the predominant winds are from a southeast direction in the autumn months and north and southeast directions the rest of year. The CALMET wind rose outputs (**Figure 4**) were compared to the observation station data from the BoM station at Narrabri (**Appendix I**) and were considered to suitable for air dispersion modelling purposes.

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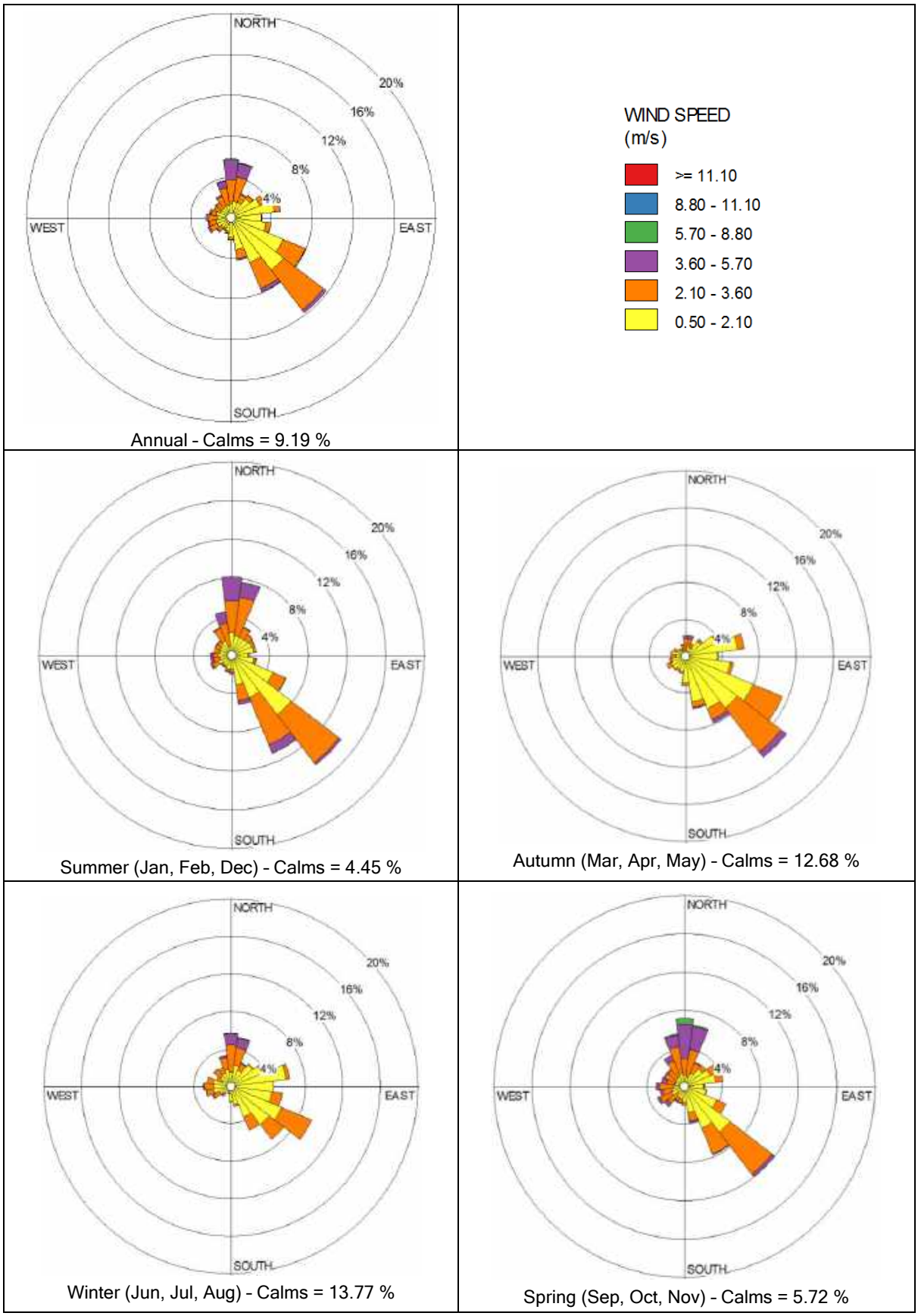

Figure 4: CALMET 2013 Wave Hill Quarry Site Seasonal Wind Roses

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5. MODELLING APPROACH/METHODOLOGY

5.1 Background Air Quality (Particulates)

Assessment of the background air quality data has been undertaken for the airshed surrounding the Wave Hill Quarry operation.

The NSW Department of Planning, Industry and Environment (DPIE) operates an air quality monitoring program that collects accurate real-time measurements of ambient level pollutants at 23 monitoring sites within the air quality monitoring network (AQMN). The AQMN has stations located around the greater metropolitan area of Sydney, the Illawarra, the Lower Hunter and selected rural sites around NSW (NSW DPIE, 2019). Given the absence of background air quality data for 2013 in the Narrabri region, the nearest monitoring location at Tamworth, approximately 120 km to the south east of the subject site, was applied for the purpose of the assessment.

The Tamworth monitoring station commenced operation in 2000 and provides hourly meteorological data and particulate concentrations. It should be noted that $PM_{2.5}$ concentration monitoring began in August 2016 at the Tamworth monitoring station. In the absence of long-term $PM_{2.5}$ monitoring measurements, this report has assumed a $PM_{2.5}$ to PM_{10} ratio of 0.5 (i.e. 50 % of PM_{10} is $PM_{2.5}$). A review of available $PM_{2.5}$ data (2016 - 2019) from the Tamworth station suggests this ratio is appropriate.

A Level 1 assessment of particulate background concentrations has been prepared for the pollutants listed in **Table 4** for the 2013 monitoring year to correspond with the meteorological data. The Level 1 assessment has assumed a worst case background concentration by using the maximum reported value.

Table 4: Background Air Quality

Pollutant	Background Concentration	Units	Averaging Time
TSP	33.2[a]	µg/m³	Annual
PM_{10}	Varies	µg/m³	24 Hours
	16.6	µg/m³	Annual
$PM_{2.5}$	Varies[b]	µg/m³	24 Hours
	8.3[c]	µg/m³	Annual

[a] Assumed from annual average PM_{10} background concentration (TSP = 2 x PM_{10}).
[b] Assumed from 24 hour average PM_{10} background concentration ($PM_{2.5}$ = PM_{10} / 2).
[c] Assumed from annual average PM_{10} background concentration ($PM_{2.5}$ = PM_{10} / 2).

The maximum 24 hour average PM_{10} background concentration reported for the 2013 monitoring period was 47.5 µg/m³, which is below the NSW EPA impact assessment criteria. **Figure 5** displays the PM_{10} 24 hour average background concentrations for 2013 and indicates no exceedances of the NSW EPA impact assessment criteria.

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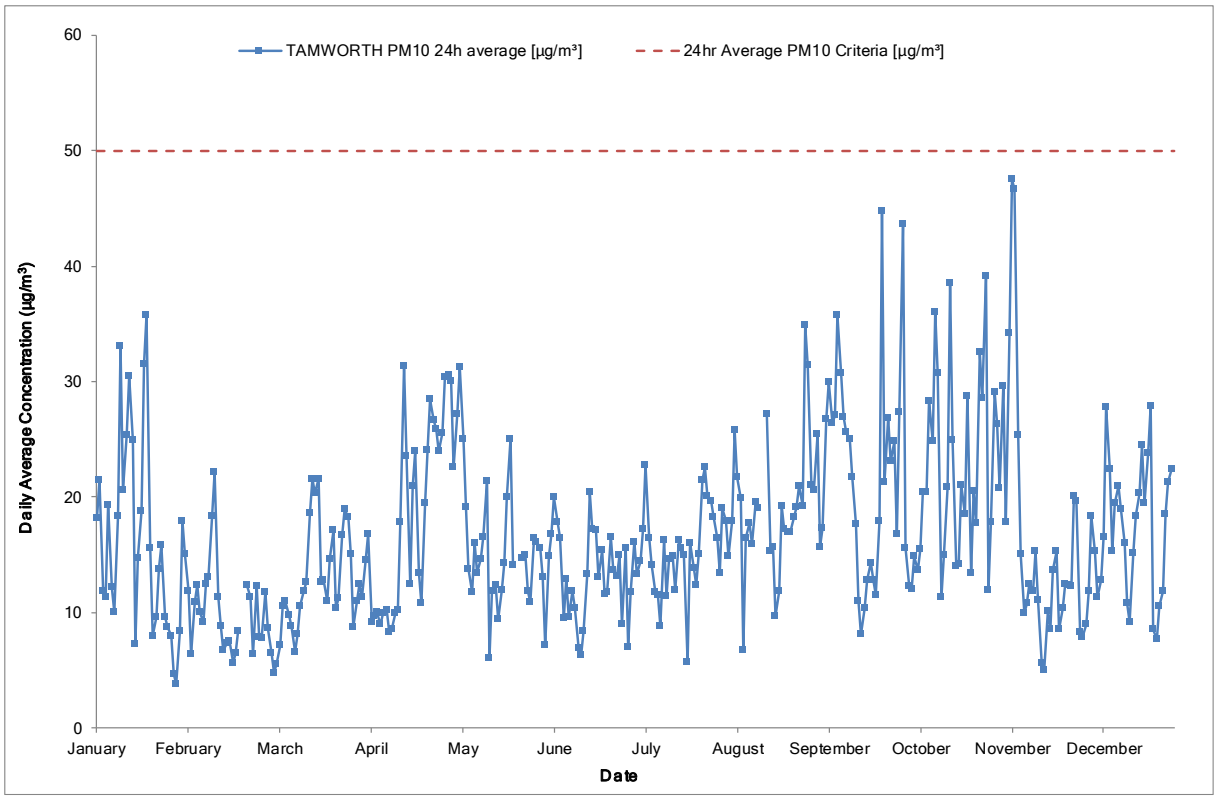

Figure 5: Daily Particulate Matter Concentrations for Tamworth 2013

5.2 Meteorological Model Configuration

Table 5 details the parameters used in the meteorological modelling to drive the CALMET model. The nearest BoM observational station at Narrabri Airport AWS is approximately 20 km north west of the Wave Hill Quarry. Surface observational data from the Narrabri Airport AWS was combined with prognostic WRF data to produce the CALMET model using 'Hybrid Mode'.

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Table 5: CALMET Meteorological Parameters Used in This Report

Identifier	Descriptor	Comment
WRF	Grid Spacing	36 km
	Year of analysis	2013
	Time step	Hourly
CALMET (v6.4.0)	Meteorological grid domain	50 km x 50 km
	Meteorological grid origin (SW corner)	783665 m; 6626835 m
	Meteorological grid resolution	0.1 km
	TERRAD value	5 km
	RMAX1	70 km
	RMAX2	70 km
	R1	30 km
	R2	30 km
	Cell Face Heights	0, 20, 40, 80, 160, 320, 700, 1300, 2300, 3000

5.3 Dispersion Modelling Configuration

CALPUFF is an advanced non steady state meteorological and air quality modelling system. The model advects 'puffs' of material emitted from modelled sources, simulating the dispersion and transformation processes along the way. The model has been adopted by the US Environmental Protection Agency (US EPA) in its guideline on air quality models. CALPUFF uses the 3D wind fields generated by CALMET with the primary output files from CALPUFF processed in CALPOST to produce time based concentration or deposition fluxes evaluated at selected receiver locations.

Particulate concentrations were simulated for a regular Cartesian receiver grid covering a 10 km by 10 km computational domain, set within the CALMET modelling domain with a grid resolution of 0.1 km. **Section 5.4** outlines the assumptions made for the AQIA. **Appendix I** contains an example CALPUFF input file.

5.4 Assumptions

Assumptions used in the computation of the GLCs and deposition for particulates using the CALPUFF dispersion model are listed below.

5.4.1 General

The following assumptions have been applied to the dispersion modelling of particulates from the Wave Hill Quarry and the Boral Quarry. Any assumptions which are specific to either dust sources are listed in **Section 5.4.2** and **Section 5.4.3.**

- Options within the CALPUFF model reflect the *NSW OEH Generic and Optimum Model Settings for the CALPUFF Modelling System* guidelines;
- Hourly meteorological data from Narrabri AWS was used to generate the hybrid CALMET meteorological file between 1 January 2013 and 31 December 2013;
- Silt content of the sites internal roadways was assumed to be 6.4%;

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- Wet deposition was not applied in the CALPUFF model;
- For dust deposition modelling, a geometric mass mean diameter (GMMD) of 12.8 µm for TSP and 7 µm for PM_{10} with geometric standard deviation (GSD) of 1.7 µm for TSP and 1.3 µm for PM_{10} respectively was applied (Midwest Research Institute, 2006); and
- Wheel generated dust from haul trucks within the quarry extraction area were modelled as multiple volume sources in CALPUFF. Each volume source has a separation distance of less than one quarter of the distance to the nearest residential receiver (i.e. 100 m). Particulate emissions were equally divided between volume sources.

5.4.2 Wave Hill Quarry

The Wave Hill Quarry was modelled using the following assumptions:

- Quarry operations have been modelled based on an extraction rate of 2,000 tonnes of basalt material extracted per day;
- 36 trucks (that is, a total of 72 vehicle movements) have been modelled per day;
- Plant equipment includes (SMK Consultants, 2019a):
  - Excavator (x2);
  - Front end loader (x3);
  - Product crusher (x3);
  - Vibrating screen (x2); and
  - Stacker (conveyor).
- Emission control factors (i.e. water sprays) are employed on the crushers and the vibrating screens (SMK Consultants, 2019b);
- Site entrance road is sealed. The unsealed haul road section (identified in **Figure 2**) has Level 2 (i.e. >2 L/m²/hr) watering implemented (75% control factor) (SMK Consultants, 2019b);
- The operating times for the quarry activities are as follows (Wave Hill Quarry, 2019):
  - Monday to Saturday: 7 am to 6 pm; and
  - Sundays and Public Holidays: Closed.
- The extraction area is assumed to be blasted. The implemented blasting frequency was conservatively assumed to be once a month. As advised by the proponent, the actual blasting frequency is likely to be less than once per month.

5.4.3 Cumulative Modelling (Boral Quarry)

The nearby Boral Quarry on Wave Hill Road was modelled using the following assumptions:

- Quarry operations have been modelled based on an extraction rate of 333 tonnes of basalt material per day. This equates to an annual extraction rate of 100,000 tonnes per year (Boral Quarry, 2019a). As this is the maximum permissible yearly extraction rate, this is considered a conservative estimate;
- 36 trucks (that is, a total of 72 vehicle movements) have been modelled per day (assumed to be the same as the Wave Hill Quarry);

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- Plant equipment includes (Boral Quarry, 2019b):
  - Primary jaw crusher;
  - Vibrating screen;
  - Excavator;
  - Front end loader;
  - Grader; and
  - Dozer.
- Emission control factors (i.e. water sprays) are employed on the primary jaw crusher and the vibrating screen (Boral Quarry, 2019b);
- Level 1 watering (<2 L/hr/m²) used on unsealed haul road (50% control factor);
- The operating times for the quarry activities are as follows (Boral Quarry, 2019a)
  - Monday to Saturday: 6 am to 6 pm; and
  - Sundays and Public Holidays: Closed.
- The extraction area is assumed to be blasted. The implemented blasting frequency was conservatively assumed to be once a month.

5.5 Emission Sources

The activities associated with the proposed operations with the potential to generate dust are:

- Blasting operations within the quarry extraction area;
- Operation of front end loader and excavator within the extraction area;
- Operation of the crushers and vibrating screens;
- Wind erosion from stockpiled quarry materials; and
- Dust generated by haul truck movements along short unpaved internal road (refer **Figure 2**).

Details of each emission source are given in **Table 6** and **Table 7**. The emission factors and estimates are based on Emission Estimation Technique (EET) Manual for Mining - Version 3.1 (DSEWPC, 2012) and AP-42 Air Pollutant Emission Factors 1 (Midwest Research Institute, 2006). Emissions from these manuals are based on typical emissions for coal mining, metalliferous mining operations and crushed stone processing. Sources of the emission factors used to calculate individual emission rates are cited in the footnotes of **Table 6** and **Table 7**. The emission factors that have been applied to the quarry operation can be considered as a conservative estimate.

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Table 6: Emissions Inventory - Wave Hill Quarry

Emitter Identifier	Emitter Name	Emission Factor			Modelled Days (days)	Modelled Working Hours (hrs/day)[1]	Emission Rate (g/s)			Modelled Location[2]		
		TSP	PM_{10}	Units			TSP	PM_{10}	$PM_{2.5}$	Easting (m)	Northing (m)	Ground Elevation (m)
Excav1[a]	Excavator	0.03	0.012	kg/t	288	10	1.389	0.667	0.100	212521	6631652	322
Excav2[a]	Excavator	0.03	0.012	kg/t	288	10	1.389	0.667	0.100	212411	6631508	332
FEL1[b]	Front End Loader	0.0016	0.00075	kg/t	288	10	0.088	0.042	0.006	212574	6631486	331
FEL2[b]	Front End Loader	0.0016	0.00075	kg/t	288	10	0.088	0.042	0.006	212499	6631477	316
FEL3[b]	Front End Loader	0.0016	0.00075	kg/t	288	10	0.088	0.042	0.006	212497	6631476	328
Crush1[c]	Cone Crusher	0.0006	0.0003	kg/t	288	10	0.033	0.015	0.003	212564	6631518	320
Crush2[c]	Jaw Crusher	0.0006	0.0003	kg/t	288	10	0.033	0.015	0.003	212534	6631507	318
Crush3[c]	Crusher	0.0006	0.0003	kg/t	288	10	0.033	0.015	0.003	212507	6631499	322
Screen1[d]	Vibrating Screen	0.0011	0.00037	kg/t	288	10	0.061	0.021	0.001	212560	6631498.00	319
Screen2[d]	Vibrating Screen	0.0011	0.00037	kg/t	288	10	0.061	0.021	0.001	212514	6631485.00	320
Stacker[e]	Stacker	0.00159	0.00015	kg/t	288	10	0.442	0.0008	0.000	212541	6631492.00	320
Blast[f]	Blast	4.50	2.334	kg/blast	288	1	1.251	0.648	0.097	212453	6631588	323
Erosion[g]	Erosion[4]	0.40	0.200	kg/ha/hr	288	24	1.111	0.556	0.083	212545	6631385	316

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HR1-HR3[h]	Wheel generated dust from truck movements	2.88	0.777	kg/VKT[3]	288	10	0.378	0.102	0.015	Varies	Varies	Varies

Notes:

Shaded cells indicate emission control factors (i.e. water sprays) have been employed.

[1] -Operating hours based on 7 am to 6 pm. With 1 hour of downtime per day. Monday to Saturday. No operations on Sunday.

[2] - Plant equipment locations based on the centre of the quarry extraction footprint.

[3] - Vehicle kilometres travelled.

[4] - Exposed surface area for erosion;10,000 m²

References (used to calculate emission rates):

[a] - Mining EET Appendix A Section 1.1.2 default factor for excavators on overburden (DSEWPC, 2012)

[b] - AP-42 Section 13.2.4 - Materials handling equation 1 (Midwest Research Institute, 2006)

[c] - AP-42 Section 11.19.2 Crushed stone processing and pulverized mineral processing, *controlled*. page 6 (Midwest Research Institute, 2006)

[d] - AP-42 Section 11.19.2 Crushed stone processing and pulverized mineral processing, *controlled*, page 6 (Midwest Research Institute, 2006)

[e] - Mining EET v3.1 page 16 default factor for misc. transfer points (including conveying) (DSEWPC, 2012)

[f] - (Dyno Nobel, 2010) - Quick reference guide, page 4, equations for first estimate in absence of data.

[g] - Mining EET v3.1 page 16 default factor for wind erosion (DSEWPC, 2012)

[h] - Mining EET v3.1 page 16 equation for wheel dust from unpaved roads at industrial sites (DSEWPC, 2012)

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Table 7: Emissions Inventory - Boral Quarry

Emitter Identifier	Emitter Name	Emission Factor			Modelled Days (days)	Modelled Working Hours (hrs/day)[1]	Emission Rate (g/s)			Modelled Location[2]		
		TSP	PM_{10}	Units			TSP	PM_{10}	$PM_{2.5}$	Easting (m)	Northing (m)	Ground Elevation (m)
Grader[a]	Grader	0.19	0.085	kg/VKT	288	11	0.096	0.043	0.006	787632	6632215	292
Excav[b]	Excavator	0.03	0.012	kg/t	288	11	0.231	0.111	0.017	787620	6632201	294
FEL[c]	Front end loader	0.0021	0.00101	kg/t	288	11	0.020	0.009	0.001	787637	6632202	294
Crush[d]	Jaw Crusher	0.0027	0.0003	kg/t	288	11	0.025	0.003	0.001	787643	6632137	292
Screen[e]	Screen	0.0011	0.00037	kg/t	288	11	0.010	0.003	0.001	787658	6632119	299
Dozer[f]	Dozer	9.796	2.086	kg/h/vehicle	288	11	2.721	0.579	0.087	787651	6632108	300
Blast[g]	Blasting	0.89	0.463	kg/blast	288	1	0.248	0.129	0.019	787752	6632144	300
Erosion[h]	Wind Erosion from Exposed Land and Stockpiles[4]	0.40	0.200	kg/ha/hr	365	24	0.378	0.189	0.028	787719	6632249	302
HR1-HR2[i]	Wheel generated dust from truck movements	2.88	0.074	kg/VKT[3]	288	11	0.276	0.011	0.011	Varies	Varies	Varies

Notes:

Shaded cells indicate emission control factors (i.e. water sprays) have been employed.

[1] -Operating hours based on 6 am to 6 pm. With 1 hour of downtime per day. Monday to Saturday. No operations on Sunday.

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[2] – Plant equipment locations based on the centre of the quarry extraction footprint.

[3] – Vehicle kilometres travelled.

[4] - Exposed surface area for erosion; 34,000 m²

References (for emission rates):

[a] – Mining EET v3.1 page 15 default factor for graders (DSEWPC, 2012)

[b] - Mining EET Appendix A Section 1.1.2 default factor for excavators on overburden (DSEWPC, 2012)

[c] - AP-42 Section 13.2.4 – Materials handling equation 1 (Midwest Research Institute, 2006)

[d] - AP-42 Section 11.19.2 Crushed stone processing and pulverized mineral processing, *controlled*, page 6 (Midwest Research Institute, 2006)

[e] - AP-42 Section 11.19.2 Crushed stone processing and pulverized mineral processing, *controlled*, page 6 Midwest Research Institute, 2006)

[f] - Mining EET v3.1 page 15 default factor for bulldozers handling material other than coal (DSEWPC, 2012)

[g] – (Dyno Nobel, 2010) – Quick reference guide, page 4, equations for first estimate in absence of data.

[h] - Mining EET v3.1 page 16 default factor for wind erosion (DSEWPC, 2012)

[i] - Mining EET v3.1 page 16 equation for wheel dust from unpaved roads at industrial sites (DSEWPC, 2012)

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6. DISPERSION MODELLING RESULTS

The predicted concentrations at selected sensitive receivers of the annual average PM_{10}, $PM_{2.5}$ and TSP for the Wave Hill Quarry are presented in **Table 8**. The subsequent modelling of particulate impacts on sensitive receivers are described in **Section 6.1** to **Section 6.4**. Contour plots for each assessment criteria are presented in **Appendix III**.

Table 8 presents a predicted cumulative 100th percentile annual average PM_{10}, $PM_{2.5}$ and TSP at sensitive receivers for the proposed quarry expansion.

6.1 Annual Average PM_{10}, $PM_{2.5}$ and TSP

Table 8: Predicted Annual Average PM_{10}, $PM_{2.5}$ and TSP at Sensitive Receivers

Receiver	Predicted Annual Average PM_{10} + Boral Quarry + Background (µg/m³)	Predicted Annual Average $PM_{2.5}$ + Boral Quarry + Background (µg/m³)	Predicted Annual Average TSP + Boral Quarry + Background (µg/m³)
Background[a] (µg/m³)	16.6	8.4[b]	33.2[c]
R1	17.7	8.7	35.8
R2	17.4	8.6	34.6
R3	16.8	8.5	33.6

[a] Background particulate concentrations obtained from the NSW OEH monitoring station at Narrabri
[b] $PM_{2.5}$ calculated as PM_{10} / 2
[c] TSP calculated as PM_{10} x 2

It should be noted that the annual average $PM_{2.5}$ background level is already exceeding the NSW EPA impact assessment criteria.

6.2 24 Hour Average PM_{10}

The predicted concentrations at selected sensitive receivers of the 24-hour average PM_{10} maximum increment for the Wave Hill Quarry are presented in **Table 9**.

Table 9: Maximum Impact of 24 Hour Average PM_{10}

Receiver	Wave Hill Quarry Maximum Predicted Increment (µg/m³)	Maximum Background Concentration (µg/m³)	Boral Quarry Calculated Increment (µg/m³) (7/11/2013)	Total (µg/m³)[1]
R1	11.79	47.5 (7/11/2013)	0.68	**59.9**
R2	6.79		0.02	**54.3**
R3	3.53		0.0	**51.0**

Notes:
[1] Shaded cells indicate exceedances of the 24 hour average PM_{10} impact assessment criteria

As the maximum background concentration used to determine the maximum impact is 95% of the criteria value (refer to **Table 2** NSW EPA Impact Assessment Criteria), the exceedances presented in **Table 9** are likely a result of elevated background. Therefore, a Level 2 contemporaneous and background assessment is required to determine if there are any additional exceedances of the PM_{10} impact assessment criteria as a result of the proposed operation.
A summary of the 24 hour average PM_{10} contemporaneous and background assessment (Level 2 Assessment) for identified sensitive receivers is presented in **Table 10**.

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Table 10: 24-Hour Average PM_{10} Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-Hour Average (µg/m³)					Date	PM_{10} 24-Hour Average (µg/m³)				
	Highest Background	Calculated Increment - Boral Quarry	Predicted Increment - Wave Hill Quarry	Receiver	Total		Background	Calculated Increment - Boral Quarry	Predicted Increment - Wave Hill Quarry	Receiver	Total
7/11/2013	47.5	0.7	0.3	R2	48.5	12/03/2013	11.9	0.0	11.7	R1	23.6
8/11/2013	46.7	0.0	0.0	R1	46.7	20/05/2013	20.0	0.6	9.2	R1	29.8
24/09/2013	44.7	0.9	1.1	R3	46.7	12/04/2013	9.9	0.0	7.5	R1	17.4
1/10/2013	43.7	0.4	2.4	R1	46.5	3/09/2013	15.7	4.5	6.8	R2	27.0
29/10/2013	39.2	0.1	0.6	R3	39.9	19/03/2013	12.8	0.0	6.7	R1	19.5
17/10/2013	38.5	0.1	0.0	R2	38.6	28/05/2013	10.9	0.0	6.3	R1	17.2
12/10/2013	36.1	0.0	0.0	R2	36.1	12/07/2013	16.2	0.0	5.9	R1	22.1
18/01/2013	35.7	1.2	1.3	R2	38.2	11/06/2013	11.9	0.0	5.7	R1	17.6
9/09/2013	35.7	0.0	0.0	R1	35.7	9/07/2013	11.7	0.0	5.4	R1	17.1
29/08/2013	34.9	0.0	0.0	R1	34.9	28/08/2013	19.2	0.0	5.3	R1	24.5
6/11/2013	34.2	0.5	0.4	R2	35.1	15/02/2013	7.6	0.0	5.1	R1	12.7
9/01/2013	33.1	0.5	0.6	R2	34.2	26/03/2013	18.9	0.3	4.4	R1	23.6
27/10/2013	32.5	0.0	0.0	R1	32.5	26/04/2013	25.9	0.0	4.3	R1	30.2
17/01/2013	31.5	1.1	2.1	R2	34.7	20/11/2013	8.5	0.0	4.3	R1	12.8
30/08/2013	31.4	0.4	1.3	R2	33.1	29/05/2013	16.5	0.1	4.2	R1	20.8
15/04/2013	31.3	2.7	2.0	R2	36.0	26/01/2013	8.0	0.1	4.1	R1	12.2
4/05/2013	31.2	0.4	0.4	R2	32.0	18/10/2013	24.9	0.0	4.0	R1	28.9

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Date	PM_{10} 24-Hour Average (µg/m³)					Date	PM_{10} 24-Hour Average (µg/m³)				
	Highest Background	Calculated Increment - Boral Quarry	Predicted Increment - Wave Hill Quarry	Receiver	Total		Background	Calculated Increment - Boral Quarry	Predicted Increment - Wave Hill Quarry	Receiver	Total
10/09/2013	30.7	0.2	0.0	R2	30.9	8/07/2013	14.1	0.0	3.9	R1	18.0
13/10/2013	30.7	0.0	0.0	R1	30.7	22/05/2013	14.1	0.7	3.8	R1	18.6
30/04/2013	30.6	1.0	1.0	R2	32.6	4/03/2013	7.1	0.0	3.6	R1	10.7
12/01/2013	30.5	0.0	0.0	R2	30.5	22/08/2013	17.2	3.6	3.6	R2	24.4
29/04/2013	30.4	1.5	2.0	R2	33.9	4/10/2013	12.1	0.0	3.6	R1	15.7
1/05/2013	30.0	0.6	1.6	R3	32.2	22/04/2013	19.5	4.9	3.5	R3	27.9
6/09/2013	29.9	1.0	1.4	R2	32.3	28/06/2013	9.0	0.0	3.5	R1	12.5
4/11/2013	29.6	0.0	0.0	R1	29.6	11/07/2013	8.9	0.0	3.4	R1	12.3

The level 2 contemporaneous and background assessment presented in **Table 10** indicates there are no exceedances of the 24-hour PM_{10} impact assessment criteria at nearby sensitive receivers.

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6.3 24-Hour Average PM2.5

The predicted concentrations at selected sensitive receiver of the 24-hour average $PM_{2.5}$ for the proposed operation are presented in **Table 11**. A maximum 24-hour $PM_{2.5}$ background concentration of 23.7 µg/m³ has been applied (refer **Table 4**) to determine if further assessment is required.

Table 11: Maximum Impact of 24 Hour Average $PM_{2.5}$

Receiver	Wave Hill Quarry Maximum Predicted Increment (µg/m³)	Maximum Background Concentration (µg/m³)	Boral Quarry Calculated Increment (µg/m³) (7/11/2013)[1]	Total (µg/m³)[2]
R1	1.8	23.7 (7/11/2013) [1]	0.1	**25.6**
R2	1.0		0.3	25.0
R3	0.3		0.0	24.0

Notes:
[1] $PM_{2.5}$ calculated as PM_{10} / 2
[2] Shaded cell indicates exceedances of the 24 hour average $PM_{2.5}$ impact assessment criteria

As the maximum background concentration used to determine the maximum impact is 95% of the criteria value (refer to **Table 2** NSW EPA Impact Assessment Criteria), the exceedance presented in **Table 11** is likely a result of elevated background. Therefore, a Level 2 contemporaneous and background assessment is required to determine if there are any additional exceedances of the $PM_{2.5}$ impact assessment criteria as a result of the proposed operation.

A summary of the 24 hour average $PM_{2.5}$ contemporaneous and background assessment (Level 2 Assessment) for identified sensitive receivers is presented in **Table 12**.

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Table 12: 24-Hour Average $PM_{2.5}$ Contemporaneous Impact and Background Assessment

Date	$PM_{2.5}$ 24-Hour Average (µg/m³)					Date	$PM_{2.5}$ 24-Hour Average (µg/m³)				
	Highest Background	Calculated Increment - Boral Quarry	Predicted Increment - Wave Hill Quarry	Receiver	Total		Background	Calculated Increment - Boral Quarry	Predicted Increment - Wave Hill Quarry	Receiver	Total
7/11/2013	23.8	0.1	0.0	R2	23.9	12/03/2013	6.0	0.0	1.8	R1	7.8
8/11/2013	23.4	0.0	0.0	R1	23.4	20/05/2013	10.0	0.1	1.4	R1	11.5
24/09/2013	22.4	0.1	0.2	R3	22.7	12/04/2013	5.0	0.0	1.1	R1	6.1
1/10/2013	21.9	0.1	0.4	R1	22.4	3/09/2013	7.9	0.9	1.0	R2	9.8
29/10/2013	19.6	0.0	0.1	R3	19.7	19/03/2013	6.4	0.0	1.0	R1	7.4
17/10/2013	19.3	0.0	0.0	R2	19.3	28/05/2013	5.5	0.0	1.0	R1	6.5
12/10/2013	18.1	0.0	0.0	R2	18.1	12/07/2013	8.1	0.0	0.9	R1	9.0
18/01/2013	17.9	0.3	0.2	R2	18.4	11/06/2013	6.0	0.0	0.9	R1	6.9
9/09/2013	17.9	0.0	0.0	R1	17.9	9/07/2013	5.9	0.0	0.8	R1	6.7
29/08/2013	17.5	0.0	0.0	R1	17.5	28/08/2013	9.6	0.0	0.8	R1	10.4
6/11/2013	17.1	0.1	0.1	R2	17.3	15/02/2013	3.8	0.0	0.8	R1	4.6
9/01/2013	16.6	0.1	0.1	R2	16.8	26/03/2013	9.5	0.0	0.7	R1	10.2
27/10/2013	16.3	0.0	0.0	R1	16.3	26/04/2013	13.0	0.0	0.6	R1	13.6
17/01/2013	15.8	0.2	0.3	R2	16.3	20/11/2013	4.3	0.0	0.6	R1	4.9
30/08/2013	15.7	0.1	0.2	R2	16.0	29/05/2013	8.3	0.0	0.6	R1	8.9
15/04/2013	15.7	0.7	0.3	R2	16.7	26/01/2013	4.0	0.0	0.6	R1	4.6
4/05/2013	15.6	0.1	0.1	R2	15.8	18/10/2013	12.5	0.0	0.6	R1	13.1

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Date	PM2.5 24-Hour Average (µg/m³)1					Date	PM2.5 24-Hour Average (µg/m³)				
	Highest Background	Calculated Increment - Boral Quarry	Predicted Increment - Wave Hill Quarry	Receiver	Total		Background	Calculated Increment - Boral Quarry	Predicted Increment - Wave Hill Quarry	Receiver	Total
10/09/2013	15.4	0.0	0.0	R2	15.4	8/07/2013	7.1	0.0	0.6	R1	7.7
13/10/2013	15.4	0.0	0.0	R1	15.4	22/05/2013	7.1	0.1	0.6	R1	7.8
30/04/2013	15.3	0.8	0.2	R2	16.3	4/03/2013	3.6	0.0	0.5	R1	4.1
12/01/2013	15.3	0.0	0.0	R2	15.3	22/08/2013	8.6	0.5	0.5	R2	9.6
29/04/2013	15.2	0.3	0.3	R2	15.8	4/10/2013	6.1	0.0	0.5	R1	6.6
1/05/2013	15.0	0.1	0.2	R3	15.3	22/04/2013	9.8	0.7	0.5	R3	11.0
6/09/2013	15.0	0.2	0.2	R2	15.4	28/06/2013	4.5	0.0	0.5	R1	5.0
4/11/2013	14.8	0.0	0.0	R1	14.8	11/07/2013	4.5	0.0	0.5	R1	5.0

The level 2 contemporaneous and background assessment presented in **Table 12** indicates there are no additional exceedances of the 24-hour $PM_{2.5}$ impact assessment criteria at nearby sensitive receivers.

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6.4 Dust Deposition

The predicted annual average dust deposition rates at selected sensitive receivers for the proposed operation are presented in **Table 13**.

Table 13: Predicted Dust Deposition at Sensitive Receivers

Receiver	Maximum Predicted Increment (g/m²/month)	Impact Assessment Criteria
R1	0.15	2 g/m²/month
R2	0.0	
R3	0.0	

There are no exceedances of the maximum increase in deposited dust level criteria of 2 g/m²/month at nearby sensitive receivers.

7. DISCUSSION

The particulate dispersion modelling indicates that the air quality impacts (that is, airborne dust) from the proposed expansion of the Wave Hill Quarry will not cause additional exceedances of the PM_{10}, $PM_{2.5}$ or TSP impact assessment criteria at sensitive receiver locations identified in this report. However, it should be noted that the annual average $PM_{2.5}$ background level was already in exceedance of the NSW EPA impact assessment criteria before considering the contributions of the quarries. The predicted cumulative impact from both quarries increases the annual average $PM_{2.5}$ from 8.4 µg/m³ to 8.7 µg/m³ for the most impacted receiver (receiver R1). This indicates that any exceedances that may occur are likely attributed to elevated background levels rather than significant incremental contributions from the operating quarries.

8. CONCLUSIONS AND RECOMMENDATIONS

Advitech modelled cumulative emissions to air impacts from the proposed Wave Hill Quarry expansion and the neighbouring Boral Quarry on nearby sensitive receivers. The results of the CALPUFF modelling indicate that the increase in annual extraction rate (from 200,000 tonnes per annum to 500,000 tonnes per annum) from the Wave Hill Quarry will result in some incremental increases in the particulate matter concentrations and dust deposition at nearby sensitive receiver locations. However, these incremental increases are predicted not to result in any additional exceedances of the NSW EPA assessment criteria for PM_{10}, $PM_{2.5}$, TSP or deposited dust.

To reduce any potential particulate impacts that may occur from the quarrying operations, Advitech recommends the following measures be implemented at the Wave Hill Quarry:

- Carry out activities on the premises in a manner that will minimise the emission of dust;
- Employ dust suppression sprays on plant crushing and screening equipment; and
- Apply water sprays (greater than 2 L/m².hr) to trafficable areas during haulage to reduce air emissions associated with truck movements.

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9. REFERENCES

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Appendix I Narrabri Airport Historical Wind Rose Data

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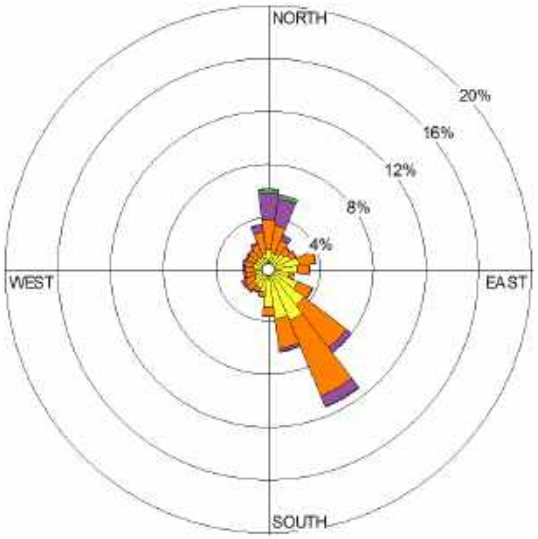
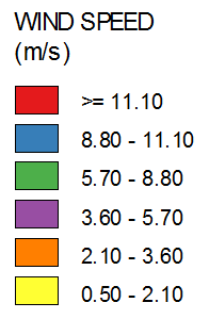
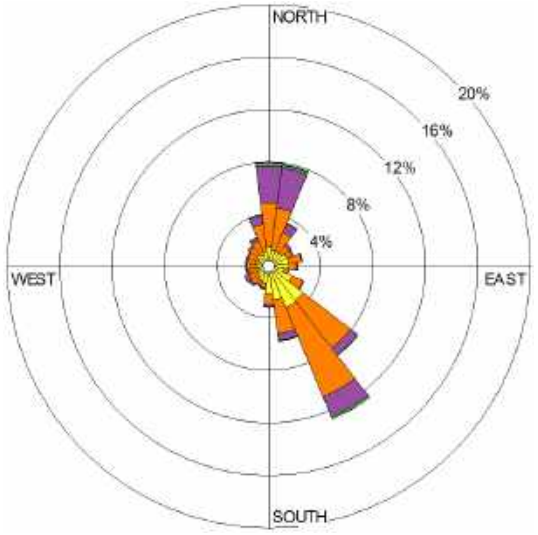
Narrabri Airport AWS (060801) 2012 - 2017 Annual and Seasonal Wind Roses

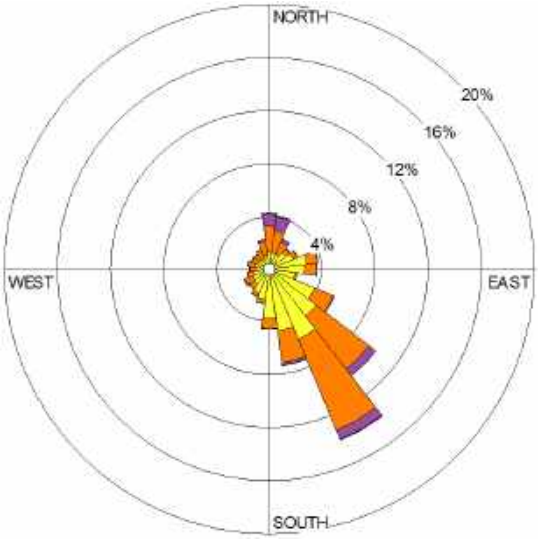


Annual - Calms = 8.98 %

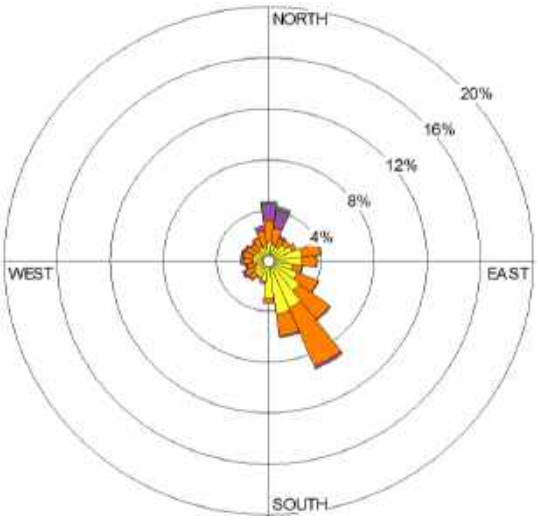




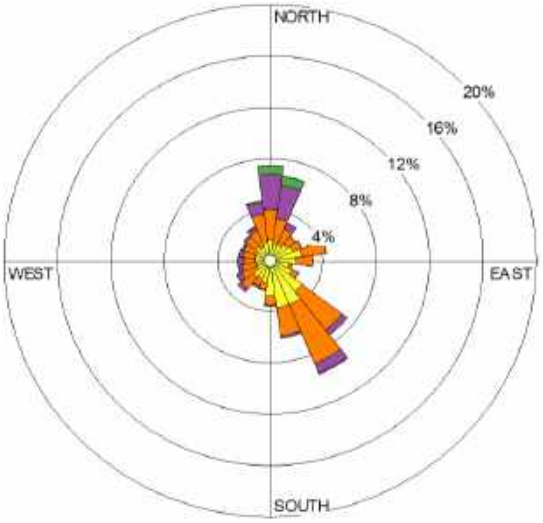
Summer (Jan, Feb, Dec) - Calms = 3.84 %



Autumn (Mar, Apr, May) - Calms = 11.76%



Winter (Jun, Jul, Aug) - Calms = 12.37%



Spring (Sep, Oct, Nov) - Calms = 7.95 %

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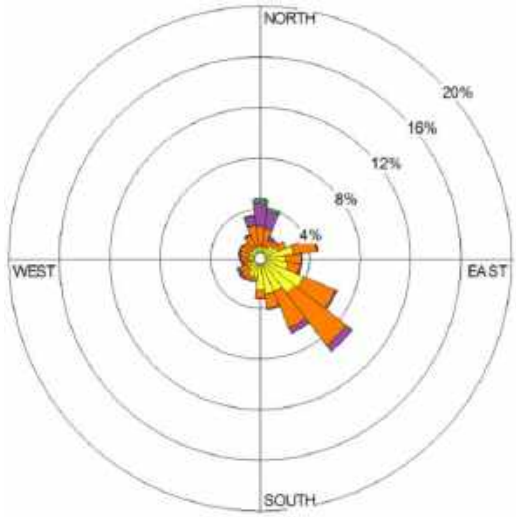
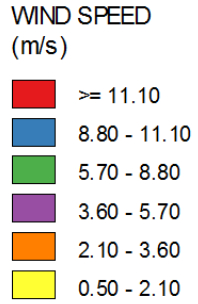
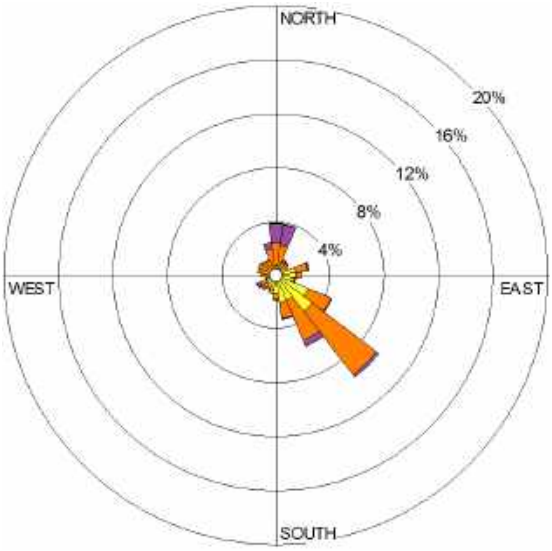
Narrabri Airport AWS (060801) 2012 Annual and Seasonal Wind Roses

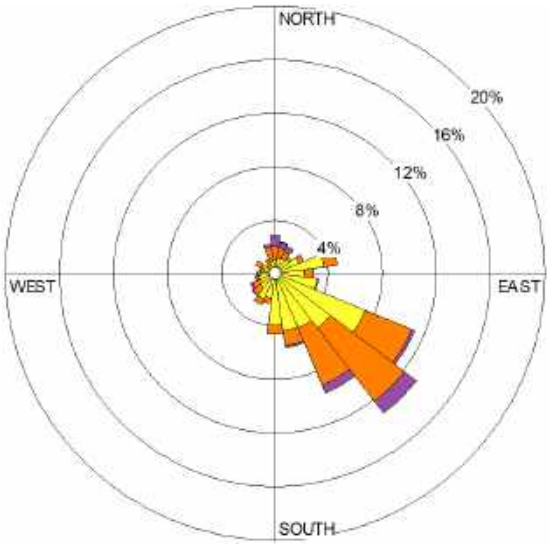


Annual - Calms = 8.57 %

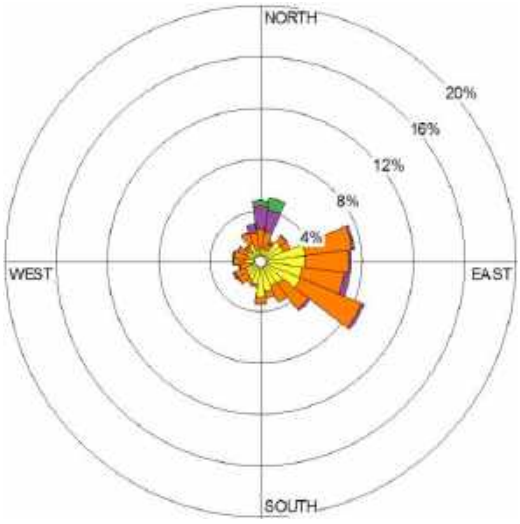




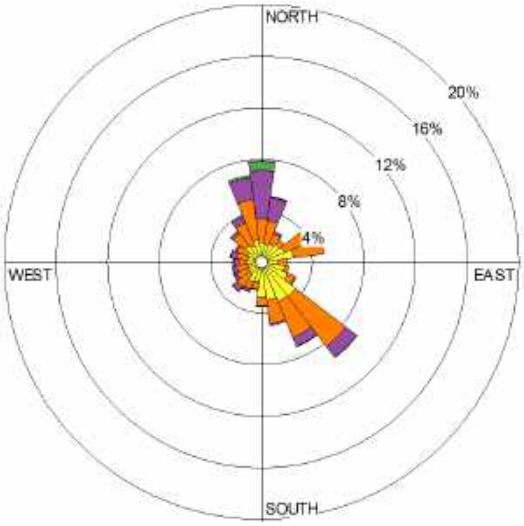
Summer (Jan, Feb, Dec) - Calms = 3.63 %



Autumn (Mar, Apr, May) - Calms = 13.71%



Winter (Jun, Jul, Aug) - Calms = 11.58%



Spring (Sep, Oct, Nov) - Calms = 7.55 %

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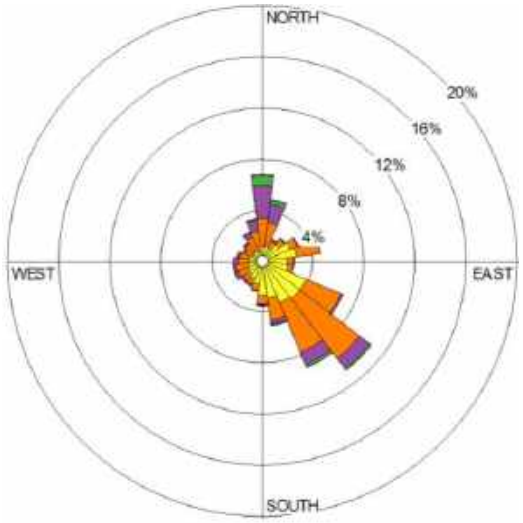
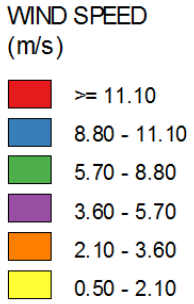
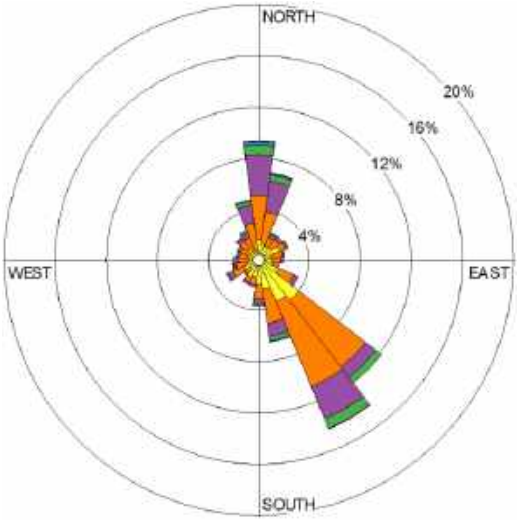
Narrabri Airport AWS (060801) 2013 Annual and Seasonal Wind Roses

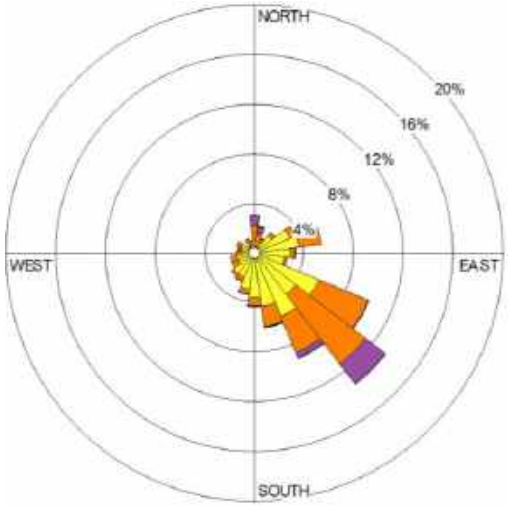


Annual - Calms = 9.94 %

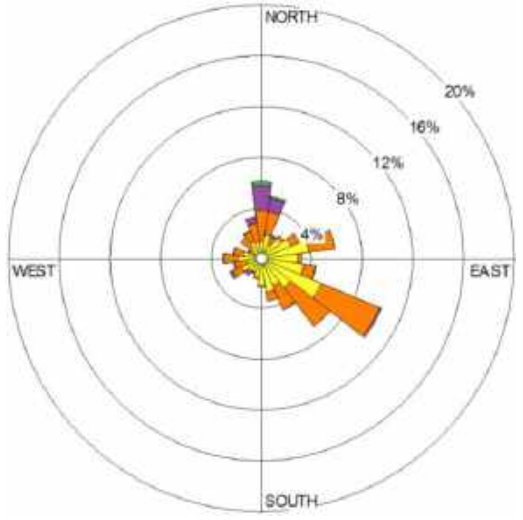




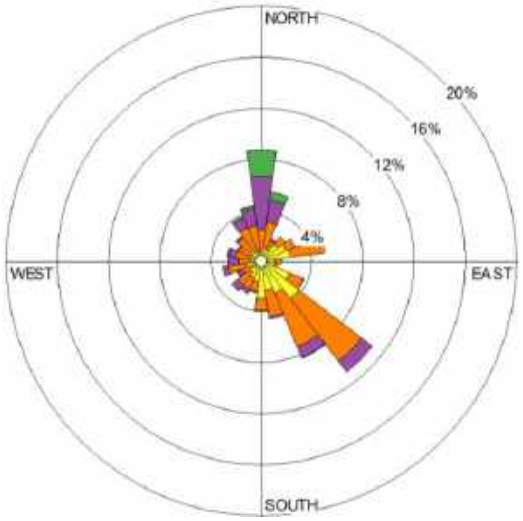
Summer (Jan, Feb, Dec) - Calms = 4.16 %



Autumn (Mar, Apr, May) - Calms = 12.65 %



Winter (Jun, Jul, Aug) - Calms = 15.90 %



Spring (Sep, Oct, Nov) - Calms = 6.90 %

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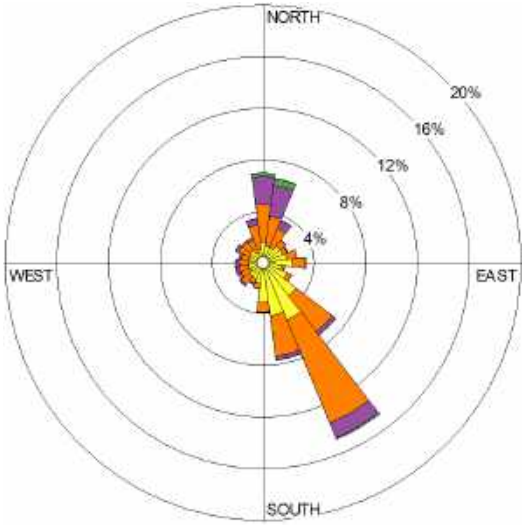
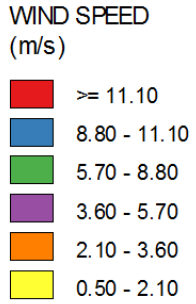
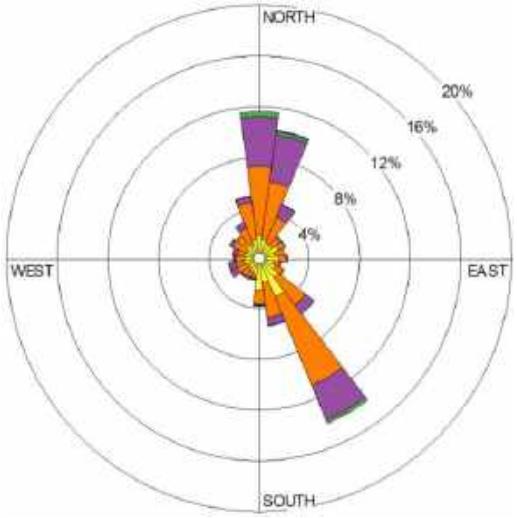
Narrabri Airport AWS (060801) 2014 Annual and Seasonal Wind Roses

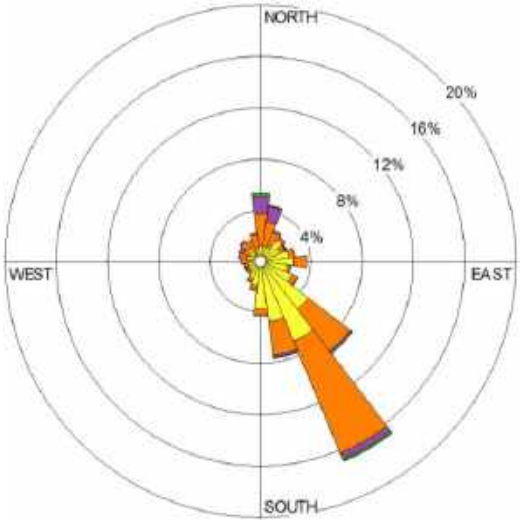


Annual - Calms = 8.86 %

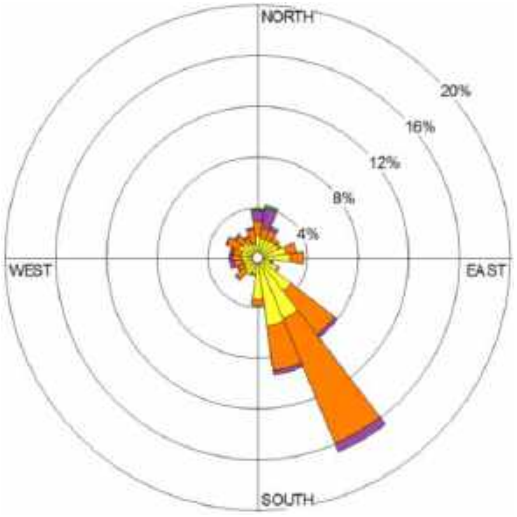




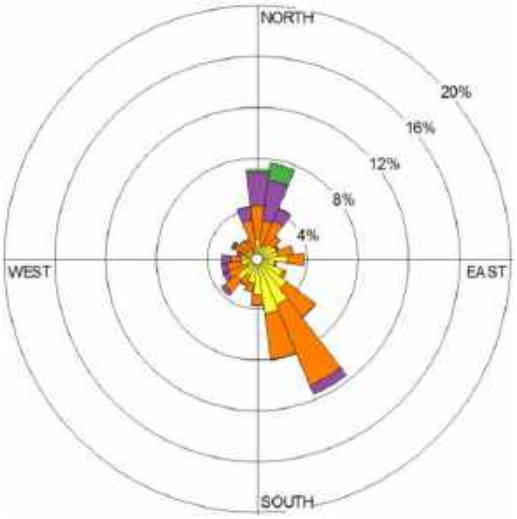
Summer (Jan, Feb, Dec) - Calms = 3.42 %



Autumn (Mar, Apr, May) - Calms = 12.34%



Winter (Jun, Jul, Aug) - Calms = 13.35%



Spring (Sep, Oct, Nov) - Calms = 6.21 %

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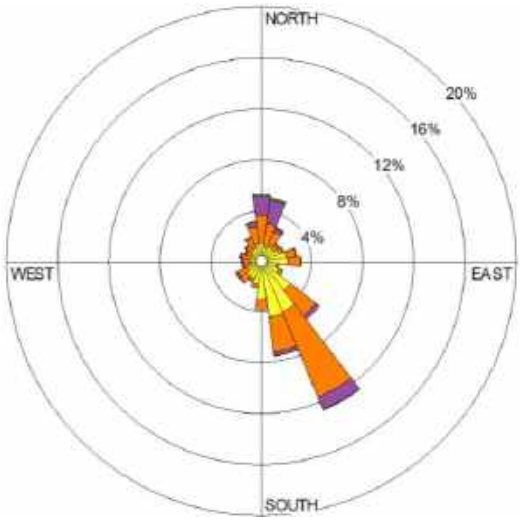
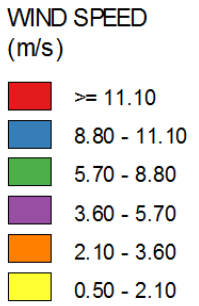
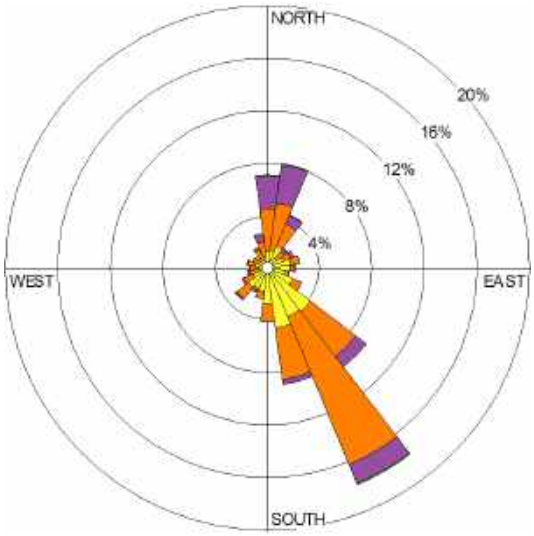
Narrabri Airport AWS (060801) 2015 Annual and Seasonal Wind Roses

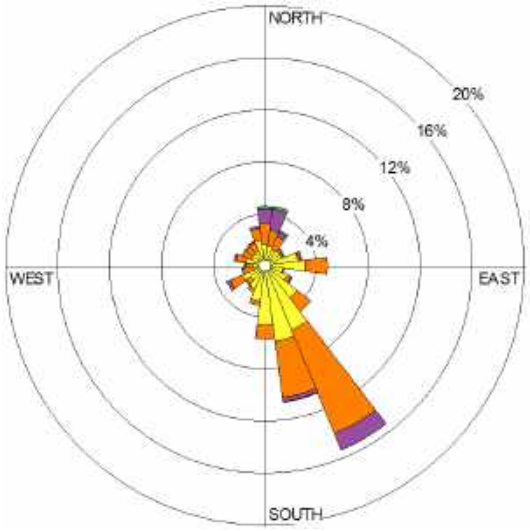


Annual - Calms = 7.38 %

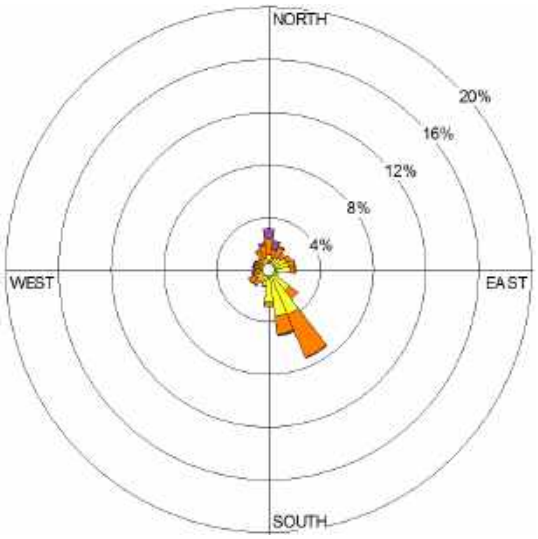




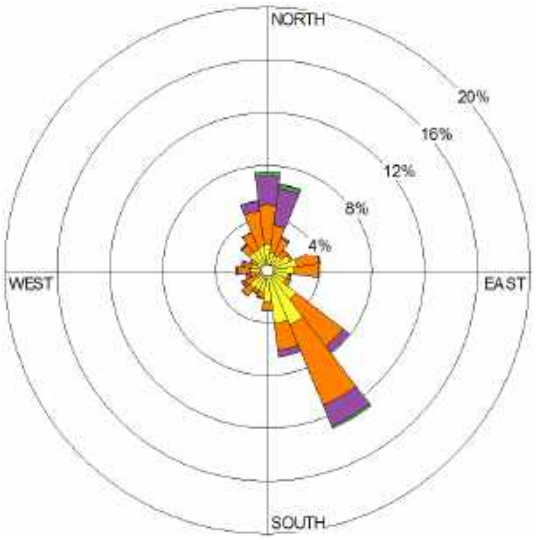
Summer (Jan, Feb, Dec) - Calms = 4.05 %



Autumn (Mar, Apr, May) - Calms = 8.72 %

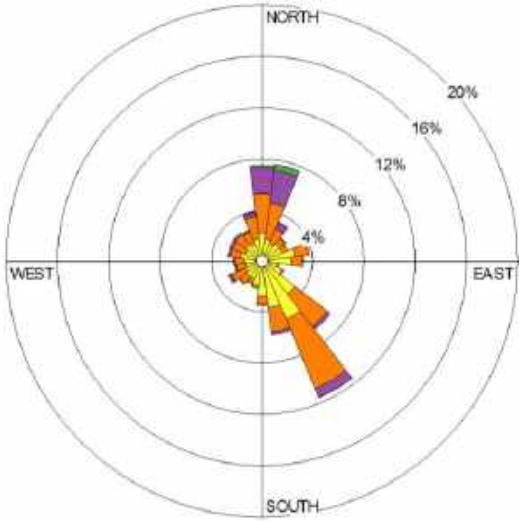


Winter (Jun, Jul, Aug) - Calms = 8.32 %

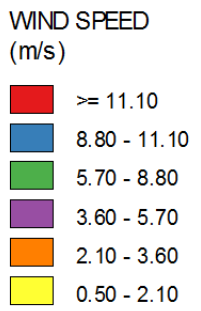


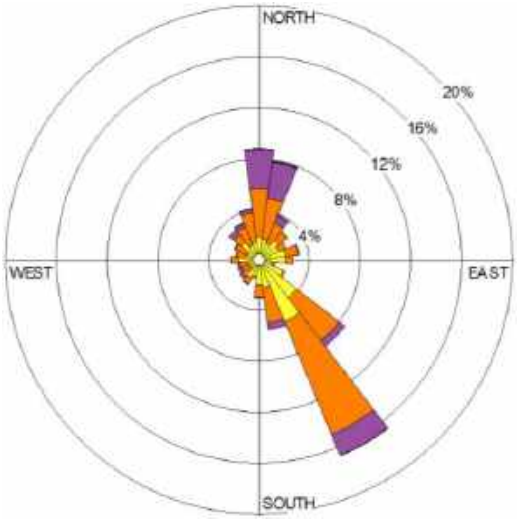
Spring (Sep, Oct, Nov) - Calms = 7.89 %

Narrabri Airport AWS (060801) 2016 Annual and Seasonal Wind Roses

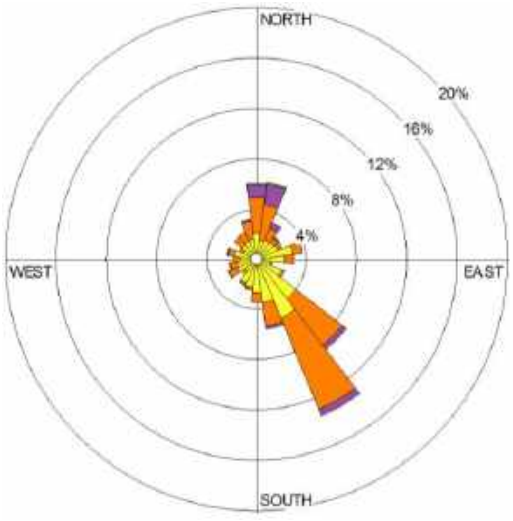


Annual - Calms = 9.44 %

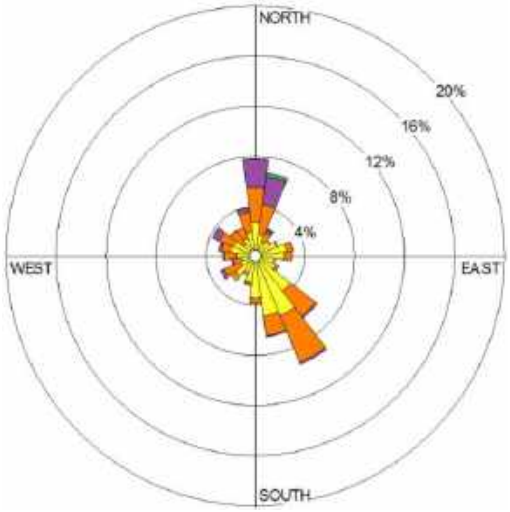




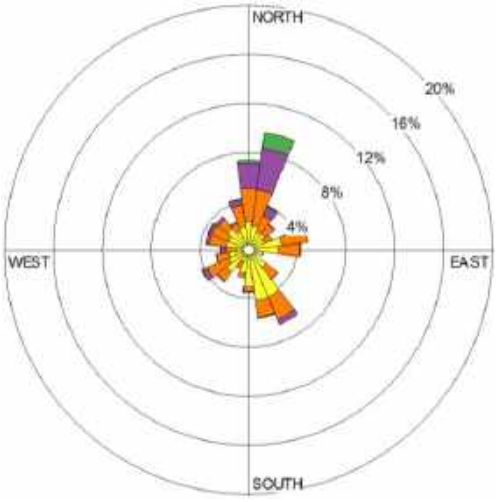
Summer (Jan, Feb, Dec) - Calms = 3.77 %



Autumn (Mar, Apr, May) - Calms = 12.06 %



Winter (Jun, Jul, Aug) - Calms = 13.04 %



Spring (Sep, Oct, Nov) - Calms = 8.87 %

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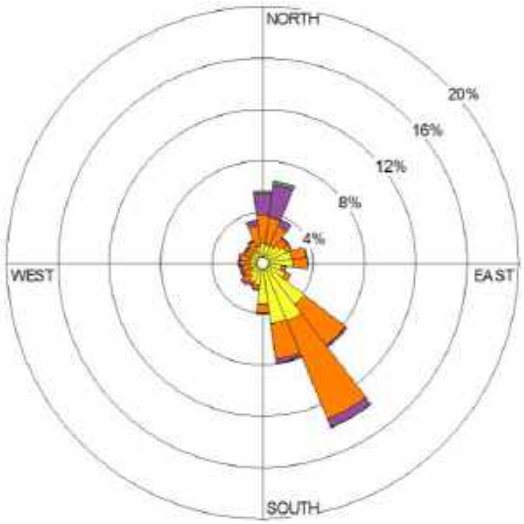
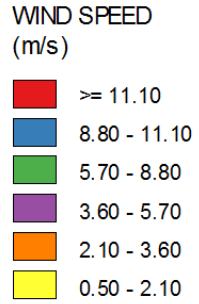
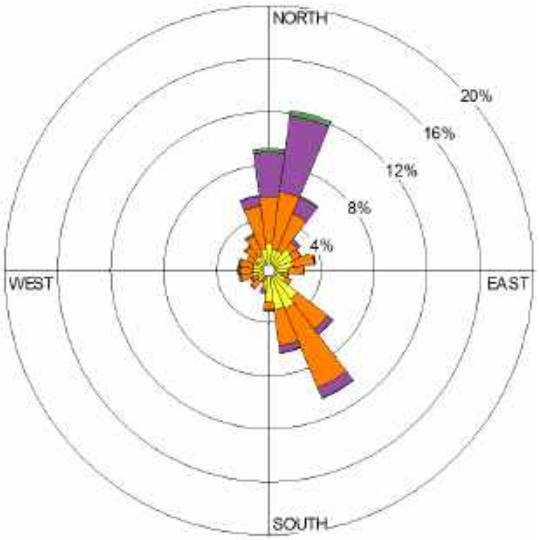
Narrabri Airport AWS (060801) 2017 Annual and Seasonal Wind Roses

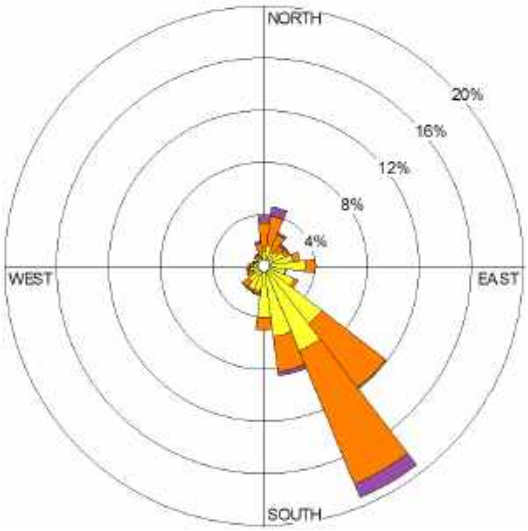


Annual - Calms = 9.97 %

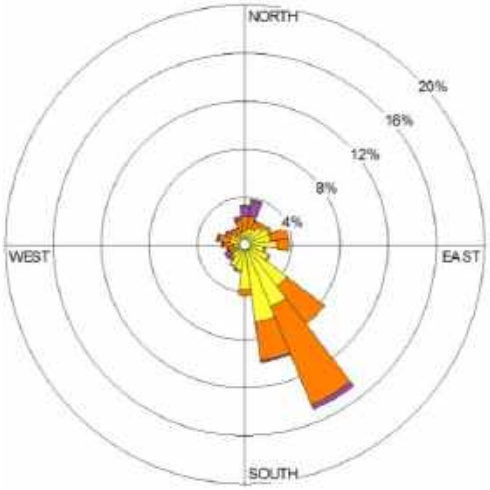




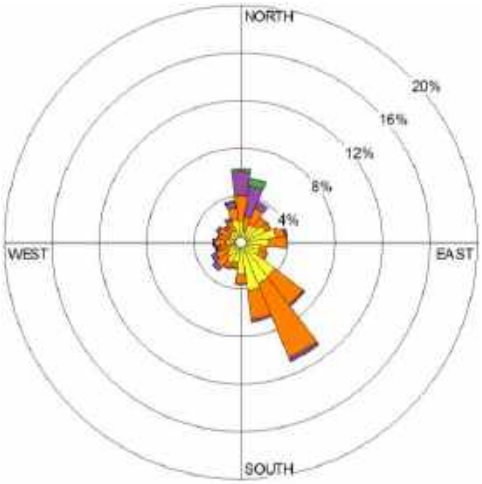
Summer (Jan, Feb, Dec) - Calms = 4.12 %



Autumn (Mar, Apr, May) - Calms = 12.06 %



Winter (Jun, Jul, Aug) - Calms = 14.17%



Spring (Sep, Oct, Nov) - Calms = 10.30 %

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Appendix II Example CALPUFF Input File

```
CALPUFF.INP     2.0             File version record
WaveHill


---------------- Run title (3 lines)
-------------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------
-----------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    ! METDAT = G:\WaveHill\CALMET
\calmet.dat !
    or
ISCMET.DAT    input    * ISCDAT =             *
    or
PLMMET.DAT    input    * PLMDAT =             *
    or
PROFILE.DAT   input    * PRFDAT =             *
SURFACE.DAT   input    * SFCDAT =             *
RESTARTB.DAT  input    * RSTARTB=             *
-------------------------------------------------------------
------------------
CALPUFF.LST   output   ! PUFLST = WaveHillGridded.lst !
CONC.DAT      output   ! CONDAT = WaveHillGridded.con !
DFLX.DAT      output   * DFDAT = *
WFLX.DAT      output   * WFDAT = *

VISB.DAT      output   * VISDAT = *
TK2D.DAT      output   * T2DDAT = *
RHO2D.DAT     output   * RHODAT = *
RESTARTE.DAT  output   * RSTARTE=             *
-------------------------------------------------------------
------------------
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT  =             *
VOLEMARB.DAT  input    ! VOLDAT =  F:\20924
\WaveHillQuarry.DAT!          *
BAEMARB.DAT   input    * ARDAT  =             *
LNEMARB.DAT   input    * LNDAT  =             *
-------------------------------------------------------------
------------------
Other Files
-----------
OZONE.DAT     input    * OZDAT  =             *
VD.DAT        input    * VDDAT  =             *
CHEM.DAT      input    * CHEMDAT=             *
AUX           input    * AUXEXT =             *
(Extension added to METDAT filename(s) for files
```



```
 with auxiliary 2D and 3D data)
H2O2.DAT      input    * H2O2DAT=             *
NH3Z.DAT      input    * NH3ZDAT=             *
HILL.DAT      input    * HILDAT=             *
HILLRCT.DAT   input    * RCTDAT=             *
COASTLN.DAT   input    * CSTDAT=             *
FLUXBDY.DAT   input    * BDYDAT=             *
BCON.DAT      input    * BCNDAT=             *
DEBUG.DAT     output   * DEBUG =             *
MASSFLX.DAT   output   * FLXDAT=             *
MASSBAL.DAT   output   * BALDAT=             *
FOG.DAT       output   * FOGDAT=             *
RISE.DAT      output   * RISDAT=             *
-------------------------------------------------------------
------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to
UPPER CASE
         T = lower case      ! LCFILES = T !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 132 characters in
length


Provision for multiple input files
----------------------------------

     Number of Modeling Domains (NMETDOM)
                                         Default: 1       !
NMETDOM =   1   !

     Number of CALMET.DAT files for run (NMETDAT)
                                         Default: 1       !
NMETDAT = 1 !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                         Default: 0       ! NPTDAT
=   0   !

     Number of BAEMARB.DAT files for run (NARDAT)
                                         Default: 0       ! NARDAT
=   0   !

     Number of VOLEMARB.DAT files for run (NVOLDAT)
                                         Default: 0       !
NVOLDAT =   0   !

!END!

-------------
Subgroup (0a)
-------------

  Provide a name for each CALMET domain if NMETDOM > 1
  Enter NMETDOM lines.
                                       a,b
Default Name             Domain Name
```


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```
------------             ------------
 none                  * DOMAIN=     *   *END*


  The following CALMET.DAT filenames are processed in sequence
  if NMETDAT > 1

  Enter NMETDAT lines, 1 line for each file name.

                                     a,c,d
Default Name  Type          File Name
------------  ----          ---------
 none         input    * METDAT=  *    *END*
-------------
    a
     The name for each CALMET domain and each CALMET.DAT file
is treated
     as a separate input subgroup and therefore must end with
an input
                group(terminator.
    b
     Use DOMAIN1= to assign the name for the outermost CALMET
domain.
     Use DOMAIN2= to assign the name for the next inner CALMET
domain.
     Use DOMAIN3= to assign the name for the next inner CALMET
domain, etc.
      -------------------------------------------------------
------------
      |   When inner domains with equal resolution (grid-cell
size)      |
      |   overlap, the data from the FIRST such domain in the
list will  |
      |   be used if all other criteria for choosing the
controlling     |
      |   grid domain are inconclusive.
|
      -------------------------------------------------------
------------
    c
     Use METDAT1= to assign the file names for the outermost
CALMET domain.
     Use METDAT2= to assign the file names for the next inner
CALMET domain.
     Use METDAT3= to assign the file names for the next inner
CALMET domain, etc.
    d
     The filenames for each domain must be provided in
sequential order

-------------
Subgroup (0b)
-------------

  The following PTEMARB.DAT filenames are processed if NPTDAT>
0
  (Each file contains a subset of the sources, for the entire
```



```
simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * PTDAT=     *   *END*


-------------
Subgroup (0c)
-------------

  The following BAEMARB.DAT filenames are processed if NARDAT>
0
  (Each file contains a subset of the sources, for the entire
simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * ARDAT=     *   *END*


-------------
Subgroup (0d)
-------------

  The following VOLEMARB.DAT filenames are processed if
NVOLDAT>0
  (Each file contains a subset of the sources, for the entire
simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * VOLDAT=     *   *END*


---------------------------------------------------------------
------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)   Default: 0       ! METRUN
= 1 !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:    Year   (IBYR)  --    No default   !
IBYR = 2011 !
                       Month  (IBMO)  --    No default   !
IBMO = 1 !
                       Day    (IBDY)  --    No default   !
IBDY = 1 !
     Starting time:    Hour   (IBHR)  --    No default   !
IBHR = 0 !
                       Minute (IBMIN) --    No default   !
```


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```
IBMIN = 0 !
                        Second (IBSEC) --    No default   !
IBSEC = 0 !

     Ending date:       Year   (IEYR)  --    No default   !
IEYR = 2012 !
                        Month  (IEMO)  --    No default   !
IEMO = 1 !
                        Day    (IEDY)  --    No default   !
IEDY = 1 !
     Ending time:       Hour   (IEHR)  --    No default   !
IEHR = 0 !
                        Minute (IEMIN) --    No default   !
IEMIN = 0 !
                        Second (IESEC) --    No default   !
IESEC = 0 !

     (These are only used if METRUN = 0)

     Base time zone:          (ABTZ)  --    No default   !
ABTZ = UTC+1000 !
      (character*8)
     The modeling domain may span multiple time zones.  ABTZ
defines the
     base time zone used for the entire simulation.  This must
match the
     base time zone of the meteorological data.
     Examples:
         Los Angeles, USA          = UTC-0800
         New York, USA             = UTC-0500
         Santiago, Chile           = UTC-0400
         Greenwich Mean Time (GMT) = UTC+0000
         Rome, Italy               = UTC+0100
         Cape Town, S.Africa       = UTC+0200
         Sydney, Australia         = UTC+1000

     Length of modeling time-step (seconds)
     Equal to update period in the primary
     meteorological data files, or an
     integer fraction of it (1/2, 1/3 ...)
     Must be no larger than 1 hour
     (NSECDT)                         Default:3600     ! NSECDT
=  3600  !
                                      Units: seconds

     Number of chemical species (NSPEC)
                                      Default: 5       ! NSPEC
= 3 !

     Number of chemical species
     to be emitted  (NSE)             Default: 3       ! NSE =
3 !

     Flag to stop run after
     SETUP phase (ITEST)              Default: 2       ! ITEST
=  2   !
     (Used to allow checking
```



```
     of the model inputs, files, etc.)
           ITEST = 1 - STOPS program after SETUP phase
           ITEST = 2 - Continues with execution of program
                       after SETUP

     Restart Configuration:

        Control flag (MRESTART)      Default: 0       !
MRESTART =  0   !

           0 = Do not read or write a restart file
           1 = Read a restart file at the beginning of
               the run
           2 = Write a restart file during run
           3 = Read a restart file at beginning of run
               and write a restart file during run

        Number of periods in Restart
        output cycle (NRESPD)        Default: 0       ! NRESPD
=  0   !

           0 = File written only at last period
          >0 = File updated every NRESPD periods

     Meteorological Data Format (METFM)
                                     Default: 1       ! METFM
=  1   !

           METFM = 1 - CALMET binary file (CALMET.MET)
           METFM = 2 - ISC ASCII file (ISCMET.MET)
           METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
           METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                       surface parameters file (SURFACE.DAT)
           METFM = 5 - AERMET tower file (PROFILE.DAT) and
                       surface parameters file (SURFACE.DAT)

     Meteorological Profile Data Format (MPRFFM)
            (used only for METFM = 1, 2, 3)
                                     Default: 1       ! MPRFFM
=  1   !

           MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)
           MPRFFM = 2 - AERMET tower file (PROFILE.DAT)

     PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
     Averaging Time (minutes) (AVET)
                                     Default: 60.0    ! AVET =
60. !
     PG Averaging Time (minutes) (PGTIME)
                                     Default: 60.0    ! PGTIME
= 60. !


     Output units for binary concentration and flux files
     written in Dataset v2.2 or later formats
     (IOUTU)                         Default: 1       ! IOUTU
=  1   !
```


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```
         1 = mass      -  g/m3 (conc) or g/m2/s (dep)
         2 = odour     -  odour_units (conc)
         3 = radiation -  Bq/m3 (conc) or Bq/m2/s (dep)


     Output Dataset format for binary concentration
     and flux files (e.g., CONC.DAT)
     (IOVERS)                        Default: 2       ! IOVERS
=  2   !
         1 = Dataset Version 2.1
         2 = Dataset Version 2.2


!END!


-------------------------------------------------------------
-----------------

INPUT GROUP: 2 -- Technical options
--------------


     Vertical distribution used in the
     near field (MGAUSS)                   Default: 1     !
MGAUSS =  1   !
        0 = uniform
        1 = Gaussian

     Terrain adjustment method
     (MCTADJ)                              Default: 3     !
MCTADJ =  3   !
        0 = no adjustment
        1 = ISC-type of terrain adjustment
        2 = simple, CALPUFF-type of terrain
            adjustment
        3 = partial plume path adjustment

     Subgrid-scale complex terrain
     flag (MCTSG)                          Default: 0     !
MCTSG =  0   !
        0 = not modeled
        1 = modeled

     Near-field puffs modeled as
     elongated slugs? (MSLUG)              Default: 0     !
MSLUG =  0   !
        0 = no
        1 = yes (slug model used)

     Transitional plume rise modeled?
     (MTRANS)                              Default: 1     !
MTRANS =  1   !
        0 = no  (i.e., final rise only)
        1 = yes (i.e., transitional rise computed)

     Stack tip downwash? (MTIP)            Default: 1     !
```



```
MTIP =  1  !
        0 = no  (i.e., no stack tip downwash)
        1 = yes (i.e., use stack tip downwash)

     Method used to compute plume rise for
     point sources not subject to building
     downwash? (MRISE)                     Default: 1     !
MRISE =  1  !
        1 = Briggs plume rise
        2 = Numerical plume rise

     Method used to simulate building
     downwash? (MBDW)                      Default: 1     !
MBDW = 1 !
        1 = ISC method
        2 = PRIME method

     Vertical wind shear modeled above
     stack top (modified Briggs plume rise)?
     (MSHEAR)                              Default: 0     !
MSHEAR =  0  !
        0 = no  (i.e., vertical wind shear not modeled)
        1 = yes (i.e., vertical wind shear modeled)

     Puff splitting allowed? (MSPLIT)      Default: 0     !
MSPLIT =  0  !
        0 = no (i.e., puffs not split)
        1 = yes (i.e., puffs are split)

     Chemical mechanism flag (MCHEM)       Default: 1     !
MCHEM = 0 !
        0 = chemical transformation not
            modeled
        1 = transformation rates computed
            internally (MESOPUFF II scheme)
        2 = user-specified transformation
            rates used
        3 = transformation rates computed
            internally (RIVAD/ARM3 scheme)
        4 = secondary organic aerosol formation
            computed (MESOPUFF II scheme for OH)
        5 = user-specified half-life with or
            without transfer to child species
        6 = transformation rates computed
            internally (Updated RIVAD scheme with
            ISORROPIA equilibrium)
        7 = transformation rates computed
            internally (Updated RIVAD scheme with
            ISORROPIA equilibrium and CalTech SOA)

     Aqueous phase transformation flag (MAQCHEM)
     (Used only if MCHEM = 6, or 7)        Default: 0     !
MAQCHEM = 0 !
        0 = aqueous phase transformation
            not modeled
        1 = transformation rates and wet
            scavenging coefficients adjusted
```


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```
            for in-cloud aqueous phase reactions
            (adapted from RADM cloud model
             implementation in CMAQ/SCICHEM)

     Liquid Water Content flag (MLWC)
     (Used only if MAQCHEM = 1)            Default: 1     !
MLWC =  1   !
        0 = water content estimated from cloud cover
            and presence of precipitation
        1 = gridded cloud water data read from CALMET
            water content output files (filenames are
            the CALMET.DAT names PLUS the extension
            AUXEXT provided in Input Group 0)

     Wet removal modeled ? (MWET)          Default: 1     !
MWET = 0 !
        0 = no
        1 = yes

     Dry deposition modeled ? (MDRY)       Default: 1     !
MDRY = 0 !
        0 = no
        1 = yes
        (dry deposition method specified
         for each species in Input Group 3)


     Gravitational settling (plume tilt)
     modeled ? (MTILT)                     Default: 0     !
MTILT =  0   !
        0 = no
        1 = yes
        (puff center falls at the gravitational
         settling velocity for 1 particle species)

     Restrictions:
         - MDRY  = 1
         - NSPEC = 1  (must be particle species as well)
         - sg    = 0  GEOMETRIC STANDARD DEVIATION in Group 8
is
                      set to zero for a single particle
diameter

     Method used to compute dispersion
     coefficients (MDISP)                  Default: 3     !
MDISP =  2   !

        1 = dispersion coefficients computed from measured
values
            of turbulence, sigma v, sigma w
        2 = dispersion coefficients from internally calculated
            sigma v, sigma w using micrometeorological
variables
            (u*, w*, L, etc.)
        3 = PG dispersion coefficients for RURAL areas
(computed using
            the ISCST multi-segment approximation) and MP
```



```
coefficients in
            urban areas
        4 = same as 3 except PG coefficients computed using
            the MESOPUFF II eqns.
        5 = CTDM sigmas used for stable and neutral
conditions.
            For unstable conditions, sigmas are computed as in
            MDISP = 3, described above.  MDISP = 5 assumes
that
            measured values are read

     Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
     (Used only if MDISP = 1 or 5)         Default: 3     !
MTURBVW =  3  !
        1 = use sigma-v or sigma-theta measurements
            from PROFILE.DAT to compute sigma-y
            (valid for METFM = 1, 2, 3, 4, 5)
        2 = use sigma-w measurements
            from PROFILE.DAT to compute sigma-z
            (valid for METFM = 1, 2, 3, 4, 5)
        3 = use both sigma-(v/theta) and sigma-w
            from PROFILE.DAT to compute sigma-y and sigma-z
            (valid for METFM = 1, 2, 3, 4, 5)
        4 = use sigma-theta measurements
            from PLMMET.DAT to compute sigma-y
            (valid only if METFM = 3)

     Back-up method used to compute dispersion
     when measured turbulence data are
     missing (MDISP2)                      Default: 3     !
MDISP2 =  3  !
     (used only if MDISP = 1 or 5)
        2 = dispersion coefficients from internally calculated
            sigma v, sigma w using micrometeorological
variables
            (u*, w*, L, etc.)
        3 = PG dispersion coefficients for RURAL areas
(computed using
            the ISCST multi-segment approximation) and MP
coefficients in
            urban areas
        4 = same as 3 except PG coefficients computed using
            the MESOPUFF II eqns.

     [DIAGNOSTIC FEATURE]
     Method used for Lagrangian timescale for Sigma-y
     (used only if MDISP=1,2 or MDISP2=1,2)
     (MTAULY)                              Default: 0     !
MTAULY =  0  !
        0 = Draxler default 617.284 (s)
        1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF
       10 < Direct user input (s)             -- e.g., 306.9


     [DIAGNOSTIC FEATURE]
     Method used for Advective-Decay timescale for Turbulence
     (used only if MDISP=2 or MDISP2=2)
```


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```
     (MTAUADV)                           Default: 0     !
MTAUADV =  0  !
        0 = No turbulence advection
        1 = Computed (OPTION NOT IMPLEMENTED)
       10 < Direct user input (s)   -- e.g., 800


     Method used to compute turbulence sigma-v &
     sigma-w using micrometeorological variables
     (Used only if MDISP = 2 or MDISP2 = 2)
     (MCTURB)                            Default: 1     !
MCTURB =  1  !
        1 = Standard CALPUFF subroutines
        2 = AERMOD subroutines

     PG sigma-y,z adj. for roughness?    Default: 0     !
MROUGH =  0  !
     (MROUGH)
        0 = no
        1 = yes

     Partial plume penetration of        Default: 1     !
MPARTL =  1  !
     elevated inversion modeled for
     point sources?
     (MPARTL)
        0 = no
        1 = yes

     Partial plume penetration of        Default: 1     !
MPARTLBA =  1  !
     elevated inversion modeled for
     buoyant area sources?
     (MPARTLBA)
        0 = no
        1 = yes

     Strength of temperature inversion   Default: 0     !
MTINV =  0  !
     provided in PROFILE.DAT extended records?
     (MTINV)
        0 = no (computed from measured/default gradients)
        1 = yes

     PDF used for dispersion under convective conditions?
                                         Default: 0     !
MPDF =  0  !
     (MPDF)
        0 = no
        1 = yes

     Sub-Grid TIBL module used for shore line?
                                         Default: 0     !
MSGTIBL = 0  !
     (MSGTIBL)
        0 = no
        1 = yes
```



```
     Boundary conditions (concentration) modeled?
                                         Default: 0     !
MBCON = 0  !
     (MBCON)
        0 = no
        1 = yes, using formatted BCON.DAT file
        2 = yes, using unformatted CONC.DAT file

     Note:  MBCON > 0 requires that the last species modeled
            be 'BCON'.  Mass is placed in species BCON when
            generating boundary condition puffs so that clean
            air entering the modeling domain can be simulated
            in the same way as polluted air.  Specify zero
            emission of species BCON for all regular sources.

     Individual source contributions saved?
                                         Default: 0     !
MSOURCE = 0  !
     (MSOURCE)
        0 = no
        1 = yes


     Analyses of fogging and icing impacts due to emissions
from
     arrays of mechanically-forced cooling towers can be
performed
     using CALPUFF in conjunction with a cooling tower
emissions
     processor (CTEMISS) and its associated postprocessors.
Hourly
     emissions of water vapor and temperature from each
cooling tower
     cell are computed for the current cell configuration and
ambient
     conditions by CTEMISS. CALPUFF models the dispersion of
these
     emissions and provides cloud information in a specialized
format
     for further analysis. Output to FOG.DAT is provided in
either
     'plume mode' or 'receptor mode' format.

     Configure for FOG Model output?
                                         Default: 0     !
MFOG =  0   !
     (MFOG)
        0 = no
        1 = yes  - report results in PLUME Mode format
        2 = yes  - report results in RECEPTOR Mode format


     Test options specified to see if
     they conform to regulatory
     values? (MREG)                      Default: 1     !
MREG =  0   !
```


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```
        0 = NO checks are made
        1 = Technical options must conform to USEPA
            Long Range Transport (LRT) guidance
                        METFM    1 or 2
                        AVET     60. (min)
                        PGTIME   60. (min)
                        MGAUSS   1
                        MCTADJ   3
                        MTRANS   1
                        MTIP     1
                        MRISE    1
                        MCHEM    1 or 3 (if modeling SOx, NOx)
                        MWET     1
                        MDRY     1
                        MDISP    2 or 3
                        MPDF     0 if MDISP=3
                                 1 if MDISP=2
                        MROUGH   0
                        MPARTL   1
                        MPARTLBA 0
                        SYTDEP   550. (m)
                        MHFTSZ   0
                        SVMIN    0.5 (m/s)


!END!


-------------------------------------------------------------
-----------------

INPUT GROUP: 3a, 3b -- Species list
-------------------

------------
Subgroup (3a)
------------

  The following species are modeled:
! CSPEC = TSP !         !END!
! CSPEC = PM10 !         !END!
! CSPEC = PM2.5 !         !END!

                                                        Dry
OUTPUT GROUP
    SPECIES          MODELED          EMITTED       DEPOSITED
NUMBER
     NAME         (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,
(0=NONE,
   (Limit: 12                                        1
=COMPUTED-GAS        1=1st CGRUP,
    Characters                                       2
=COMPUTED-PARTICLE   2=2nd CGRUP,
    in length)                                       3=USER-
SPECIFIED)     3= etc.)
!         TSP=       1,               1,           0,
```



```
0   !
!        PM10=       1,               1,           0,
0   !
!       PM2.5=       1,               1,           0,
0   !

!END!

  Note:  The last species in (3a) must be 'BCON' when using
the
         boundary condition option (MBCON > 0).  Species BCON
should
         typically be modeled as inert (no chem transformation
or
         removal).


------------
Subgroup (3b)
------------
  The following names are used for Species-Groups in which
results
  for certain species are combined (added) prior to output.
The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size
distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.


-------------------------------------------------------------
-----------------


INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                      Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                     Default=0.0     ! FEAST  =
0.000  !
     (FNORTH)                    Default=0.0     ! FNORTH =
```


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```
0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                    No Default      ! IUTMZN = 55
!

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                    Default: N      ! UTMHEM = S !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection
origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                     No Default      ! RLAT0 = 0N
!
     (RLON0)                     No Default      ! RLON0 = 0E
!

         TTM :  RLON0 identifies central (true N/S) meridian
of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian
of projection
                RLAT0 selected for convenience
         PS  :  RLON0 identifies central (grid N/S) meridian
of projection
                RLAT0 selected for convenience
         EM  :  RLON0 identifies central meridian of
projection
                RLAT0 is REPLACED by 0.0N (Equator)
         LAZA:  RLON0 identifies longitude of tangent-point of
mapping plane
                RLAT0 identifies latitude of tangent-point of
mapping plane

     Matching parallel(s) of latitude (decimal degrees) for
projection
     (Used only if PMAP= LCC or PS)
     (XLAT1)                     No Default      ! XLAT1 = 0N
!
     (XLAT2)                     No Default      ! XLAT2 = 0N
!

         LCC :  Projection cone slices through Earth's surface
at XLAT1 and XLAT2
         PS  :  Projection plane slices through Earth at XLAT1
                (XLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and
include a
            letter N,S,E, or W indicating north or south
latitude, and
            east or west longitude.  For example,
```



```
            35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E


     Datum-region
     ------------

     The Datum-Region for the coordinates is identified by a
character
     string.  Many mapping products currently available use
the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).
Other local
     models may be in use, and their selection in CALMET will
make its output
     consistent with local mapping products.  The list of
Datum-Regions with
     official transformation parameters is provided by the
National Imagery and
     Mapping Agency (NIMA).

     NIMA Datum - Regions(Examples)
     ---------------------------------------------------------
---------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global
coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN
FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR
CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

     Datum-region for output coordinates
     (DATUM)                     Default: WGS-84    ! DATUM =
WGS-84 !


METEOROLOGICAL Grid:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =
100 !
            No. Y grid cells (NY)      No default     ! NY =
100 !
         No. vertical layers (NZ)      No default     ! NZ =
11 !

           Grid spacing (DGRIDKM)      No default     !
DGRIDKM = 0.1 !
                                       Units: km

                Cell face heights
                    (ZFACE(nz+1))      No defaults
                                       Units: m
```


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```
   ! ZFACE = 0,20,40,80,160,320,640,1000,1500,2000,2500,3000 !

            Reference Coordinates
           of SOUTHWEST corner of
                grid cell(1, 1):

            X coordinate (XORIGKM)     No default     !
XORIGKM = 783.665 !
            Y coordinate (YORIGKM)     No default     !
YORIGKM = 6626.835 !
                                     Units: km


COMPUTATIONAL Grid:

     The computational grid is identical to or a subset of the
MET. grid.
     The lower left (LL) corner of the computational grid is
at grid point
     (IBCOMP, JBCOMP) of the MET. grid.  The upper right (UR)
corner of the
     computational grid is at grid point (IECOMP, JECOMP) of
the MET. grid.
     The grid spacing of the computational grid is the same as
the MET. grid.

        X index of LL corner (IBCOMP)      No default     !
IBCOMP = 1 !
                  (1 <= IBCOMP <= NX)

        Y index of LL corner (JBCOMP)      No default     !
JBCOMP = 1 !
                  (1 <= JBCOMP <= NY)


        X index of UR corner (IECOMP)      No default     !
IECOMP = 100 !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     !
JECOMP = 100 !
                  (1 <= JECOMP <= NY)


SAMPLING Grid (GRIDDED RECEPTORS):

     The lower left (LL) corner of the sampling grid is at
grid point
     (IBSAMP, JBSAMP) of the MET. grid.  The upper right (UR)
corner of the
     sampling grid is at grid point (IESAMP, JESAMP) of the
MET. grid.
     The sampling grid must be identical to or a subset of the
computational
     grid.  It may be a nested grid inside the computational
grid.
```



```
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.

        Logical flag indicating if gridded
        receptors are used (LSAMP)         Default: T     !
LSAMP = T !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)      No default     !
IBSAMP = 1 !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)      No default     !
JBSAMP = 1 !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)      No default     !
IESAMP = 100 !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     !
JESAMP = 100 !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                      Default: 1     !
MESHDN = 1 !
        (MESHDN is an integer >= 1)

!END!


-------------------------------------------------------------
-----------------


INPUT GROUP: 5 -- Output Options
--------------
                                                  *
*
     FILE                        DEFAULT VALUE
VALUE THIS RUN
     ----                        -------------
--------------

   Concentrations (ICON)              1                   !
ICON = 1 !
   Dry Fluxes (IDRY)                  1                   !
IDRY = 0 !
   Wet Fluxes (IWET)                  1                   !
IWET = 0 !
   2D Temperature (IT2D)              0                   !
IT2D = 0 !
   2D Density (IRHO)                  0                   !
IRHO = 0 !
   Relative Humidity (IVIS)           1                   !
```


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```
IVIS = 0 !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                          Default: T         !
LCOMPRS = T !

   *
    0 = Do not create file, 1 = create file


    QA PLOT FILE OUTPUT OPTION:

       Create a standard series of output files (e.g.
       locations of sources, receptors, grids ...)
       suitable for plotting?
       (IQAPLOT)                      Default: 1         !
IQAPLOT = 1 !
         0 = no
         1 = yes

    DIAGNOSTIC PUFF-TRACKING OUTPUT OPTION:

       Puff locations and properties reported to
       PFTRAK.DAT file for postprocessing?
       (IPFTRAK)                      Default: 0         !
IPFTRAK =  0   !
         0 = no
         1 = yes, update puff output at end of each timestep
         2 = yes, update puff output at end of each sampling
step

    DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

       Mass flux across specified boundaries
       for selected species reported?
       (IMFLX)                        Default: 0         !
IMFLX =  0  !
         0 = no
         1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
                  are specified in Input Group 0)

       Mass balance for each species
       reported?
       (IMBAL)                        Default: 0         !
IMBAL =  0  !
         0 = no
         1 = yes (MASSBAL.DAT filename is
              specified in Input Group 0)


    NUMERICAL RISE OUTPUT OPTION:

       Create a file with plume properties for each rise
       increment, for each model timestep?
       This applies to sources modeled with numerical rise
```



```
       and is limited to ONE source in the run.
       (INRISE)                       Default: 0         !
INRISE =  0  !
         0 = no
         1 = yes (RISE.DAT filename is
                  specified in Input Group 0)


    LINE PRINTER OUTPUT OPTIONS:

       Print concentrations (ICPRT)   Default: 0         !
ICPRT =  1   !
       Print dry fluxes (IDPRT)       Default: 0         !
IDPRT =  0   !
       Print wet fluxes (IWPRT)       Default: 0         !
IWPRT =  0   !
       (0 = Do not print, 1 = Print)

       Concentration print interval
       (ICFRQ) in timesteps           Default: 1         !
ICFRQ =  1   !
       Dry flux print interval
       (IDFRQ) in timesteps           Default: 1         !
IDFRQ =  1   !
       Wet flux print interval
       (IWFRQ) in timesteps           Default: 1         !
IWFRQ =  1   !

       Units for Line Printer Output
       (IPRTU)                        Default: 1         !
IPRTU =  3   !
                      for            for
                 Concentration    Deposition
          1 =       g/m**3         g/m**2/s
          2 =      mg/m**3        mg/m**2/s
          3 =      ug/m**3        ug/m**2/s
          4 =      ng/m**3        ng/m**2/s
          5 =     Odour Units

       Messages tracking progress of run
       written to the screen ?
       (IMESG)                        Default: 2         !
IMESG =  2   !
         0 = no
         1 = yes (advection step, puff ID)
         2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)


     SPECIES (or GROUP for combined species) LIST FOR OUTPUT
OPTIONS

                 ---- CONCENTRATIONS ----   ------ DRY FLUXES
------   ------ WET FLUXES ------   -- MASS FLUX --
   SPECIES
   /GROUP        PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON
DISK?   PRINTED?  SAVED ON DISK?   SAVED ON DISK?
   -------       ------------------------
```


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```
------------------------   ------------------------
---------------
!          TSP=   0,           1,           0,           0,
0,           0,           0   !
!         PM10=   0,           1,           0,           0,
0,           0,           0   !
!        PM2.5=   0,           1,           0,           0,
0,           0,           0   !
  Note:  Species BCON (for MBCON > 0) does not need to be
saved on disk.


     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                  Default: F
! LDEBUG = F !

       First puff to track
       (IPFDEB)                                  Default: 1
! IPFDEB =  1  !

       Number of puffs to track
       (NPFDEB)                                  Default: 1
! NPFDEB =  1  !

       Met. period to start output
       (NN1)                                     Default: 1
! NN1 =  1   !

       Met. period to end output
       (NN2)                                     Default: 10
! NN2 =  10  !

!END!


-----------------------------------------------------------------
-----------------


INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain
inputs
-------------------------

---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)        Default: 0
! NHILL =  0   !

       Number of special complex terrain
       receptors  (NCTREC)                       Default: 0
! NCTREC =  0   !

       Terrain and CTSG Receptor data for
       CTSG hills input in CTDM format ?
```



```
       (MHILL)                                   No Default
! MHILL =  2   !
       1 = Hill and Receptor data created
           by CTDM processors & read from
           HILL.DAT and HILLRCT.DAT files
       2 = Hill data created by OPTHILL &
           input below in Subgroup (6b);
           Receptor data in Subgroup (6c)

       Factor to convert horizontal dimensions  Default: 1.0
! XHILL2M = 1.0 !
       to meters (MHILL=1)

       Factor to convert vertical dimensions    Default: 1.0
! ZHILL2M = 1.0 !
       to meters (MHILL=1)

       X-origin of CTDM system relative to      No Default
! XCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

       Y-origin of CTDM system relative to      No Default
! YCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

---------------
Subgroup (6b)
---------------

                      1 **
     HILL information


HILL           XC         YC       THETAH  ZGRID  RELIEF
EXPO 1    EXPO 2   SCALE 1    SCALE 2    AMAX1     AMAX2
 NO.          (km)       (km)       (deg.)   (m)      (m)
(m)        (m)        (m)         (m)        (m)        (m)
----        ----      ----      ------  -----  ------
------    ------   -------    -------    -----     -----

---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                      XRCT         YRCT        ZRCT
XHH
                      (km)         (km)         (m)
                     ------       -----      ------
----


-------------------
1
```


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```
     Description of Complex Terrain Variables:
          XC, YC  = Coordinates of center of hill
          THETAH  = Orientation of major axis of hill
(clockwise from
                    North)
          ZGRID   = Height of the  0  of the grid above mean
sea
                    level
          RELIEF  = Height of the crest of the hill above the
grid elevation
          EXPO 1  = Hill-shape exponent for the major axis
          EXPO 2  = Hill-shape exponent for the major axis
          SCALE 1 = Horizontal length scale along the major
axis
          SCALE 2 = Horizontal length scale along the minor
axis
          AMAX    = Maximum allowed axis length for the major
axis
          BMAX    = Maximum allowed axis length for the major
axis

          XRCT, YRCT = Coordinates of the complex terrain
receptors
          ZRCT    = Height of the ground (MSL) at the complex
terrain
                    Receptor
          XHH     = Hill number associated with each complex
terrain receptor
                     (NOTE: MUST BE ENTERED AS A REAL NUMBER)

   **
     NOTE: DATA for each hill and CTSG receptor are treated as
a separate
           input subgroup and therefore must end with an input
group terminator.

-----------------------------------------------------------------
-----------------


INPUT GROUP: 7 -- Chemical parameters for dry deposition of
gases
--------------

      SPECIES     DIFFUSIVITY      ALPHA STAR      REACTIVITY
MESOPHYLL RESISTANCE     HENRY'S LAW COEFFICIENT
       NAME        (cm**2/s)
(s/cm)                (dimensionless)
     -------     -----------      ----------      ----------
--------------------     ------------------------



!END!


-----------------------------------------------------------------
```



```
-----------------


INPUT GROUP: 8 -- Size parameters for dry deposition of
particles
--------------

     For SINGLE SPECIES, the mean and standard deviation are
used to
     compute a deposition velocity for NINT (see group 9)
size-ranges,
     and these are then averaged to obtain a mean deposition
velocity.

     For GROUPED SPECIES, the size distribution should be
explicitly
     specified (by the 'species' in the group), and the
standard deviation
     for each should be entered as 0.  The model will then use
the
     deposition velocity for the stated mean diameter.

      SPECIES      GEOMETRIC MASS MEAN        GEOMETRIC
STANDARD
       NAME             DIAMETER                  DEVIATION
                         (microns)                 (microns)
      -------      -------------------
------------------


!END!


-----------------------------------------------------------------
-----------------


INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------

     Reference cuticle resistance (s/cm)
     (RCUTR)                            Default: 30    !  RCUTR
= 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                              Default: 10    !    RGR
= 10.0 !
     Reference pollutant reactivity
     (REACTR)                           Default: 8     ! REACTR
= 8.0 !

     Number of particle-size intervals used to
     evaluate effective particle deposition velocity
     (NINT)                             Default: 9     !   NINT
=  9  !

     Vegetation state in unirrigated areas
     (IVEG)                             Default: 1     !   IVEG
```


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```
=  1   !
        IVEG=1 for active and unstressed vegetation
        IVEG=2 for active and stressed vegetation
        IVEG=3 for inactive vegetation

!END!


-------------------------------------------------------------
-----------------


INPUT GROUP: 10 -- Wet Deposition Parameters
---------------


                     Scavenging Coefficient -- Units: (sec)**
(-1)

       Pollutant      Liquid Precip.       Frozen Precip.
       ---------      --------------       --------------


!END!


-------------------------------------------------------------
-----------------


INPUT GROUP: 11a, 11b -- Chemistry Parameters
---------------------

---------------
Subgroup (11a)
---------------

     Several parameters are needed for one or more of the
chemical transformation
     mechanisms.  Those used for each mechanism are:
                                       M                B
                                       A  B  R  R  R    C  B
N
                                  B    V  C  N  N  N  M  K  C
O    D
                                  C  M  G  K  I  I  I  H  H  K
F  V  E
                              M  K  N  N  N  T  T  T  2  2  P
R  C  C
                              O  O  H  H  H  E  E  E  O  O  M
A  N  A
     Mechanism (MCHEM)        Z  3  3  3  3  1  2  3  2  2  F
C  X  Y
     --------------------
---------------------------------------------
     0 None                   .  .  .  .  .  .  .  .  .  .  .
.  .  .
```



```
     1 MESOPUFF II            X  X  .  .  X  X  X  X  .  .  .
.  .  .
     2 User Rates             .  .  .  .  .  .  .  .  .  .  .
.  .  .
     3 RIVAD                  X  X  .  .  X  .  .  .  .  .  .
.  .  .
     4 SOA                    X  X  .  .  .  .  .  .  .  .  X
X  X  .
     5 Radioactive Decay      .  .  .  .  .  .  .  .  .  .  .
.  .  X
     6 RIVAD/ISORRPIA         X  X  X  X  X  X  .  .  X  X  .
.  .  .
     7 RIVAD/ISORRPIA/SOA     X  X  X  X  X  X  .  .  X  X  X
X  .  .


     Ozone data input option (MOZ)     Default: 1            !
MOZ =  1   !
     (Used only if MCHEM = 1, 3, 4, 6, or 7)
        0 = use a monthly background ozone value
        1 = read hourly ozone concentrations from
            the OZONE.DAT data file

     Monthly ozone concentrations in ppb (BCKO3)
     (Used only if MCHEM = 1,3,4,6, or 7 and either
        MOZ = 0, or
        MOZ = 1 and all hourly O3 data missing)
                                       Default: 12*80.
     !  BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00,
80.00, 80.00, 80.00, 80.00, 80.00, 80.00 !

     Ammonia data option (MNH3)        Default: 0            !
MNH3 =  0   !
     (Used only if MCHEM = 6 or 7)
        0 = use monthly background ammonia values (BCKNH3) -
no vertical variation
        1 = read monthly background ammonia values for each
layer from
            the NH3Z.DAT data file

     Ammonia vertical averaging option (MAVGNH3)
     (Used only if MCHEM = 6 or 7, and MNH3 = 1)
        0 = use NH3 at puff center height (no averaging is
done)
        1 = average NH3 values over vertical extent of puff
                                       Default: 1            !
MAVGNH3 =  1   !

     Monthly ammonia concentrations in ppb (BCKNH3)
     (Used only if MCHEM = 1 or 3, or
                if MCHEM = 6 or 7, and MNH3 = 0)
                                       Default: 12*10.
     !  BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00,
10.00, 10.00, 10.00, 10.00, 10.00, 10.00 !

     Nighttime SO2 loss rate in %/hour (RNITE1)
     (Used only if MCHEM = 1, 6 or 7)
```


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```
     This rate is used only at night for MCHEM=1
     and is added to the computed rate both day
     and night for MCHEM=6,7 (heterogeneous reactions)
                                        Default: 0.2          !
RNITE1 = .2 !

     Nighttime NOx loss rate in %/hour (RNITE2)
     (Used only if MCHEM = 1)
                                        Default: 2.0          !
RNITE2 = 2.0 !

     Nighttime HNO3 formation rate in %/hour (RNITE3)
     (Used only if MCHEM = 1)
                                        Default: 2.0          !
RNITE3 = 2.0 !

     H2O2 data input option (MH2O2)    Default: 1            !
MH2O2 =  1   !
     (Used only if MCHEM = 6 or 7, and MAQCHEM = 1)
        0 = use a monthly background H2O2 value
        1 = read hourly H2O2 concentrations from
            the H2O2.DAT data file

     Monthly H2O2 concentrations in ppb (BCKH2O2)
     (Used only if MQACHEM = 1 and either
        MH2O2 = 0 or
        MH2O2 = 1 and all hourly H2O2 data missing)
                                        Default: 12*1.
     !  BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00,
1.00, 1.00, 1.00, 1.00, 1.00 !


 --- Data for SECONDARY ORGANIC AEROSOL (SOA) Options
     (used only if MCHEM = 4 or 7)

     The MCHEM = 4 SOA module uses monthly values of:
          Fine particulate concentration in ug/m^3 (BCKPMF)
          Organic fraction of fine particulate     (OFRAC)
          VOC / NOX ratio (after reaction)         (VCNX)

     The MCHEM = 7 SOA module uses monthly values of:
          Fine particulate concentration in ug/m^3 (BCKPMF)
          Organic fraction of fine particulate     (OFRAC)

     These characterize the air mass when computing
     the formation of SOA from VOC emissions.
     Typical values for several distinct air mass types are:

        Month    1    2    3    4    5    6    7    8    9
10   11   12
                Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep
Oct  Nov  Dec

     Clean Continental
        BCKPMF   1.   1.   1.   1.   1.   1.   1.   1.   1.
1.   1.   1.
        OFRAC  .15  .15  .20  .20  .20  .20  .20  .20  .20
```



```
.20  .20  .15
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.
50.  50.  50.

     Clean Marine (surface)
        BCKPMF  .5   .5   .5   .5   .5   .5   .5   .5   .5
.5   .5   .5
        OFRAC  .25  .25  .30  .30  .30  .30  .30  .30  .30
.30  .30  .25
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.
50.  50.  50.

     Urban - low biogenic (controls present)
        BCKPMF  30.  30.  30.  30.  30.  30.  30.  30.  30.
30.  30.  30.
        OFRAC  .20  .20  .25  .25  .25  .25  .25  .25  .20
.20  .20  .20
        VCNX     4.   4.   4.   4.   4.   4.   4.   4.   4.
4.   4.   4.

     Urban - high biogenic (controls present)
        BCKPMF  60.  60.  60.  60.  60.  60.  60.  60.  60.
60.  60.  60.
        OFRAC  .25  .25  .30  .30  .30  .55  .55  .55  .35
.35  .35  .25
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.
15.  15.  15.

     Regional Plume
        BCKPMF  20.  20.  20.  20.  20.  20.  20.  20.  20.
20.  20.  20.
        OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30
.30  .30  .20
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.
15.  15.  15.

     Urban - no controls present
        BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100.
100. 100. 100.
        OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35
.35  .35  .30
        VCNX     2.   2.   2.   2.   2.   2.   2.   2.   2.
2.   2.   2.

     Default: Clean Continental
     !  BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00,
1.00, 1.00, 1.00, 1.00, 1.00 !
     !  OFRAC  = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20,
0.20, 0.20, 0.20, 0.20, 0.15 !
     !  VCNX   = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00,
50.00, 50.00, 50.00, 50.00, 50.00, 50.00 !

 --- End Data for SECONDARY ORGANIC AEROSOL (SOA) Option


     Number of half-life decay specification blocks provided
in Subgroup 11b
```


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```
     (Used only if MCHEM = 5)
     (NDECAY)                                    Default: 0
! NDECAY =  0   !

!END!


--------------
Subgroup (11b)
--------------

     Each species modeled may be assigned a decay half-life
(sec), and the associated
     mass lost may be assigned to one or more other modeled
species using a mass yield
     factor. This information is used only for MCHEM=5.

     Provide NDECAY blocks assigning the half-life for a
parent species and mass yield
     factors for each child species (if any) produced by the
decay.
     Set HALF_LIFE=0.0 for NO decay (infinite half-life).


                              a            b
        SPECIES      Half-Life   Mass Yield
         NAME          (sec)       Factor
        -------      ---------   ----------

     *   SPEC1   =    3600.,        -1.0   *    (Parent)
     *   SPEC2   =     -1.0,         0.0   *    (Child)
   *END*

--------
    a
     Specify a half life that is greater than or equal to zero
for 1 parent species
     in each block, and set the yield factor for this species
to -1
    b
     Specify a yield factor that is greater than or equal to
zero for 1 or more child
     species in each block, and set the half-life for each of
these species to -1

     NOTE: Assignments in each block are treated as a separate
input
           subgroup and therefore must end with an input group
terminator.
           If NDECAY=0, no assignments and input group
terminators should appear.

-------------------------------------------------------------
-----------------


INPUT GROUP: 12 -- Misc. Dispersion and Computational
```



```
Parameters
---------------

     Horizontal size of puff (m) beyond which
     time-dependent dispersion equations (Heffter)
     are used to determine sigma-y and
     sigma-z (SYTDEP)                            Default: 550.
! SYTDEP = 5.5E02 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                    Default: 0
! MHFTSZ =  0   !

     Stability class used to determine plume
     growth rates for puffs above the boundary
     layer (JSUP)                                Default: 5
! JSUP =  5   !

     Vertical dispersion constant for stable
     conditions (k1 in Eqn. 2.7-3)  (CONK1)      Default: 0.01
! CONK1 = .01 !

     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                     Default: 0.1
! CONK2 = .1 !

     Factor for determining Transition-point from
     Schulman-Scire to Huber-Snyder Building Downwash
     scheme (SS used for Hs < Hb + TBD * HL)
     (TBD)                                       Default: 0.5
! TBD = .5 !
        TBD < 0   ==> always use Huber-Snyder
        TBD = 1.5 ==> always use Schulman-Scire
        TBD = 0.5 ==> ISC Transition-point

     Range of land use categories for which
     urban dispersion is assumed
     (IURB1, IURB2)                              Default: 10
! IURB1 =  10  !
                                                            19
! IURB2 =  19  !

     Site characterization parameters for single-point Met
data files ---------
     (needed for METFM = 2,3,4,5)

        Land use category for modeling domain
        (ILANDUIN)                               Default: 20
! ILANDUIN =  20  !

        Roughness length (m) for modeling domain
        (Z0IN)                                   Default: 0.25
! Z0IN = .25 !

        Leaf area index for modeling domain
```


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```
        (XLAIIN)                                Default: 3.0
! XLAIIN = 3.0 !

        Elevation above sea level (m)
        (ELEVIN)                                Default: 0.0
! ELEVIN = .0 !

        Latitude (degrees) for met location
        (XLATIN)                                Default: -999.
! XLATIN = -999. !

        Longitude (degrees) for met location
        (XLONIN)                                Default: -999.
! XLONIN = -999. !

     Specialized information for interpreting single-point Met
data files -----

        Anemometer height (m) (Used only if METFM = 2,3)
        (ANEMHT)                                Default: 10.
! ANEMHT = 10.0 !

        Form of lateral turbulance data in PROFILE.DAT file
        (Used only if METFM = 4,5 or MTURBVW = 1 or 3)
        (ISIGMAV)                               Default: 1
! ISIGMAV =  1  !
            0 = read sigma-theta
            1 = read sigma-v

        Choice of mixing heights (Used only if METFM = 4)
        (IMIXCTDM)                              Default: 0
! IMIXCTDM =  0  !
            0 = read PREDICTED mixing heights
            1 = read OBSERVED mixing heights

     Maximum length of a slug (met. grid units)
     (XMXLEN)                                   Default: 1.0
! XMXLEN = 1.0 !

     Maximum travel distance of a puff/slug (in
     grid units) during one sampling step
     (XSAMLEN)                                  Default: 1.0
! XSAMLEN = 1.0 !

     Maximum Number of slugs/puffs release from
     one source during one time step
     (MXNEW)                                    Default: 99
! MXNEW =  99   !

     Maximum Number of sampling steps for
     one puff/slug during one time step
     (MXSAM)                                    Default: 99
! MXSAM =  99   !

     Number of iterations used when computing
     the transport wind for a sampling step
     that includes gradual rise (for CALMET
```



```
     and PROFILE winds)
     (NCOUNT)                                   Default: 2
! NCOUNT =  2   !

     Minimum sigma y for a new puff/slug (m)
     (SYMIN)                                    Default: 1.0
! SYMIN = 1.0  !

     Minimum sigma z for a new puff/slug (m)
     (SZMIN)                                    Default: 1.0
! SZMIN = 1.0  !

     Maximum sigma z (m) allowed to avoid
     numerical problem in calculating virtual
     time or distance.  Cap should be large
     enough to have no influence on normal events.
     Enter a negative cap to disable.
     (SZCAP_M)                                  Default:
5.0e06 ! SZCAP_M = 5.0E06 !

     Default minimum turbulence velocities sigma-v and sigma-w
     for each stability class over land and over water (m/s)
     (SVMIN(12) and SWMIN(12))

                    ----------  LAND  ----------
---------  WATER  ----------
        Stab Class :  A    B    C    D    E    F         A
B    C    D    E    F
                      ---  ---  ---  ---  ---  ---       ---
---  ---  ---  ---  ---
     Default SVMIN : .50, .50, .50, .50, .50, .50,      .37,
.37, .37, .37, .37, .37
     Default SWMIN : .20, .12, .08, .06, .03, .016,     .20,
.12, .08, .06, .03, .016

           ! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500,
0.370, 0.370, 0.370, 0.370, 0.370, 0.370!
           ! SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030, 0.016,
0.200, 0.120, 0.080, 0.060, 0.030, 0.016!

     Divergence criterion for dw/dz across puff
     used to initiate adjustment for horizontal
     convergence (1/s)
     Partial adjustment starts at CDIV(1), and
     full adjustment is reached at CDIV(2)
     (CDIV(2))                                  Default:
0.0,0.0  ! CDIV = .0, .0 !

     Search radius (number of cells) for nearest
     land and water cells used in the subgrid
     TIBL module
     (NLUTIBL)                                  Default: 4
! NLUTIBL =  4  !

     Minimum wind speed (m/s) allowed for
     non-calm conditions. Also used as minimum
     speed returned when using power-law
```


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```
     extrapolation toward surface
     (WSCALM)                                   Default: 0.5
! WSCALM = .5 !

     Maximum mixing height (m)
     (XMAXZI)                                   Default: 3000.
! XMAXZI = 3000.0 !

     Minimum mixing height (m)
     (XMINZI)                                   Default: 50.
! XMINZI = 20.0 !

     Default wind speed classes --
     5 upper bounds (m/s) are entered;
     the 6th class has no upper limit
     (WSCAT(5))                       Default   :
                                      ISC RURAL : 1.54, 3.09,
5.14, 8.23, 10.8 (10.8+)

                                Wind Speed Class :  1     2
3     4     5
                                                     ---   ---
---   ---   ---
                                        ! WSCAT = 1.54, 3.09,
5.14, 8.23, 10.80 !

     Default wind speed profile power-law
     exponents for stabilities 1-6
     (PLX0(6))                        Default   : ISC RURAL
values
                                      ISC RURAL : .07, .07,
.10, .15, .35, .55
                                      ISC URBAN : .15, .15,
.20, .25, .30, .30

                                 Stability Class :  A     B
C     D     E     F
                                                     ---   ---
---   ---   ---   ---
                                         ! PLX0 = 0.07, 0.07,
0.10, 0.15, 0.35, 0.55 !

     Default potential temperature gradient
     for stable classes E, F (degK/m)
     (PTG0(2))                        Default: 0.020, 0.035
                                         ! PTG0 = 0.020,
0.035 !

     Default plume path coefficients for
     each stability class (used when option
     for partial plume height terrain adjustment
     is selected -- MCTADJ=3)
     (PPC(6))                    Stability Class :  A     B
C     D     E     F
                                    Default  PPC : .50,  .50,
.50,  .50,  .35,  .35
                                                     ---   ---
```



```
---   ---   ---   ---
                                          !  PPC = 0.50, 0.50,
0.50, 0.50, 0.35, 0.35 !

     Slug-to-puff transition criterion factor
     equal to sigma-y/length of slug
     (SL2PF)                                    Default: 10.
! SL2PF = 10.0 !

     Puff-splitting control variables ------------------------

       VERTICAL SPLIT
       --------------

       Number of puffs that result every time a puff
       is split - nsplit=2 means that 1 puff splits
       into 2
       (NSPLIT)                                 Default:   3
! NSPLIT =  3  !

       Time(s) of a day when split puffs are eligible to
       be split once again; this is typically set once
       per day, around sunset before nocturnal shear develops.
       24 values: 0 is midnight (00:00) and 23 is 11 PM
(23:00)
       0=do not re-split    1=eligible for re-split
       (IRESPLIT(24))                           Default:  Hour 17 =
1
       !  IRESPLIT =
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

       Split is allowed only if last hour's mixing
       height (m) exceeds a minimum value
       (ZISPLIT)                                Default: 100.
! ZISPLIT = 100.0 !

       Split is allowed only if ratio of last hour's
       mixing ht to the maximum mixing ht experienced
       by the puff is less than a maximum value (this
       postpones a split until a nocturnal layer develops)
       (ROLDMAX)                                Default: 0.25
! ROLDMAX = 0.25 !


       HORIZONTAL SPLIT
       ----------------

       Number of puffs that result every time a puff
       is split - nsplith=5 means that 1 puff splits
       into 5
       (NSPLITH)                                Default:   5
! NSPLITH =  5  !

       Minimum sigma-y (Grid Cells Units) of puff
       before it may be split
       (SYSPLITH)                               Default:  1.0
! SYSPLITH = 1.0 !
```


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```
       Minimum puff elongation rate (SYSPLITH/hr) due to
       wind shear, before it may be split
       (SHSPLITH)                          Default:  2.
! SHSPLITH = 2.0 !

       Minimum concentration (g/m^3) of each
       species in puff before it may be split
       Enter array of NSPEC values; if a single value is
       entered, it will be used for ALL species
       (CNSPLITH)                          Default:  1.0E-07
! CNSPLITH = 1.0E-07 !

     Integration control variables ------------------------

       Fractional convergence criterion for numerical SLUG
       sampling integration
       (EPSSLUG)                           Default:   1.0e-04
! EPSSLUG = 1.0E-04 !

       Fractional convergence criterion for numerical AREA
       source integration
       (EPSAREA)                           Default:   1.0e-06
! EPSAREA = 1.0E-06 !

       Trajectory step-length (m) used for numerical rise
       integration
       (DSRISE)                            Default:   1.0
! DSRISE = 1.0 !

       Boundary Condition (BC) Puff control variables
------------------------

       Minimum height (m) to which BC puffs are mixed as they
are emitted
       (MBCON=2 ONLY).  Actual height is reset to the current
mixing height
       at the release point if greater than this minimum.
       (HTMINBC)                           Default:   500.
! HTMINBC = 500.0 !

       Search radius (km) about a receptor for sampling
nearest BC puff.
       BC puffs are typically emitted with a spacing of one
grid cell
       length, so the search radius should be greater than
DGRIDKM.
       (RSAMPBC)                           Default:   10.
! RSAMPBC = 10.0 !

       Near-Surface depletion adjustment to concentration
profile used when
       sampling BC puffs?
       (MDEPBC)                            Default:   1
! MDEPBC =  1  !
          0 = Concentration is NOT adjusted for depletion
          1 = Adjust Concentration for depletion
```



```
!END!


-------------------------------------------------------------
-----------------


INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  ! NPT1
= 0 !

     Units used for point source
     emissions below                (IPTU)  Default: 1  !
IPTU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour
compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !
NSPT1 =  0  !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  !
NPT2 =  0  !

     (If NPT2 > 0, these point
     source emissions are read from
     the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
                                        a
          POINT SOURCE: CONSTANT DATA
          ----------------------------
```


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b c
Source X Y Stack Base Stack
Exit Exit Bldg. Emission
No. Coordinate Coordinate Height Elevation Diameter
Vel. Temp. Dwash Rates
(km) (km) (m) (m) (m)
(m/s) (deg. K)
------ ---------- ---------- ------ ------ --------
----- -------- ----- --------

---

a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

SRCNAM is a 12-character name for a source
(No default)
X is an array holding the source data listed by the column headings
(No default)
SIGYZI is an array holding the initial sigma-y and sigma-z (m)
(Default: 0.,0.)
FMFAC is a vertical momentum flux factor (0. or 1.0) used to represent
the effect of rain-caps or other physical configurations that
reduce momentum rise associated with the actual exit velocity.
(Default: 1.0 -- full momentum used)
ZPLTFM is the platform height (m) for sources influenced by an isolated
structure that has a significant open area between the surface
and the bulk of the structure, such as an offshore oil platform.
The Base Elevation is that of the surface (ground or ocean),
and the Stack Height is the release height above the Base (not
above the platform). Building heights entered in Subgroup 13c
must be those of the buildings on the platform, measured from
the platform deck. ZPLTFM is used only with MBDW=1 (ISC
downwash method) for sources with building downwash.
(Default: 0.0)

b
0. = No building downwash modeled
1. = Downwash modeled for buildings resting on the surface
2. = Downwash modeled for buildings raised above the

surface (ZPLTFM > 0.)
NOTE: must be entered as a REAL number (i.e., with decimal point)

c
An emission rate must be entered for every pollutant modeled.
Enter emission rate of zero for secondary pollutants that are
modeled, but not emitted. Units are specified by IPTU
(e.g. 1 for g/s).

Subgroup (13c)

Subgroup (13c)

BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH

Source(a)
No. Effective building height, width, length and X/Y offset (in meters)
every 10 degrees. LENGTH, XBADJ, and YBADJ are only needed for
MBDW=2 (PRIME downwash option)

---

a
Building height, width, length, and X/Y offset from the source are treated
as a separate input subgroup for each source and therefore must end with
an input group terminator. The X/Y offset is the position, relative to the
stack, of the center of the upwind face of the projected building, with the
x-axis pointing along the flow direction.

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Subgroup (13d)

POINT SOURCE: VARIABLE EMISSIONS DATA[a]

Use this subgroup to describe temporal variations in the emission rates given in 13b. Factors entered multiply the rates in 13b.
Skip sources here that have constant emissions. For more elaborate variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0
0 = Constant
1 = Diurnal cycle (24 scaling factors: hours

1-24)
2 = Monthly cycle (12 scaling factors: months 1-12)
3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12
5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

---
[a] Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters

Subgroup (14a)

Number of polygon area sources with parameters specified below (NAR1) No default !
NAR1 = 0 !

Units used for area source emissions below (IARU) Default: 1 !
IARU = 1 !
1 = g/m**2/s
2 = kg/m**2/hr
3 = lb/m**2/hr
4 = tons/m**2/yr
5 = Odour Unit * m/s (vol. flux/m**2 of odour compound)
6 = Odour Unit * m/min

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```
           7 =     metric tons/m**2/yr
           8 =     Bq/m**2/s  (Bq = becquerel =
disintegrations/s)
           9 =     GBq/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !
NSAR1 =  0  !

     Number of buoyant polygon area sources
     with variable location and emission
     parameters (NAR2)                      No default  !
NAR2 =  0   !
     (If NAR2 > 0, ALL parameter data for
     these sources are read from the file: BAEMARB.DAT)

!END!

---------------
Subgroup (14b)
---------------
                                        a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                          b
Source           Effect.    Base      Initial    Emission
 No.             Height   Elevation   Sigma z     Rates
                   (m)       (m)        (m)
-------          ------    ------     --------   ---------

--------
    a
     Data for each source are treated as a separate input
subgroup
     and therefore must end with an input group terminator.
    b
     An emission rate must be entered for every pollutant
modeled.
     Enter emission rate of zero for secondary pollutants that
are
     modeled, but not emitted.  Units are specified by IARU
     (e.g. 1 for g/m**2/s).

---------------
Subgroup (14c)
---------------

           COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON
           ---------------------------------------------------
-----
Source
a
 No.       Ordered list of X followed by list of Y, grouped by
source
------
```



```
---------------------------------------------------------------

--------
    a
     Data for each source are treated as a separate input
subgroup
     and therefore must end with an input group terminator.


---------------
Subgroup (14d)
---------------
                                                   a
          AREA SOURCE: VARIABLE EMISSIONS DATA
          ------------------------------------

     Use this subgroup to describe temporal variations in the
emission
     rates given in 14b.  Factors entered multiply the rates
in 14b.
     Skip sources here that have constant emissions.  For more
elaborate
     variation in source parameters, use BAEMARB.DAT and NAR2
> 0.

     IVARY determines the type of variation, and is source-
specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours
1-24)
           2 =       Monthly cycle (12 scaling factors: months
1-12)
           3 =       Hour & Season (4 groups of 24 hourly
scaling factors,
                                    where first group is DEC-
JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling
factors, where
                                    first group is Stability
Class A,
                                    and the speed classes have
upper
                                    bounds (m/s) defined in
Group 12
           5 =       Temperature   (12 scaling factors, where
temperature
                                    classes have upper bounds
(C) of:
                                    0, 5, 10, 15, 20, 25, 30,
35, 40,
                                    45, 50, 50+)



--------
    a
```


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```
     Data for each species are treated as a separate input
subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------
-----------------

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
----------------------------

---------------
Subgroup (15a)
---------------

     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                            No default
!  NLN2 =  0   !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)        No default
! NLINES = 0 !

     Units used for line source
     emissions below                (ILNU)          Default: 1
!  ILNU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour
compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0  !
NSLN1 =  0  !

     Maximum number of segments used to model
     each line (MXNSEG)                           Default: 7
! MXNSEG = 7 !

     The following variables are required only if NLINES > 0.
They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which                Default: 6
! NLRISE = 6 !
        transitional rise is computed
```



```
        Average building length (XL)                No default
! XL =  !
                                                    (in
meters)

        Average building height (HBL)               No default
! HBL =  !
                                                    (in
meters)

        Average building width (WBL)                No default
! WBL =  !
                                                    (in
meters)

        Average line source width (WML)             No default
! WML =  !
                                                    (in
meters)

        Average separation between buildings (DXL)  No default
! DXL =  !
                                                    (in
meters)

        Average buoyancy parameter (FPRIMEL)        No default
! FPRIMEL =  !
                                                    (in m**
4/s**3)

!END!

---------------
Subgroup (15b)
---------------

          BUOYANT LINE SOURCE: CONSTANT DATA
          ----------------------------------

a
Source     Beg. X      Beg. Y      End. X    End. Y
Release    Base        Emission
 No.     Coordinate  Coordinate  Coordinate Coordinate  Height
Elevation      Rates
            (km)        (km)        (km)       (km)       (m)
(m)
------   ----------  ----------  ---------  ----------
-------   ---------    ---------

--------

    a
     Data for each source are treated as a separate input
subgroup
     and therefore must end with an input group terminator.
```


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[b]
An emission rate must be entered for every pollutant modeled.
Enter emission rate of zero for secondary pollutants that are
modeled, but not emitted. Units are specified by ILNTU
(e.g. 1 for g/s).

Subgroup (15c)

BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA [a]

Use this subgroup to describe temporal variations in the emission
rates given in 15b. Factors entered multiply the rates in 15b.
Skip sources here that have constant emissions.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0
0 = Constant
1 = Diurnal cycle (24 scaling factors: hours 1-24)
2 = Monthly cycle (12 scaling factors: months 1-12)
3 = Hour & Season (4 groups of 24 hourly scaling factors,
where first group is DEC-JAN-FEB)
4 = Speed & Stab. (6 groups of 6 scaling factors, where
first group is Stability Class A,
and the speed classes have upper
bounds (m/s) defined in Group 12
5 = Temperature (12 scaling factors, where temperature
classes have upper bounds (C) of:
0, 5, 10, 15, 20, 25, 30, 35, 40,
45, 50, 50+)

---
[a] Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters

Subgroup (16a)

Number of volume sources with
parameters provided in 16b,c (NVL1) No default !
NVL1 = 0 !

Units used for volume source
emissions below in 16b (IVLU) Default: 1 !
IVLU = 1 !
1 = g/s
2 = kg/hr
3 = lb/hr
4 = tons/yr
5 = Odour Unit * m**3/s (vol. flux of odour compound)
6 = Odour Unit * m**3/min
7 = metric tons/yr
8 = Bq/s (Bq = becquerel = disintegrations/s)
9 = GBq/yr

Number of source-species
combinations with variable
emissions scaling factors
provided below in (16c) (NSVL1) Default: 0 !
NSVL1 = 0 !

Number of volume sources with
variable location and emission
parameters (NVL2) No default !
NVL2 = 10 !

(If NVL2 > 0, ALL parameter data for
these sources are read from the VOLEMARB.DAT file(s))

!END!

Subgroup (16b)

VOLUME SOURCE: CONSTANT DATA [a]
---

[b]

X Coordinate	Y Coordinate	Effect. Height	Base Elevation	Initial Sigma y	Initial Emission

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Sigma z Rates
(km) (km) (m) (m) (m)
(m)
--- --- --- --- ---
--- ---

---
a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

b
An emission rate must be entered for every pollutant modeled.
Enter emission rate of zero for secondary pollutants that are
modeled, but not emitted. Units are specified by IVLU
(e.g. 1 for g/s).

Subgroup (16c)

VOLUME SOURCE: VARIABLE EMISSIONS DATA[a]

Use this subgroup to describe temporal variations in the emission
rates given in 16b. Factors entered multiply the rates in 16b.
Skip sources here that have constant emissions. For more elaborate
variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0
0 = Constant
1 = Diurnal cycle (24 scaling factors: hours 1-24)
2 = Monthly cycle (12 scaling factors: months 1-12)
3 = Hour & Season (4 groups of 24 hourly scaling factors,
where first group is DEC-JAN-FEB)
4 = Speed & Stab. (6 groups of 6 scaling factors, where
first group is Stability Class A,
and the speed classes have upper
bounds (m/s) defined in Group 12
5 = Temperature (12 scaling factors, where

temperature
classes have upper bounds (C) of:
0, 5, 10, 15, 20, 25, 30, 35, 40,
45, 50, 50+)

---
a
Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information
---

Subgroup (17a)

Number of non-gridded receptors (NREC) No default !
NREC = 3 !

!END!

Subgroup (17b)

NON-GRIDDED (DISCRETE) RECEPTOR DATA[a]

Receptor No.	X Coordinate (km)	Y Coordinate (km)	Ground Elevation (m)	Height Above Ground (m)[b]
1 ! X =	788.256,	6631.709,301,1.5!	!END!	
2 ! X =	789.603,	6631.152,272,1.5!	!END!	
3 ! X =	790.246,	6631.605,285,1.5!	!END!	

a
Data for each receptor are treated as a separate input subgroup
and therefore must end with an input group terminator.

b
Receptor height above ground is optional. If no value is

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```
entered,
     the receptor is placed on the ground.
```


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Appendix III Contour Plots (Increment Only)

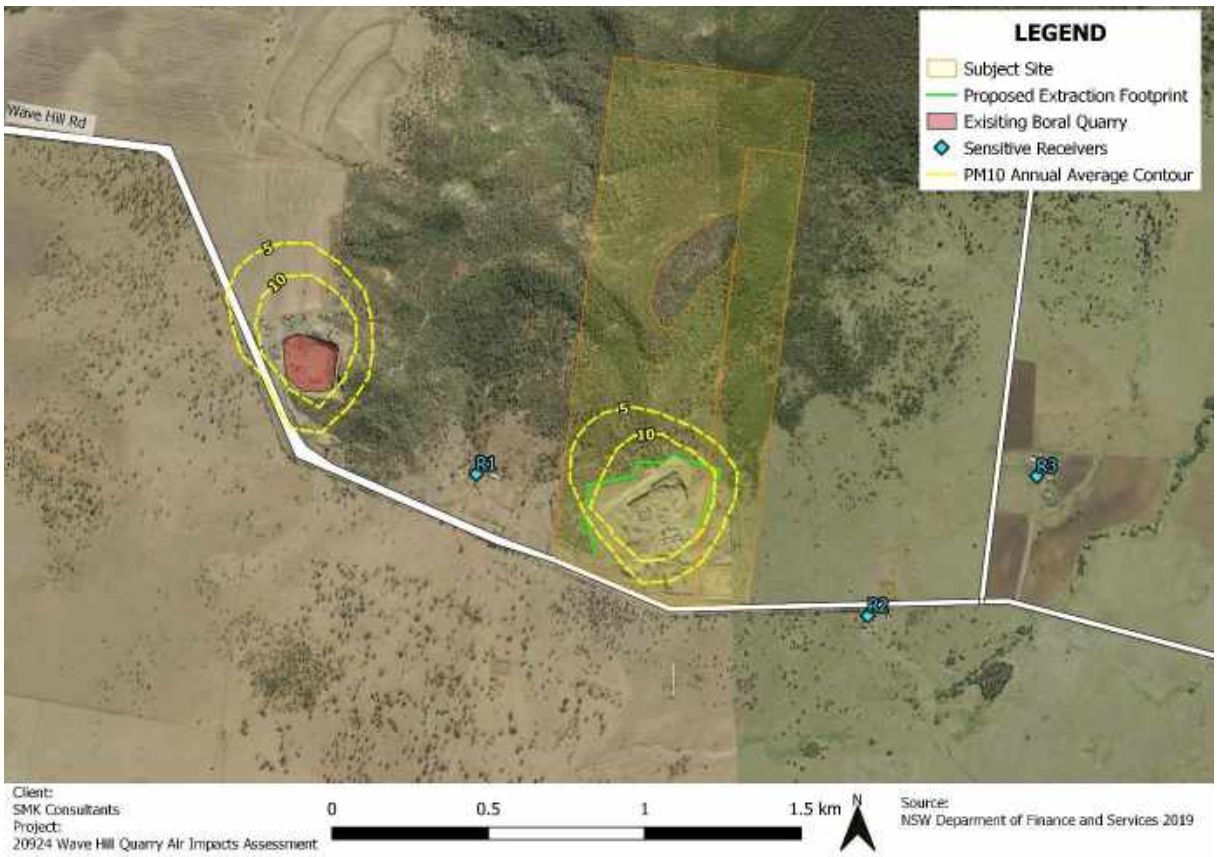

Figure 6: 100th Percentile Annual Average PM_{10} Concentration
(Contour labels = 5, 10 µg/m³)

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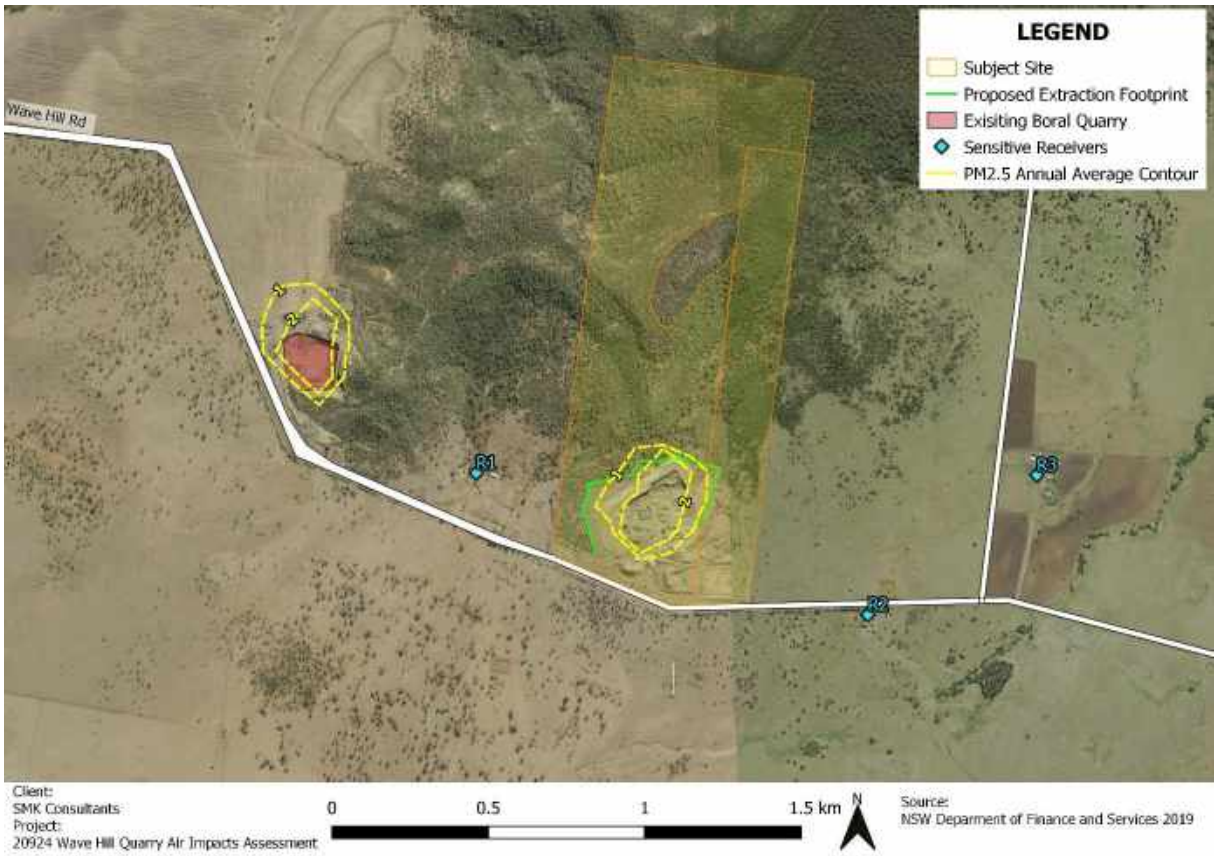

Figure 7: 100th Percentile Annual Average $PM_{2.5}$ Concentration
(Contour labels = 1, 2 µg/m³)

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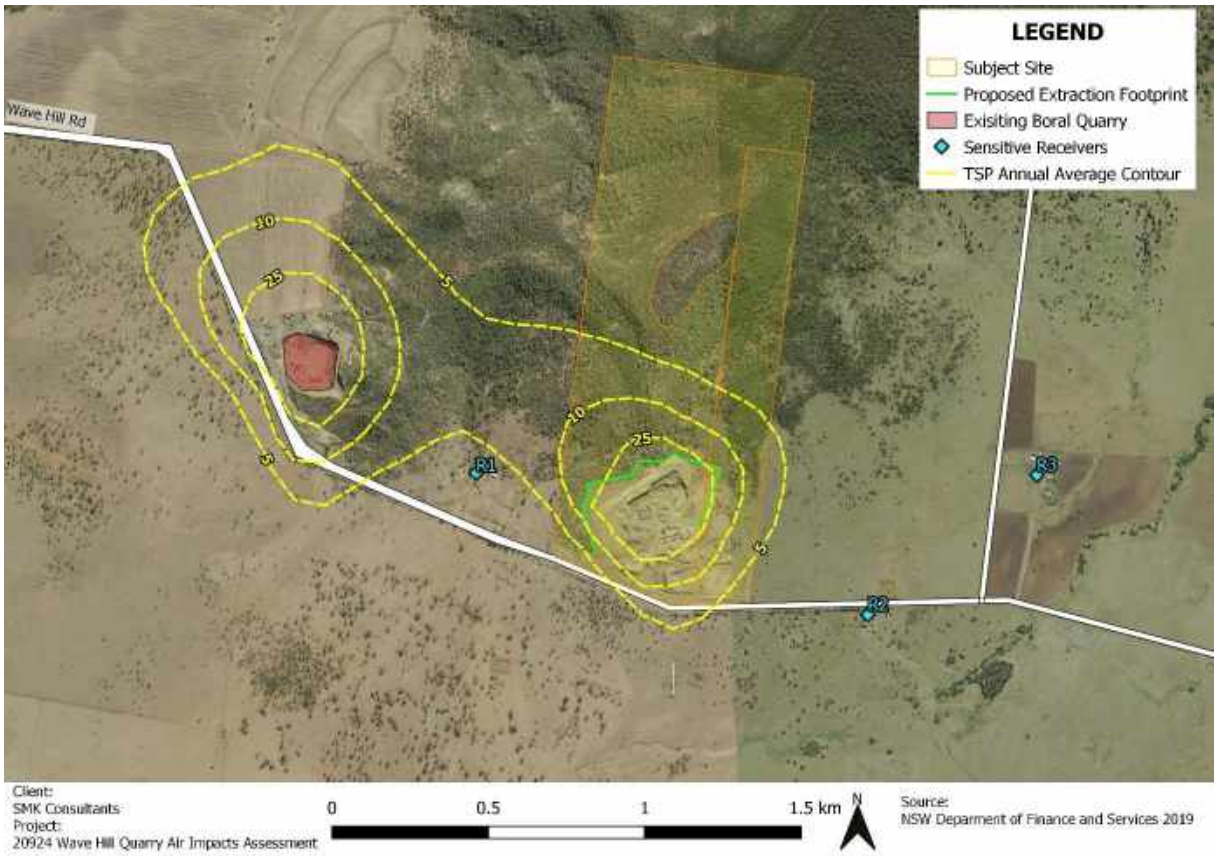

Figure 8: 100th Percentile Annual Average TSP Concentration (Contour labels = 5, 10, 25 µg/m³)

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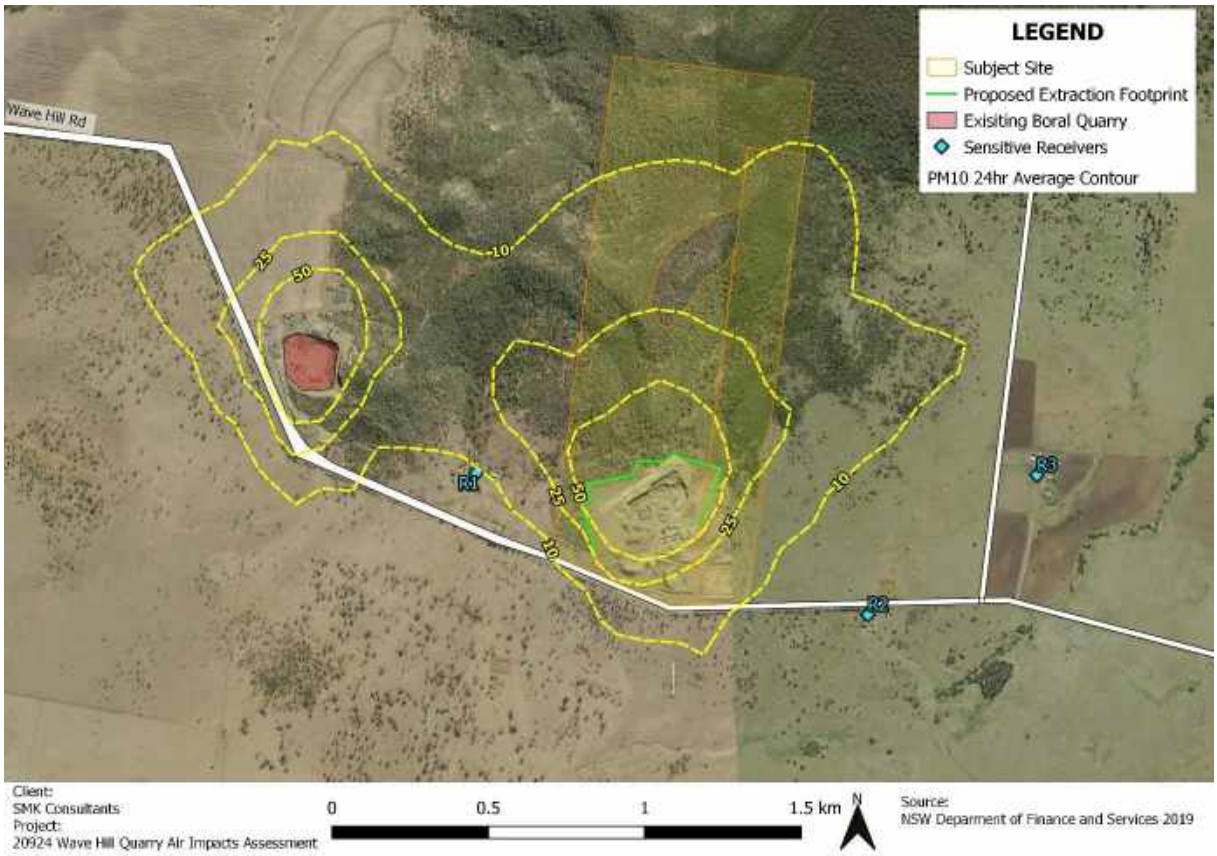

Figure 9: 100th Percentile 24-hr Average PM_{10} Concentration
(Contour labels = 10, 25, 50 µg/m³)

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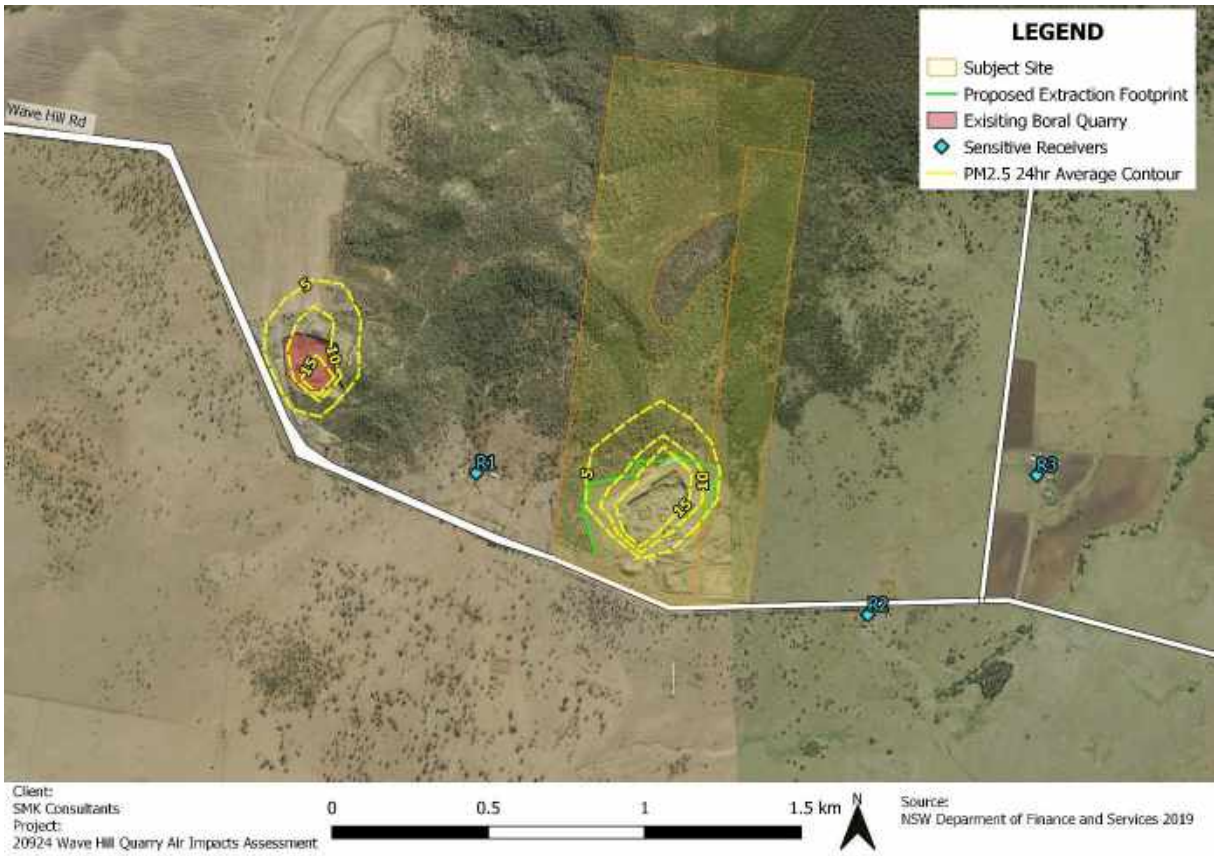

Figure 10: 100th Percentile 24-hr Average $PM_{2.5}$ Concentration
(Contour labels = 5, 10, 15 µg/m³)

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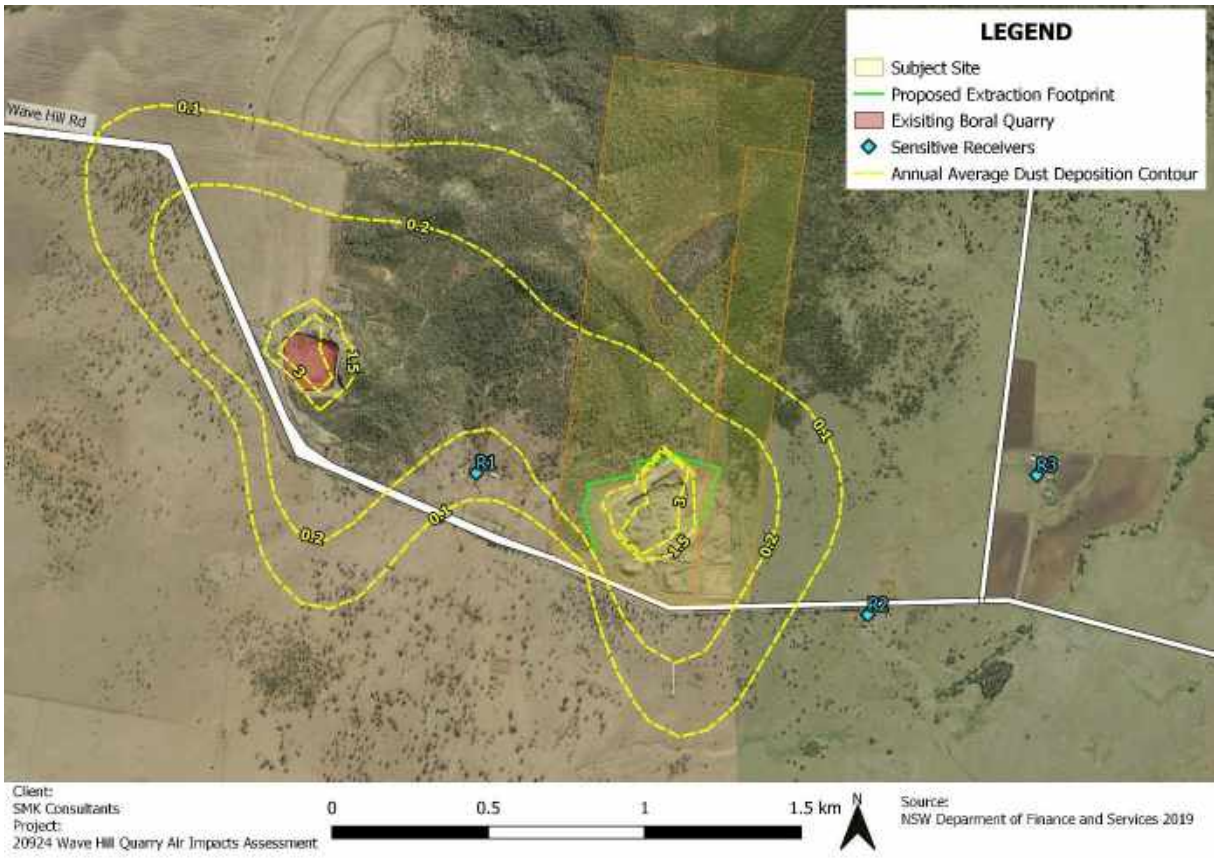

Figure 11: 100th Percentile Annual Average Incremental Dust Deposition Rate
(Contour labels = 0.1, 0.2, 1.5, 2 g/m²/month)

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Appendix 5: Noise Impact Assessment

SMK
CONSULTANTS

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Report

Noise Impact Assessment

Wave Hill Quarry

Johnstone Concrete and Landscaping Supplies Pty Ltd

18 May, 2020

Rev 0 (Final)

advitech.com.au

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Report Details

Noise Impact Assessment - Wave Hill Quarry

Job #: J0191228, Folder #: F20924, Revision: 0 (Final), Date: 18 May, 2020

Doc Reference: , Filename: 20924 Wave Hill NIA Rev0.docx

Prepared For

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History

Date	Revision	Comments
23 March, 2020	A	Draft Issue for Review,
18 May, 2020	0	Final Issue

Endorsements

Function	Signature	Name and Title	Date
Prepared by		Louis Abell (Grad. M.A.A.S) Environmental Scientist	18 May, 2020
Checked by		Clayton Sparke (M.A.A.S) Environmental Specialist (Acoustics)	18 May, 2020
Authorised for Release by		Dr Rod Bennison Lead Environmental Scientist	18 May, 2020

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EXECUTIVE SUMMARY

Advitech Environmental was engaged to prepare an assessment of potential noise impacts associated with the modification of the Wave Hill quarry. The modification is proposed to increase the annual extraction rate at the Wave Hill quarry from 200,000 tonnes per annum to 500,000 tonnes per annum in order to meet demand of the proposed inland rail project.

Project Tigger Noise Levels for adjacent receiving environments were reviewed, and the assessment conservatively adopted the most stringent criteria for the project area. Modelling of operational activities indicate that predicted $L_{Aeq,15minute}$ noise levels will likely be below the PNTL criteria under all operational conditions during calm and prevailing conditions, provided that mitigation controls associated with the formation of a 5 metre earthen bund from the existing stockpiles to the south east of the site is implemented. It is also recommended that if the operation of drill rig plant is to occur at the same time as fixed plant quarrying activities, that the drill rig should be positioned so that the front facing drilling component of the plant is not directed towards the south east. This will assist in reducing any negligible residual noise impacts that may be experienced at receiver R2.

The results of the sleep disturbance analysis indicate that the L_{Amax} noise levels would not exceed the sleep disturbance criterion at any receiver locations. Additionally, predicted $L_{Aeq,15\ minute}$ noise levels associated with site activities prior to 7am are not expected to exceed MNTL. As a result, stockpile maintenance and loading of trucks may be undertaken prior to 7:00 without expectation of adverse impact.

While adverse operational and blasting impacts are not expected, this activity may be audible at some locations given the characteristics of the receiving environment. It is thus recommended that measures be put in place to ensure the timely and effective response to any concerns raised by adjacent receivers. Cumulative blast impacts may be effectively managed through a program of consultation with any other quarries within development area that are undertaking blasting, to ensure that blasting is not undertaken at the same time.

Modelling indicates that road traffic noise generated by the development is likely to comply with the relevant criteria for both the day and night periods at all receivers adjacent to the proposed haulage route during standard operational periods and periods under peak demand.

It is predicted that cumulative impacts associated with the operation of existing quarries within the project site will comply with the recommended amenity noise levels. Assessment of conservative road traffic noise impacts indicate that both quarries are likely able to operate at similar haulage volumes without the prospect of adverse noise impacts.

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Appendix II Noise Contour Predictions

Appendix III Sound Power Level Analysis – Drill Rig and Calibration Certificates

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1. INTRODUCTION

Advitech Pty Limited (trading as Advitech Environmental) was engaged by Johnston Concrete and Landscaping Supplies Pty Ltd (JCLS) on behalf of SMK Consultants. SMK Consultants is preparing an Environmental Impact Assessment that will facilitate an increase in the annual extraction rate at the Wave Hill Quarry in the Narrabri Shire Council area in NSW. The approved Quarry is intended to provide a long-term supply of ballast to the Inland Rail project. The Wave Hill Quarry proposal is considered Designated Development under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). As such, this Noise Impact Assessment supports the EIA completed in accordance with the Planning Secretary's environmental assessment requirements (SEARs) (EAR 1237).

It should be noted that this report was prepared by Advitech Pty Limited for Johnstone Concrete and Landscaping Supplies Pty Ltd ('the customer') in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

2. BACKGROUND AND OBJECTIVES

Johnstone Concrete and Landscaping Supplies proposes to increase the annual extraction rate for the Wave Hill Quarry from 200,000 tonnes per annum to no more than 500,000 tonnes per annum to meet demand of the proposed Inland Rail project. No other alterations to the current operation of the Wave Hill Quarry are proposed. The Wave Hill Quarry is located along Wave Hill Road, approximately 25 km west south west of the township of Narrabri New South Wales (NSW). A site map of the Quarry location is provided in **Figure 1**. The quarry lies on Lot 89 DP 821255 within the Narrabri Shire Local Government Area comprising 123.3 hectares of undulating land. The site contains significant deposits of basalt and is one of several possible sources of material for the proposed rail project, mainly ballast.

The objective of this noise assessment was to identify noise impacts associated with the proposed modification to the annual extraction rate, including production and blasting stages, and to provide advice with regard to reasonable and feasible mitigation strategies where necessary. As construction activities are not required for this modification, the assessment of construction noise impacts will not form part of the NIA. Another quarry facility (referred to in this report as the 'Boral Quarry') located on Lot 1 DP 1225128 on Wave Hill Road, Narrabri, is located approximately 1.5 km east from the Wave Hill Quarry. To properly account for cumulative noise impacts associated with the two closely situated quarrying facilities, Advitech has included the assessment of noise impacts associated with the potential contributions from Boral Quarry.

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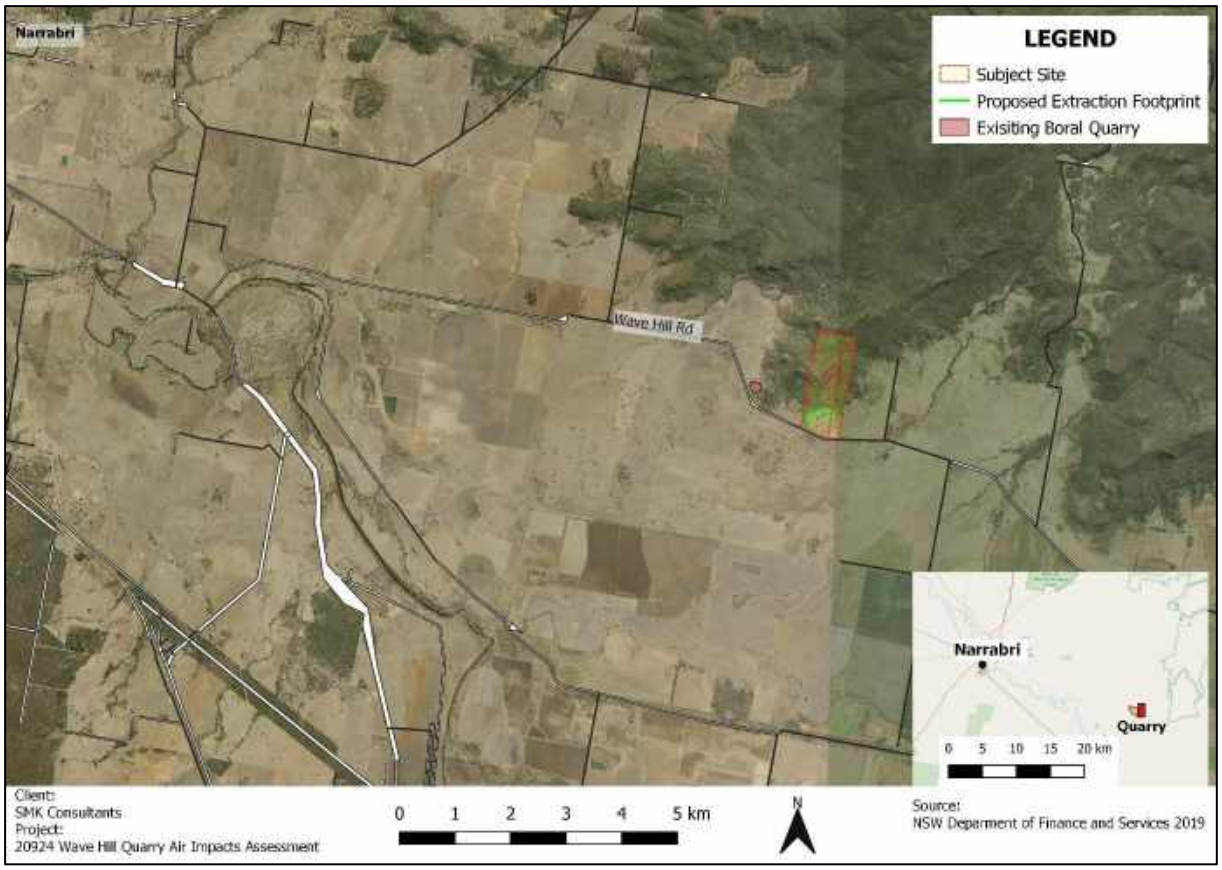

Figure 1: Site Location (Regional Context)

2.1 Project Description

The revised development proposal for the Wave Hill Quarry will change only the annual extraction limit, site operations and equipment will remain the same. It is important to note that construction activities will not be required as part of this development. The site layout and indicative quarry extraction area is presented in **Figure 2**. A summary of the quarrying/extraction operations are as follows:

- the Wave Hill Quarry will extract up to 500,000 metric tonnes of material per annum;
- the hours of operation will be 11 hours Monday to Friday and 6 hours on Saturday;
- the quarry will be subject to typical daily and weekly extraction activities such as, winning, crushing and stockpiling of material as well as removing prepared product and transporting it. Additionally, no change will occur to blasting activities. At present, blasting occurs every 3 to 6 months. Drilling and blasting hours of operation are limited to the EPL and Council approved times;
- the extracted material will be delivered primarily to supply ballast materials for Australian Governments Inland Rail project. Blue metal products will also be extracted from the quarry to supply the local council; and
- d aily tonnage will be a maximum of 2,000 tonne per day. This is the current maximum capacity and therefore no increase will occur. The aim is to utilise the road train truck and dog units which will result in approximately 36-truck movements (2-way) per day. The expected production per day will be 10-hours, resulting in 3.6 trucks per hour on average. Allowing for two-way trips, the movement of trucks along the haul route will involve an average of 7.2 trucks per hour.

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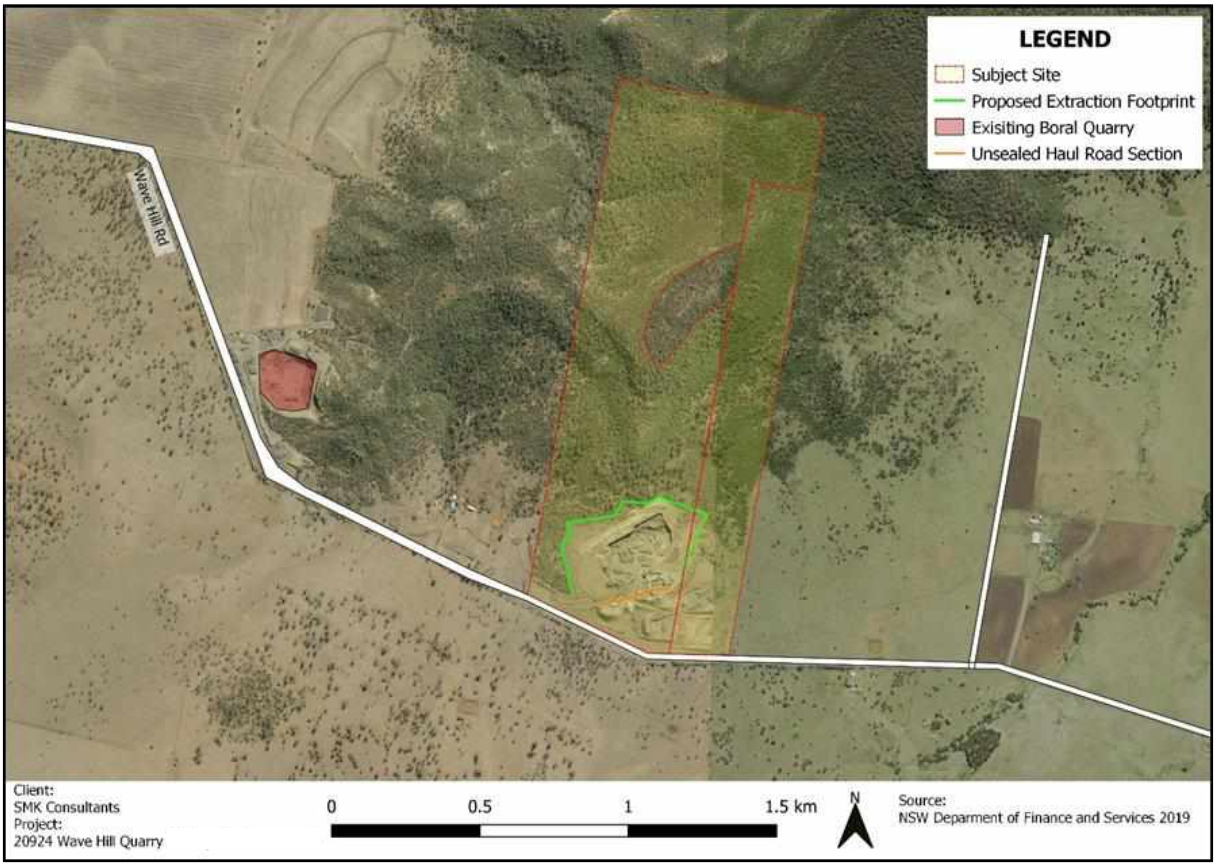

Figure 2: Wave Hill Quarry Overview (Source: SMK Consultants)

3. METHODOLOGY

3.1 Secretary's Environmental Assessment Requirements

The report will be appended to an EIA which must comply with the requirements of Clauses 6 and 7 of the Environmental Planning and Assessment Regulation 2000, and which addresses environmental considerations identified in the SEARs relevant to noise and vibration impacts.

The SEARs note the following requirements for a noise impact assessment including:

- *Noise - including a quantitative assessment of potential:*
  - *construction and operational noise and off-site transport noise impacts of the development in accordance with the Interim Construction Noise Guideline, NSW Noise Policy for Industry and NSW Road Noise Policy respectively;*
  - *reasonable and feasible mitigation measures to minimise noise emissions; and*
  - *monitoring and management measures;*
- Blasting & Vibration:
  - *proposed hours, frequency, methods and impacts; 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, buildings, livestock, infrastructure and significant natural features.*

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Additionally, Narrabri Shire Council notes:

- *The site is located less than 1500 metres away from another quarry operated by Boral. The proponent is requested to assess cumulative noise, air and blasting impacts at the receptor location positioned between these two sites in particular, as well as the other two (2) receptors identified.*

Department of Industry – Crown Lands and Water notes:

- *Lot 89 adjoins Crown Perpetual Lease 109315 by Kristian John Bogdanoff, with residence on site. The proposed works stop short about 100m from the lease boundary and about 300m from the residence. It is requested that the EIS addresses in detail the mitigation measures proposed in regards to dust/noise and vibration from blast/hammering for the residence. It is requested that direct consultation also be made with the leaseholder, Mr Kristian John Bogdanoff.*

The NSW EPA requires the following considerations:

- *Construction noise associated with the proposed development should be assessed using the Interim Construction Noise Guideline (DECC, 2009)*

3.2 Assessment Methodology

The methodology adopted to address the requirements established by the SEARs includes:

- an assessment of the existing environment, including:
  - identification of potentially sensitive receivers adjacent to the operation;
  - efforts to characterise the existing noise environment, identify relevant receiver types and establish Project Noise Trigger Levels (PNTL) for the assessment of potential impacts. This assessment includes the analysis of background noise levels in accordance with Fact Sheet A of the NPfI;
  - analysis of prevailing meteorology: to identify significant meteorological conditions that may influence the way that impacts associated with the development may manifest;
- calculation of noise levels that may be generated by the development, including:
  - identification of significant operational and meteorological scenarios that may have potential to generate noise enhancing conditions;
  - development of a noise model: (ISO9613 calculation methodology) to derive predicted noise levels associated with the development at adjacent sensitive receivers;
  - determination of premises based contributions from the development, using descriptors established by the relevant guidelines;
- assessment of results, including:
  - recommendations for noise criteria that may be written into a development consent;
  - comparison of noise predictions against these criteria, and evaluation of potential impacts; and
  - recommendations for management of potentially adverse or residual impacts.

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3.3 Guidelines and Standards Referenced by this Assessment

The assessment was performed with reference to the following guidelines, policies and standards:

- AS1055:2018 Acoustics – Description and measurement of environmental noise.
- AS 2436 Guide to noise and vibration control on construction, demolition and maintenance sites.
- AS2187.2-2006 Explosives – Stage 2: Storage of Explosives
- Noise Policy for Industry (NPfI). EPA, 2017.
- Road Noise Policy (RNP). EPA, 2011.
- Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990).
- Assessing Vibration: a technical guideline (EPA, 2006).

4. THE EXISTING ENVIRONMENT

4.1 Sensitive Receivers

Identification of potentially sensitive receivers was initially undertaken via cross referencing of:

- aerial imagery;
- the Geocoded National Address File (G-NAF) (an open source national database of address points), maintained by the Federal Department of Industry, Innovation and Science;
- Limited ground truthing during field inspection; and
- inclusion of receivers specifically identified by the Narrabri Shire Council as part of the SEARs.

4.1.1 Noise Environments Adjacent to the Quarry

The receiving environment was identified as isolated receivers located in rural areas adjacent to the proposed quarry site. **Table 1** provides the locations for each sensitive receiver. The nearest potentially affected residences are shown on **Figure 3**.

Table 1: Sensitive Receiver Details

Receiver Type	Receiver ID	Address	Approximate distance to site footprint (m)	Direction	Receiver Type
Quarry	R1	'Glen Aston' - 939 Wave Hill Road	300	W	Private Residence
	R2	'Brenowen' - 1092 Wave Hill Road	400	SE	Private Residence
	R3	Wave Hill residence' - 1143 Wave Hill Road	1000	E	Private Residence

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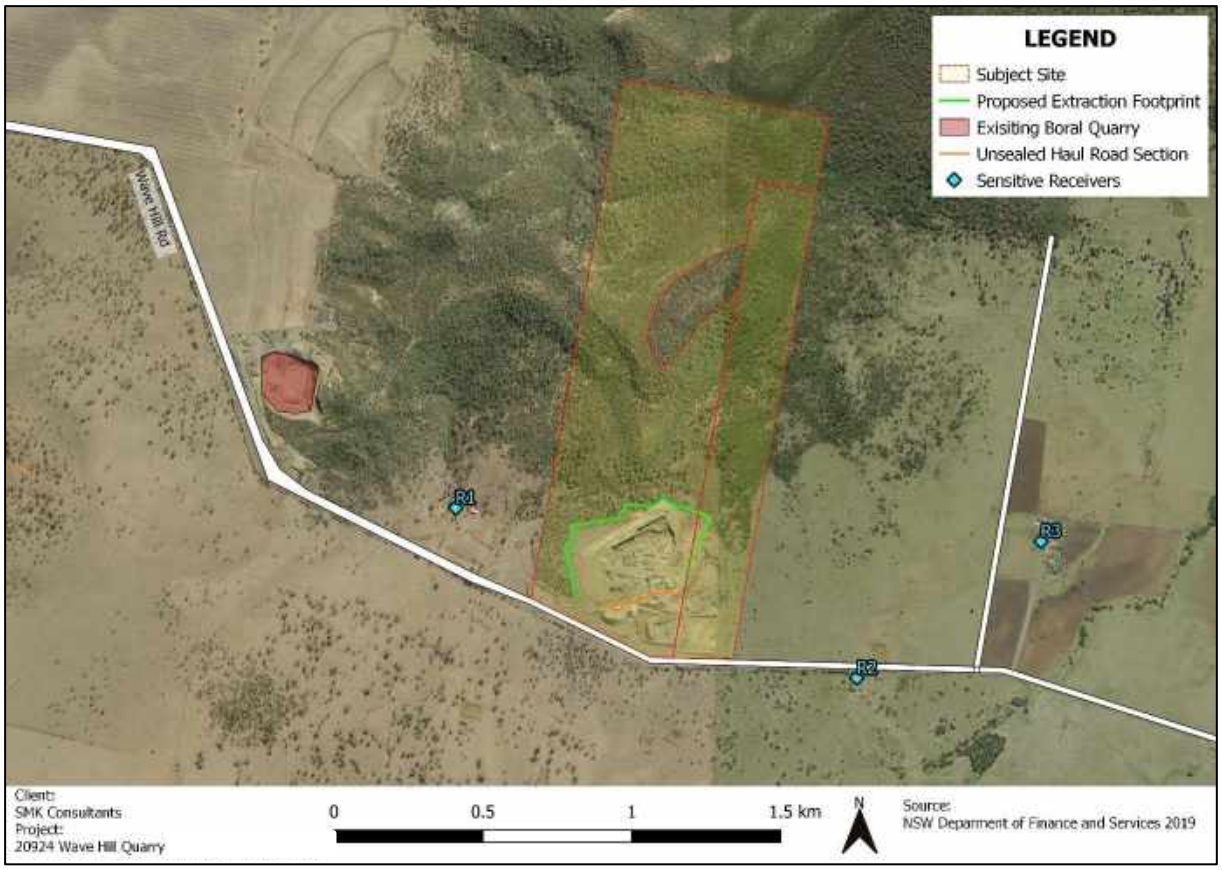

Figure 3: Sensitive Receiver Locations

4.2 Assessment of Existing Noise Environment

Short term operator attended noise monitoring was undertaken during a site inspection on 10 January 2019. The purpose of this monitoring was to identify and document predominant sources of noise, and thus characterise the noise environment at the development site and adjacent to the proposed haulage route. A summary of the results is presented in **Table 2**.

Table 2: Details of monitoring

Location	Date	Measured noise level dB(A)			Observations
		L_{A90}	L_{A1}	L_{Aeq}	
'Glen Aston' - 939 Wave Hill Road	10/01/2019 8:30	31	53	48	Birds, insects, gusting wind, car pass-by
'Brenowen' - 1092 Wave Hill Road	10/01/2019 9:25	30	48	39	Quarry operation, birds, gusting wind
Wave Hill residence' - 1143 Wave Hill Road	10/01/2019 11:45	30	46	36	Quarry operation, birds, gusting wind

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4.3 Assessment of Prevailing Meteorology

The NPfI identifies that noise propagation may be enhanced under certain meteorological conditions, and that (if present) these conditions should be accounted for as part of the assessment process. The guide provides two options for the assessment of these impacts:

- a simple method, which adopts worst case noise enhancing conditions; and
- a more detailed analysis of prevailing meteorology, to identify whether enhancing conditions occur with adequate frequency to be considered a feature of the local environment:
  - where enhancing conditions occur with adequate frequency, noise enhancing meteorological parameters should be adopted by the noise modelling; and
  - where enhancing conditions are not a feature of the environment, modelling should adopt a set of standard meteorological parameters.

Definitions of the standard and enhancing conditions established by the NPfI are reproduced in **Table 3.**

Table 3: Standard and noise-enhancing meteorological conditions

Meteorological Condition	Meteorological Parameters
Standard conditions	Day/evening/night: stability categories A-D with wind speed up to 0.5 m/s at 10 m AGL.
Noise-enhancing conditions	Daytime/evening: stability categories A-D with light winds (up to 3 m/s at 10 m AGL) Night-time: stability categories A-D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL.

The nearest Bureau of Meteorology (BoM) Automatic Weather Station (AWS) is located at Narrabri Airport, approximately 20km north west of the proposed development site. Monitoring records from 2013 were analysed to identify whether any prevailing wind patterns may be considered a feature of this environment.

4.3.1 Prevailing Winds

The NPfI indicates that where a wind or stability condition may occur for more than 30% of the time during any assessment period (day, evening or night) of any season, then the parameters for noise enhancing conditions should be adopted as part of the assessment. The results presented in **Table 4** indicate that none of the prevailing winds are observed for more than 30% of the time during any season.

Although no prevailing winds with a frequency of over 30% were identified, there is a historical annual and seasonal trend of dominating winds about the south-south east for winds >3m/s. For this reason, operational scenarios were modelled using prevailing conditions with south east winds in addition to standard calm meteorological conditions. Seasonal wind-roses associated with this assessment are provided in **Appendix I**.

Table 4: Frequency of most dominant prevailing winds (+/-22.5deg, <3m/s)

Season	Prevailing Winds		
	Day	Evening	Night
Spring	SE (6%)	E (13%)	E (12%)
Summer	NE (5%)	NE (7%)	NE (6%)
Autumn	SE (6%)	SE (8%)	SE (7%)
Winter	SE (13%)	SE (14%)	SE (15%)

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4.3.2 Temperature Inversion

The NPfI indicates that for temperature inversion to be a significant characteristic of the area it needs to occur for 30% or more of the total evening and night-time period (6:00 pm to 7:00 am) during winter. The AWS at Narrabri Airport does return observations that would enable assessment of atmospheric stability and temperature inversion frequency; however, previous experience suggests that these phenomena have potential to be a feature in rural environments. For this reason, F class stability will be included in the assessment of activities that are to occur during the night period.

4.3.3 Drainage Flow Winds

The NPfI identifies that a default wind drainage value is to be applied where sources are situated at a higher altitude than receivers with no intervening topography. Limited ground truthing and desktop analysis of topographical contours within a 5km buffer of the subject site have identified that the area is relatively flat. Based on this examination, drainage-flow wind does was not considered to apply to this Project.

4.3.4 Summary of Prevailing Weather Conditions

Meteorological conditions presented in **Table 5** were adopted for this assessment in accordance with the NPfI.

Table 5: Adopted meteorological conditions for assessment of noise impacts

Meteorological Condition	Day	Night
Standard conditions	Stability category D, no wind	Stability category D, no wind
Prevailing conditions	Stability category D with SE winds at 3 m/s 10 m AGL.	Stability category F with SE winds at 2 m/s 10 m AGL.
Temperature	15 °C	10 °C
Relative Humidity	60%	80%

5. ASSESSMENT CRITERIA

5.1 Noise Assessment Criteria

Wave Hill Quarry currently operates in accordance with Environmental Protection Licence (EPL) 20139 which addresses the conditions of:

- Narrabri Shire Council – Schedule of development consent conditions DA 60/2013;
- NSW EPA General Terms of Approval Notice No. 1509154; and
- NSW EPA Industrial Noise Policy 2000.

Currently EPL 20139 sets the following noise limits:

Table 6: Noise limits (EPL 20139)

Locality and location	Day $L_{Aeq,\ 15\ minute}$	Evening $L_{Aeq,\ 15\ minute}$	Night $L_{Aeq,\ 15\ minute}$	Night $L_{A,1minute}$
All surrounding residences	35	35	35	45

Note: a) Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays & Public Holidays;
b) Evening is defined as the period from 6pm to 10pm;

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c) Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays & Public Holidays.

As the SEARs requests that assessment of this modification is to be conducted under NPfI 2017, background noise levels where re-assessed to define the PNTL for the project. The EPA document *Implementation and transitional arrangements for the Noise Policy for Industry (2017)* outlines that the NPfI will be used to assess and develop requirements for existing industrial developments/activities under circumstances where the planning authority requires a noise impact assessment to support the modification *or* where a significant change to existing plant, equipment or processes is proposed.

5.2 Assessment of Project Noise Trigger Levels

The NSW Noise Policy for Industry (NPfI) presents a methodology for determining Project Noise Trigger Levels (PNTL) for industrial development. Ambient and background noise measurements were undertaken in a rural environment approximately 3.5km from Wave Hill Quarry. With exception of the quarry, the noise environment at the monitoring location was considered similar to that of receivers adjacent to the quarry in terms of exposure to nearby road traffic and environmental noise sources. These results were analysed in accordance with Fact Sheet A of the NPfI and used to determine PNTL relevant to the proposed development. Assessment in **Table 7** establishes the RBL for the project.

Table 7: Assessment of PNTL in adjacent receiving environment

Metric	Day	Evening	Night
Rating Background Level	35	35	31
Project Intrusiveness Criteria	40	40	36
Recommended Amenity Level	50	45	40
Project Amenity Criteria	48[1]	43[1]	38[1]
Project Trigger Noise Level	40	40	36

Note: All criteria measured in dB(A).

Note 1: Project amenity level established as level equal to the Recommended Amenity Noise Levels for Rural receivers minus 5dB(A) plus 3dB(A) to convert from a period level to a 15-minute level, in accordance with guidance established in Fact Sheet F of the NPfI.

The Project Intrusiveness Criterion is the more stringent of the two criteria and is thus adopted as the PNTL for the development.

5.3 Maximum Noise Level Triggers

The NPfI provides updated guidance relating to the assessment of maximum noise level events that carry potential to cause sleep disturbance. In this context, potential for sleep disturbance is considered in terms of events that may induce awakenings or cause disturbance to sleep stages. The guide establishes the following requirements:

Where the subject development night-time noise levels at a residential location exceed:

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

… a detailed maximum noise level event assessment should be undertaken.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

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Table 8: Maximum Noise Level Triggers (MNLT)

Metric	MNLT
$L_{Aeq,15minute}$	40 dB(A)
L_{AFMax}	52dB(A)

5.4 Construction Noise Criteria

The NSW *Interim Construction Noise Guideline* (ICNG) (2009) provides guidance on managing construction works to minimise noise. However, it should be noted that no additional construction activities will occur at this site as a result of the modification to the annual extraction rate. For this reason, all activities associated with the quarry operations will be assessed under the NPfI as operational activities. No further analysis of activities associated with criteria outlined in the ICNG will be carried out as part of this assessment.

5.5 Road Traffic Noise Criteria

Continuation of site generated road traffic up to historic approved traffic volumes requires assessment for potential noise impact. The principle guidance to assess the impact of the road traffic noise on assessment locations is in the NSW EPA's Road Noise Policy 2011 (RNP). The RNP provides a framework for the management of noise issues associated with road traffic from existing roads, new road projects, road redevelopment projects and new traffic-generating developments. The primary aim of the RNP is to provide assessment criteria for road traffic noise based on protecting amenity and wellbeing. **Table 9** presents the road noise assessment criteria for residential land uses nearest to roads that are potentially affected by an increase in traffic, reproduced from Table 3 of the RNP for road categories relevant to the project.

Table 9: Road traffic noise assessment criteria for residential land uses

Road Category	Type of Project / Land Use	Assessment Criteria - dB(A)	
		Day 7am - 10pm	Night 10pm - 7am
Freeway / arterial / sub-arterial roads	Existing residences affected by additional traffic on existing freeways / arterial / sub-arterial roads generated by land use developments	$L_{Aeq, (15hour)}$ 60 (external)	$L_{Aeq, (9hour)}$ 55 (external)

Note: Wave Hill Road and Maules Creek Road are the focus of road traffic noise assessment and have both been identified as sub-arterial roads.

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5.6 Ground Vibration and Air-blast Overpressure Criteria

The NSW EPA recommends that impacts associated with blasting be assessed in accordance the Australian and New Zealand Environment Council (ANZEC 1990) *Technical basis for guidelines to minimise annoyance due to blasting overpressure and vibration*. The guideline establishes the following criteria to minimise annoyance associated with blasting:

- Air-blast Overpressure:
  - the recommended peak maximum level for air blast overpressure at sensitive receivers is 115 dB(Lin); and
  - the maximum air blast overpressure level should not exceed 115 dB(Lin) during more than 5% of blasts in any 12 month period, and should never exceed 120 dB(Lin);
- Ground Vibration:
  - the recommended maximum peak particle velocity (PPV) value of 5 mm/s; and
  - the maximum PPV should not exceed 5mm/s during more than 5% of blasts in any 12 month period, and should never exceed 10 mm/s; and
- Timing:
  - blasting should be restricted to the hours 9:00 to 17:00, Monday to Saturday; and
  - blasting should not take place on Sundays or public holidays.

These criteria represent thresholds for the assessment of potential impacts at residential receivers adjacent to the proposed development. Australian Standard AS2187.2-2006 provides outline methods for evaluating potential ground vibration and air blast overpressure impacts.

6. ASSESSMENT OF OPERATIONAL NOISE LEVELS

6.1 Operational Activities

A model of operational noise impacts was constructed using the ISO9613 calculation method within the Predictor-Lima software package. The operation of the Wave Hill Quarry is comprised of a number of noise generating scenarios that differ depending on materials required for each individual contract secured by JCLS. Advitech Environmental understands that there are two main areas that extracted material is sent to be processed by either mobile or fixed crushing and screening plant. JCLS have outlined that these two main processing areas operate in isolation from each other and will not operate at the same time. The main noise generating activities have been presented as four scenarios below:

- pre blast drilling to prepare the quarry for blasting (day period only);
- operation of mobile crushing plant, including screening and stockpiling (day period only);
- operation of fixed crushing plant, including screening and stockpiling (day period only); and
- arrival of heavy vehicles along internal hauls routes within the site and stockpile maintenance from 6:30am, defined as the night period.

The operational noise model assumes:

- pre-blast drilling will be conducted on the eastern segment on what is identified as level three of the quarry (RL 339m) and will move progressively to the north as aggregate is blasted, transported and stockpiled on the lower bench of the quarry (RL 331m). This

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activity has been measured onsite to confirm sound power level of the equipment. This analysis is presented in **Appendix III**;

- the fixed crushing plant has acoustic cladding installed on two of the vibratory screens. In order to model accurate noise levels associated with this modification, several measurements were taken onsite to verify the sound power levels emitted from this plant;
- Although identified as 'mobile crushing plant', JCLS have outlined that this equipment is to remain stationary in the area indicated 'mobile plant' in **Figure 4**.
- internal product haulage conducted by road registered trucks has been modelled for 72 movements a day in both the fixed and mobile crushing operational scenarios; and
- it is assumed that one (1) excavator and one (1) moxy dump truck are utilised during fixed and mobile crushing operations.

A summary of Sound Power Level (SWL) for plant utilised during these operational phase activities are shown in **Table 10.** Where information was not available directly from the proponent, SWL data were sourced from a library of representative plant, and cross referenced against existing assessment of similarly sized quarrying operations. Noise predictions presented in **Section 6.2** are determined on this basis.

Figure 4: Wave Hill quarry site layout

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Table 10: Operational stage noise scenarios

Scenario	Description of Utilisation	Plant	SWL, dB(A)	Activity SWL dB(A)	Meteorological Parameters[1]	Hours of Operation[2]	
						Mon-Fri	Sat
Pre-blast Drilling	Drilling rig operating to drill blast pattern	DR121 Rock Pilot Drill Rig	115	115	Standard & Prevailing conditions - Day[1]	9:00am to 3:00pm	Nil
Mobile Quarrying Operations	Including extraction, crushing and sizing operations, loading of haulage trucks from stockpile	Jaw Crusher	115	119	Standard & Prevailing conditions - Day[1]	7:00am to 6:00pm	7:00am to 6:00pm
		Cone Crusher	115				
		Vibrating Screen/Stockpiler (3)	111				
		CAT 980k Front End Loader	109				
		CAT 769D Moxy/Dump truck	107				
		CAT 336D Excavator	107				
		Truck & Dog	107				
Fixed Quarrying Operations	Including extraction, crushing and sizing operations, loading of haulage trucks from stockpile	Trio Crusher, VSI Impactor & Vibratory Screens (4)	117	119	Standard & Prevailing conditions - Day[1]	7:00am to 6:00pm	7:00am to 6:00pm
		CAT 980k Front End Loader	109				
		CAT 769D Moxy/Dump truck	107				
		Truck & Dog	107				
		CAT 336D Excavator	107				
Truck Loading & Stockpiling	Maintenance of stockpiles and Loading of haul trucks by front end loader	Front End Loader	109 (L_{Max} 128)	128	Standard & Prevailing conditions - Night[1]	6:30am to 5:30pm	6:30am to 5:30pm
		Truck & Dog	107				

Note[1]: Adopted meteorological conditions for assessment of noise impacts are defined in **Table 5**.

Note[2]: Time of day is defined as follows:

- day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays
- evening – the period from 6 pm to 10 pm
- night – the remaining periods.

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6.2 Noise Level Predictions

A summary of predicted $L_{Aeq,15minute}$ noise levels at the nearest sensitive receivers associated with operation of the proposed quarry (pre-blast, drilling, operation of fixed and mobile quarrying plant) under calm meteorological conditions is provided in **Table 11**.

Table 11: Noise impact predictions $L_{Aeq,15minute}$ dB(A) Day (Calm conditions)

Receiver	Pre-blast Drilling	Mobile Quarrying Operations	Fixed Quarrying Operations	PNTL Day $L_{Aeq,15minute}$	Above PNTL?
R1	<30	34	34	40	No
R2	31	**44**	40	40	Yes (mobile quarrying)
R3	<30	36	32	40	No

The results of modelling indicate that predicted operational noise levels will be above the PNTL criteria at the 'Brenowen' residence (R2) by up to 4dB(A) when mobile quarrying operations are undertaken at Wave Hill quarry during calm conditions.

As pre-blast drilling may operate at the same time as quarrying activities, a scenario was assessed relating to the simultaneous operation of the pre-blast drill plant and quarrying operations. **Table 12** below summarises the results.

Table 12: Quarrying & pre-blast drilling Noise impact predictions $L_{Aeq,15minute}$ dB(A) Day (Calm conditions)

Receiver	Mobile Quarrying & Drill rig	Fixed Quarrying & Drill rig	PNTL Day $L_{Aeq,15minute}$	Above PNTL?
R1	34	34	40	No
R2	**44**	**41**	40	Yes
R3	37	33	40	No

The results of modelling indicate that predicted operational noise levels will be above the PNTL criteria at the 'Brenowen' residence (R2) by up to 4dB(A) when mobile quarrying operations are undertaken simultaneously with pre-blast drilling activities at Wave Hill quarry during calm conditions. Additionally, operational noise levels will be marginally above the PNTL criteria at the 'Brenowen' residence (R2) by up to 1dB(A) when fixed quarrying operations are undertaken simultaneously with pre-blast drilling activities at Wave Hill quarry during calm conditions.

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Noise predictions in **Table 13** below outline the influence of prevailing south-south east winds on the defined operational scenarios at Wave Hill quarry.

Table 13: Noise impact predictions $L_{Aeq,15minute}$ dB(A) Day (SE winds at 3m/s)

Receiver	Pre-blast Drilling	Mobile Quarrying Operations	Fixed Quarrying Operations	PNTL Day $L_{Aeq,15minute}$	Above PNTL?
R1	<30	37	37	40	No
R2	<30	40	37	40	No
R3	<30	33	<30	40	No

The results of modelling indicate that although predicted fixed and mobile operational quarry noise impacts will increase at receivers R1, all receivers will be below the PNTL criteria for all operational activities under prevailing meteorological conditions.

The simultaneous operation of the pre-blast drill plant and quarrying operations was also assessed under these meteorological conditions and is presented in **Table 12.**

Table 14: Quarrying & pre-blast drilling noise impact predictions $L_{Aeq,15minute}$ dB(A) Day (SE winds at 3m/s)

Receiver	Mobile Quarrying + Drill rig	Fixed Quarrying + Drill rig	PNTL Day $L_{Aeq,15minute}$	Above PNTL?
R1	37	37	40	No
R2	40	38	40	Yes
R3	34	30	40	No

The results of modelling indicate that predicted operational noise levels will be below the PNTL criteria when mobile quarrying operations are undertaken simultaneously with pre-blast drilling activities at Wave Hill quarry during prevailing meteorological conditions.

Additionally, it is noted that activities associated with the maintenance of stockpiles and loading of haul trucks by front end loader is to occur prior to 7am. **Table 15** below identifies impacts associated with this activity, which has been assessed under the night period PNTL for both standard and prevailing meteorological conditions as outlined in **Table 5.**

Table 15: Truck Loading & Stockpiling noise impact predictions $L_{Aeq,15minute}$ dB(A) Night

Receiver	Standard conditions	Prevailing Conditions	PNTL Night $L_{Aeq,15minute}$	Above PNTL?
R1	<30	<30	36	No
R2	<30	<30	36	No
R3	<30	<30	36	No

The results of modelling indicate all receivers will be below the PNTL criteria if truck loading and stockpiling activities are to occur before 7am under both standard and prevailing meteorological conditions.

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Results of noise modelling are summarised as follows:

- exceedances of up to 4dB(A) are expected at receiver R2 if quarrying operations utilising the mobile plant are conducted during calm conditions;
- exceedances of up to 4dB(A) are expected at receiver R2 if quarrying operations utilising the mobile plant are conducted in unison with pre-blast drilling activities during calm conditions. Exceedances of up to 1dB(A) are expected at receiver R2 if quarrying operations utilising the fixed plant are conducted in unison with pre-blast drilling activities during calm conditions;
- both fixed and mobile quarrying operations, and pre blast drilling activities (operating in isolation from each other) are predicted to comply with the PNTL under prevailing conditions (south-east winds up to 3m/s);
- both fixed and mobile quarrying operations in conjunction with pre blast drilling activities are predicted to comply with the PNTL under prevailing conditions (south-east winds up to 3m/s); and
- all receivers will be below the PNTL criteria if truck loading and stockpiling activities are to occur before 7am under both standard and prevailing meteorological conditions.

Additional mitigation measures are recommended to reduce residual noise impacts that may be experienced under infrequent conditions at receiver R2. **Section 6.3** provides mitigation measures that will attempt to address potential residual noise impacts encountered at receiver R2.

6.3 Operational Mitigation Measures

6.3.1 Mitigation of mobile quarrying activities

Based on the results of noise modelling, the main contribution to site generated noise emissions is the operation of mobile equipment towards the south east boundary of the quarry. Currently, a void between two stockpiles means that there is direct line of sight between these sources and receiver.

It is recommended that these two stockpile areas are consolidated to act as a noise barrier and to eliminate the direct line of sight to the R2 receiver. A comparison of predicted $L_{Aeq,15minute}$ noise levels at receiver R2 based on the implementation of a consolidated stockpile barrier 5 metres high against current mobile quarrying plant operational levels is summarised below.

Table 16: Noise impact predictions $L_{Aeq,15minute}$ dB(A) Day

Receiver	Mobile quarrying under current operational conditions Calm / SE	Mobile quarrying with consolidated stockpile Calm / SE	PNTL Day $L_{Aeq,15minute}$	Above PNTL?
R1	34 / 37	34 / 37	40	No
R2	**44** / 40	39 / 35	40	Yes (without consolidated stockpile barrier - calm)
R3	36 / 33	36 / 32	40	No

The results of modelling indicate that predicted operational noise levels associated with mobile plant could be reduced by 5db(A) at receiver R2 if the existing stockpile (earth barrier) to the south-east is consolidated and maintained at a height of 5 metres. It is predicted will be below the PNTL criteria at the R2 if this control is implemented. It is noted that the barrier may be subject to further design of

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verification of efficacy, however modelling indicates that this represents an effective and feasible mitigation measure. The indicative location of this area is displayed in **Figure 5**.

Figure 5: Stockpile area with direct line of site between mobile quarrying operations and Receiver R2

It is evident that the operation of the drill rig for pre blasting activities may lead to exceedances when conducted in conjunction with the operation of mobile quarrying plant under calm conditions. To determine whether the simultaneous operation of pre blast drill and mobile quarrying plant with the incorporated stockpile barrier will lead to noise levels above the PNLT at sensitive receivers, an assessment was conducted with results provided in **Table 17** below.

Table 17: Noise impact predictions $L_{Aeq,15minute}$ dB(A) Day (Calm)

Receiver	Mobile quarrying & drill rig activities with consolidated stockpile Calm / SE	PNTL Day $L_{Aeq,15minute}$	Above PNTL?
R1	34 / 37	40	No
R2	40 / 36	40	No
R3	37 / 33	40	No

The results of modelling indicate that predicted operational noise levels associated with the simultaneous operation of the drill rig and mobile will comply with the PNTL at all receivers.

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6.3.2 Mitigation of simultaneous pre-blast drilling and fixed plant quarrying activities

It is apparent that the operation of the drill rig for pre blasting activities may lead minor to exceedances of up to 1dB(A) above the PNTL at receiver R2 when conducted in conjunction with the operation of fixed quarrying plant under calm conditions. Analysis outlined in **Appendix III** indicates that sound power levels were approximately 5dB(A) lower when measurements were taken at the rear of the operational drill, compared to measurements taken at the front of the drill. It is recommended that positioning the front of the drilling plant away from the most affected receiver (R2) will aid in reducing the noise levels below the PNTL at all receivers. This mitigation measure will ensure that the most intrusive aspect of the drilling plant (drill-bit boring though earth) is distanced from the affected receiver and shielded from the receiver at the source by the rest of the physical plant. In order to further reduce impacts that may be experienced at the most affected receiver (R2), the following mitigation measures are recommended:

- reducing the incidences in which pre-blast drilling operations are conducted at the same time as other noise generating activities onsite (quarrying using either mobile or fixed plant);
- implementing drilling plans that increase the distance between drilling operations and receiver R2. It is recommended that drilling progresses towards the north west or north; and
- scheduling periods in which both drilling and quarrying activities are operational around times of high background noise (local road traffic or when other local noise sources are active) where possible to provide masking or to reduce the amount that the site noise intrudes above the background.

If the above mitigation measures are employed, it is likely that any potential residual noise generated from the concurrent operation of drilling and quarrying activities would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.

6.4 Summary of Operational Activity Results

Provided the mitigation measures outlined in **Section 6.3** are implemented, it is predicted that operational activities will be below the PNTL at all receivers. A summary of operational activity results is outlined in **Table 18** below.

Table 18: Summary of operational activities at Wave Hill Quarry, $L_{Aeq,15minute}$ dB(A)

Receiver	Pre-blast Drilling Calm / SE	Mobile Quarrying Operations Calm / SE	Fixed Quarrying Operations Calm / SE	PNTL Day $L_{Aeq,15minute}$	Above PNTL?
R1	<30 /<30	34 / 37	34 / 37	40	No
R2	31 / <30	39 / 35	40 / 37	40	No
R3	<30 / <30	36 / 32	32 / <30	40	No

If pre-blast drilling operations are to occur in conjunction with fixed mobile plant, it is predicted that there may be a minor exceedance of up to 1dB(A) above the PNTL at receiver R2. This is considered a negligible residual impact and mitigation measures outlined in **Section 6.3** will aid in the reduction of any potential residual noise generated. A summary of operational activity results is outlined in below.

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Table 19: Summary of cumulative quarrying & drill rig activities, $L_{Aeq,15minute}$ dB(A)

Receiver	Mobile Quarrying + Drill rig Calm / SE	Fixed Quarrying + Drill rig Calm / SE	PNTL Day $L_{Aeq,15minute}$	Above PNTL?
R1	34 / 37	34 / 37	40	No
R2	40 / 36	**41** / 38	40	Yes (Fixed & drill plant - Calm)
R3	37 / 33	33 / 30	40	No

6.5 Maximum Noise Level Predictions

Assessment of predicted noise levels associated with short-term high-level events (L_{AMax}) with potential to cause sleep disturbance at adjacent sensitive receivers are provided in **Table 20**. Loading of material into hoppers or truck bodies was identified as the activity most likely to generate peak noise events. Modelling results presented in **Table 20** indicate that maximum noise levels are not expected to exceed the MNTL of 52dB(A) at received adjacent to the proposed development, and further assessment of impacts is not undertaken.

Table 20: Maximum noise level predictions, activities outside daytime hours (L_{AMax} dB(A))

Receiver	Predicted L_{Amax}	Criteria (Night) L_{Amax}	Above MNLT?
R1	41	52	No
R2	45	52	No
R3	39	52	No

Assessment of truck loading and stockpiling activities during night period (**Table 15**) indicates that noise levels above the PNTL are not expected, and would thus comply with the $L_{Aeq,15minute}$ MNTL of 40dB(A). Further to this, operational quarrying activities will not occur at outside daytime hours and will not cause sleep disturbance related noise impacts. On this basis, assessment is limited to analysis of emissions against prediction of L_{AMax} values.

7. ROAD TRAFFIC NOISE IMPACTS

At present, the production of material onsite is limited to project-based demands. The site produces between 200 to 2000 tonnes per day with extended periods in which no operations occur. Management generally operate at an average capacity of 1,000-1,500 tonne per day to generate stockpiles of various aggregate including road base gravels, gravel for concrete batching and ballast for rail projects in the region. The direct relationship between production rate of quarried material and haulage volumes has been utilised to determine traffic contributions from Wave Hill quarry.

No increase in average traffic volumes from the quarry are expected as a result of the modification, however, to model a worst-case scenario, existing haulage contributions (no build option) will be based on average production rates of 1500 tonnes. Predicted haulage contributions (build option) will be based on maximum production rates of 2000 tonnes. It is anticipated that 72 haulage movements will occur per day based on maximum production rates (2000 tonnes). As the average production rate is assumed to be 1500 tonnes (75% of maximum production rate), existing haulage movements have been calculated to be 52 movements per day (75% of 72 movements).

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The nearest residential facades potentially affected by road traffic generated by the quarry operations as a result of the proposed modification are located on Wave Hill road and Maules Creek Road, to the west of the site access road. Conservative assumptions have been made for the purpose of road traffic noise assessment to provide potential worst-case scenario in terms of road traffic volumes on proposed traffic routes.

For the purpose of assessing road traffic noise the following assumptions have been made:

- the proposed heavy-vehicle (HV) movements associated with the proposed modification will occur predominantly during the day period, with all heavy vehicle traffic entering and leaving site from the west. Haulage operations are to occur between 7am to 6pm from Monday to Friday and between 7am and 1pm on Saturdays, however heavy vehicles will be permitted to enter site from 6:30am;
- heavy-vehicle movements associated with the proposed modification will occur for one hour during the night period, this captures heavy vehicles in transit to site prior to 7am;
- the model allows for 4 light vehicle (LV) movements per day to capture staff arriving and leaving site;
- as the traffic management plan for this modification has not been finilised and further discussion with Council is required to determine the route through Narrabri, traffic noise impact assessment is restricted to the assessment of receivers along the Wave Hill Road and Maules Creek Road section of the haul route (approximately 12km west of quarry); and
- the nearest residence on Wave Hill Road potentially affected by quarry-related traffic is 20 metres from the road. Traffic volumes and other assumptions are provided in **Table 21.**

Table 21: Road traffic volumes for noise modelling (6am to 6pm)

Road (traffic Speed)	Existing (no build)				Predicted (build)			
	LV	HV	All traffic	% Heavy Vehicles	LV	HV	All traffic	% Heavy Vehicles
Wave Hill Road / Maules Creek Road (100km/h)	4	52	56	93%	4	72	76	95%

The Calculation of Road Traffic Noise (CoRTN) (UK Department of Transport) method was used to predict the noise levels at the nearest potentially affected receivers in accordance with Appendix B4 of the RNP. This prediction method considers traffic flow volume, average speed, percentage of heavy vehicles and road gradient to establish noise source strength, and includes attenuation due to distance, façade adjustments, ground absorption and screening from buildings or barriers where relevant. Road traffic noise levels predicted at the nearest receivers (facades facing the road) to the relevant roads are shown in **Table 22.**

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Table 22: Road traffic results – Day time, $L_{Aeq,Period}$, dB(A)

Receiver	Approx. setback from road (m)	Existing noise levels (D/N)	Predicted noise levels (D/N)	Criteria (D/N)	> 2dB(A) increase?	Compliant
1092 Wave Hill Rd	25	51 / 41	52 / 42	60 / 55	No	Yes
200 Wave Hill Rd	330	43 / 33	44 / 34	60 / 55	No	Yes
222 Wave Hill Rd	80	48 / 38	50 / 39	60 / 55	No	Yes
236 Maules Creek Rd	90	48 / 38	50 / 39	60 / 55	No	Yes
239 Wave Hill Rd	100	46 / 36	48 / 37	60 / 55	No	Yes
42 Wave Hill Rd	210	45 / 35	46 / 36	60 / 55	No	Yes
5 Wave Hill Rd	35	50 / 40	52 / 41	60 / 55	No	Yes
55 Wave Hill Rd	420	42 / 31	43 / 33	60 / 55	No	Yes
619 Wave Hill Road	20	52 / 41	53 / 42	60 / 55	No	Yes
63 Wave Hill Road	350	42 / 32	44 / 33	60 / 55	No	Yes
87 Wave Hill Road	290	43 / 33	45 / 34	60 / 55	No	Yes
939 Wave Hill Road	170	45 / 34	46 / 35	60 / 55	No	Yes
94 Maules Creek Rd	150	47 / 36	48 / 37	60 / 55	No	Yes

Review of modelling results indicates:

- Noise levels may increase at receivers along Wave Hill Road and Maules Creek Road but will continue to be below the criteria;
- the noise levels may increase from existing levels by up to but no more than 2dB(A) at some receivers, however all receivers will be below the relevant criteria for both periods; and
- given that the above predictions are based on conservative assumptions, it is noted that road traffic noise associated with the proposed modification is likely to be lower than levels presented in this report.

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As detailed route plans through the township of Narrabri were not available at the time of this assessment, the following recommendations are provided to minimise adverse road noise impacts that may be encountered upon determination of final design:

- Consultation with residents adjacent to the Haul Route;
- Developing an effective traffic management plan to ensure that drivers:
  - adhere to sign-posted speed limits (40km/h through school zone);
  - maintain and operate vehicles in a manner that does not generate excessive noise;
  - schedule haulage of product to maximise periods of respite;
  - contains a mechanism for monitoring adherence to the plan, and for responding to complaints;
- Where practical, utilise larger capacity vehicles to minimise the number of movements; and
- Operation of vehicles at speeds below signposted speeds (i.e. at 50km/h) in built up areas may provide opportunities to reduce levels of impact.

8. ASSESSMENT OF BLAST IMPACTS

Australian Standard AS2187.2-2006 provides outline methods for evaluating potential ground vibration and air blast overpressure impacts associated with explosive blasting. A quantitative assessment of potential impacts has been prepared on the basis of minimum separation distances from the blast area to the nearest sensitive receiver (R1, approximately 720m to the west from the blast area) and preliminary blast design information. Impacts at more distant receiver locations are assumed to be acceptable where air blast and ground vibration levels comply with limits at the assessment location.

8.1 Estimating Overpressure Levels

Appendix J7 of *AS2187.2-2006 Explosives - Storage and use. Part 2: Use of explosives* provides the following method for evaluating potential airblast overpressure levels:

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

Where: P is air pressure (Pa);
R is the distance between charge and point of measurement (m);
Q is maximum instantaneous charge (charge mass per delay) (kg);
K_a,is the site constant; and
a is the site exponent.

Additional detail contained in Clause J7.3 of AS2187.2:2006 provides the following values for the site constant and site exponent for confined blasthole charges:

K_a = range between 10 to 100;
a = -1.45

Equation J5.1 in AS2187.2:2006 allows for the expression of overpressure impacts in decibels:

$$SPL = 10 \times \log_{10} \left(\frac{P}{P_0} \right)^2$$

Where: P is estimated overpressure level (μPa); and
P_0 is the reference pressure of 20 μPa.

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A summary of air blast overpressure impacts based on blast design information provided by the proponent is presented in **Table 23**. The results indicate that, based on observed separation distances, air blast overpressure levels are unlikely to exceed the human annoyance criteria presented in the ANZEC guideline at the nearest sensitive receiver.

Table 23: Assessment of air blast impacts at nearest receiver

Scenario	Separation Distance	Hole Diameter	MIC	Air blast Overpressure	Limit
1	720	89mm	171kg	113dB	115dB
2		89mm	160kg	112dB	

8.2 Estimating Ground Vibration Impact

Appendix J7 of *AS2187.2-2006 Explosives - Storage and use. Part 2: Use of explosives* provides the following method for evaluating potential ground vibration levels:

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

Where: V is ground vibration as vector peak particle velocity (mm/s);
R is the distance between charge and point of measurement (m);
Q is maximum instantaneous charge (charge mass per delay) (kg); and
K_g, B are constants related to site and rock properties for estimation purposes.

Discussion presented in Clause J7.3 of AS2187.2:2006 states that, in the absence of site specific constants the following values may be used to estimate vibration levels (50% probability of exceedence) in average conditions:

K_g = 1140
B = -1.6

In the absence of detailed understanding of site specific vibration propagation characteristics, the constants for average conditions are applied to this assessment.

8.2.1 Assessment of Ground Vibration Impacts

A summary of assessed ground vibration impacts is presented in **Table 29.** The results indicate that, based on the observed separation distances, ground vibration levels are unlikely to exceed the criteria for human annoyance at sensitive receivers adjacent to the blast site.

Table 29: Assessment ground vibration impacts

Scenario	Sep Distance	Hole Diameter	MIC	Ground Vibration PPV	Limit
1	720	89mm	171kg	1.9mm/s	5mm/s
2		89mm	160kg	1.8mm/s	

8.2.2 Mitigation of Blast Impacts

While the assessment indicates blasting activities are likely to comply with the relevant criteria, impacts may be perceived by sensitive receivers adjacent to the site. AS2187.2-2006 provides guidance on

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methods to manage blasting in such a way as to minimise ground vibration and overpressure impacts, including:

- Reducing the maximum instantaneous charge and us of appropriate delays;
- Establishing blast times in accordance with prevailing meteorological conditions;
- Optimising blast design; and
- Orienting blasts away from receivers (where possible).

It is also recommended that provisions are made for notifying neighbours of planned blasts and monitoring of overpressure and ground vibration of blasts as they occur. This should aid in the establishment of mechanisms to modify blast designs and respond to any complaints as may be required.

9. ASSESSMENT OF CUMULATIVE IMPACTS

While analysis presented in **Sections 6 to 8** provides assessment of project related impacts, potential exists for cumulative impacts associated with the proposed development, and other developments that may operate in the same environment. As previously outlined in **Section 3.1**, the Narrabri Council have stated that:

> *The site is located less than 1500 metres away from another quarry operated by Boral. The proponent is requested to assess cumulative noise, air and blasting impacts at the receptor location positioned between these two sites in particular, as well as the other two (2) receptors identified.*

It is understood that the Boral quarry exists approximately 1.5 kilometres west of the Wave Hill quarry and is operated under EPL 3778. The NSW EPA website has indicated that the most recent licence review was completed on 15 June, 2015. This licence indicates that the following noise limits apply:

Table 24: Boral Quarry EPL 3778 noise limits, dB(A)

Locality and location	Day $L_{Aeq,\ 15\ minute}$	Evening $L_{Aeq,\ 15\ minute}$	Night $L_{Aeq,\ 15\ minute}$	Night $L_{A,1minute}$
All surrounding residences	35	35	35	45

9.1 Operational Impacts

The NPfI outlines that, to limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels (specified in **Table 7**). During the day period (when quarrying and processing operations at the proposed Wave Hill Quarry would occur) the recommended amenity noise level for adjacent receivers would be 50dB(A).

To analyse the potential cumulative noise impacts that the simultaneous operation of both the quarries would have on the surrounding residential receivers, the day criteria of 35dB(A) outlined in Boral quarry EPL was logarithmically added to the predicted operational noise levels from Wave Hill quarry. Note that this method of assessing cumulative impacts represents the worst-case scenario. It is not expected that noise levels at the threshold of the Boral quarry criteria (35db(A)) would be experienced uniformly across receivers in the vicinity of the Wave Hill Quarry, as this site is further from receivers R2 and R3 than it is from receiver R1. By using the worst-case scenario to inform a predictive indication of cumulative noise impacts, it will be insured that noise impacts can be effectively managed into the future,

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should modifications take place at either quarry. **Table 25** represents worst case cumulative impacts during the operational activities conducted at Wave Hill Quarry. The following assumptions have been adopted for this analysis:

- operational activities are conducted under calm meteorological conditions;
- the noise reductions associated with operational mitigation measures recommended for mobile plant operation outlined in **Section 6.3** have been applied; and
- the noise contributions from the Boral quarry are at levels of 35dB(A) for each receiver.

Table 25: Predicted worst case cumulative noise impacts, dB(A)

Receiver	Source	Pre-blast Drilling	Mobile Quarrying Operations	Fixed Quarrying Operations	Recommended Amenity Level Day $L_{Aeq,15minute}$	Above Recommended Amenity Level?
R1	Wave Hill Contribution	<30	34	34	n/a	No
	Boral Contribution	35	35	35	n/a	
	Cumulative Level	35	38	38	50	
R2	Wave Hill Contribution	34	39	40	n/a	No
	Boral Contribution	35	35	35	n/a	
	Cumulative Level	38	40	41	50	
R3	Wave Hill Contribution	31	36	32	n/a	No
	Boral Contribution	35	35	35	n/a	
	Cumulative Level	36	39	37	50	

This assessment indicates that cumulative noise levels are likely to fall below the 50dB(A) recommended amenity noise level for the day period. This assessment is considered a worst-case scenario, and thus no cumulative impact may be expected at any of the receivers in the vicinity of Wave Hill quarry.

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9.2 Road Traffic Noise Impacts

Road traffic noise associated with product haulage from the proposed Wave Hill Quarry is not expected to exceed the road traffic noise criteria at any sensitive receivers when assessed under the RNP. As no data was available for traffic volumes contributions from the Boral quarry, an assessment (utilising the CoRTN method) was conducted assuming that the Boral quarry daily haulage numbers were consistent with the build option at the Wave Hill Quarry (72 heavy vehicles). This, in affect doubles the road traffic contributions associated with the build option on Wave Hill and Maules Creek Road to 144 heavy vehicles per day. **Table 26** represents worst case cumulative impacts associated with 144 heavy vehicle movements along Wave Hill Road and Maules Creek Road per day.

Table 26: Cumulative worst-case traffic noise impacts – $L_{Aeq,Period}$ dB(A)

Receiver	Approximate distance from road (m)	Worst case predicted cumulative noise levels	Criteria (D/N)	Above Criteria
1092 Wave Hill Rd	25	56 / 45	60 / 55	No
200 Wave Hill Rd	330	47 / 36	60 / 55	No
222 Wave Hill Rd	80	53 / 42	60 / 55	No
236 Maules Creek Rd	90	53 / 42	60 / 55	No
239 Wave Hill Rd	100	51 / 40	60 / 55	No
42 Wave Hill Rd	210	49 / 38	60 / 55	No
5 Wave Hill Rd	35	55 / 44	60 / 55	No
55 Wave Hill Rd	420	46 / 35	60 / 55	No
619 Wave Hill Road	20	56 / 45	60 / 55	No
63 Wave Hill Road	350	47 / 36	60 / 55	No
87 Wave Hill Road	290	47 / 36	60 / 55	No
939 Wave Hill Road	170	49 / 38	60 / 55	No
94 Maules Creek Rd	150	51 / 40	60 / 55	No

This assessment indicates that cumulative noise levels associated with road traffic noise are likely to fall below the 60dB(A) criteria for the day period and 55dB(A) for the night period. This is considered a worst case scenario and thus road traffic noise levels above the relevant criteria should not be expected at any of the receivers as a result of cumulative traffic volumes in the vicinity of Wave Hill quarry.

9.3 Blasting Impacts

Unlike operational and construction phase impacts (which are typically continuous in nature), management of potential cumulative blast impacts may be effectively managed through a program of consultation with any other development that are undertaking blasting, to ensure that blasting is not undertaken at the same time.

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10. DISCUSSION AND RECOMMENDATIONS

10.1 Assessment Conditions and Criteria

Analysis of background noise monitoring indicates that the receiving environmental adjacent to the proposed development site is rural in nature, influenced predominantly by environmental and distant transportation sources. In all cases, the PNTL were established in terms of the Intrusiveness Criteria. For the purposes of evaluating potential impacts, it is recommended at that the PNTL be adopted as the assessment criteria for the development. Review of prevailing meteorology indicates that there are no wind conditions observed more than 30% of the time during any season, however, historical annual and seasonal trends of winds about the south east were identified. For this reason, operational scenarios were modelled under prevailing conditions with winds >3m/s about the south east in addition to standard calm meteorological conditions. Although temperature inversions are indicated not meet the criteria as a significant feature of this environment, F class stability was adopted for the assessment of truck loading & stockpiling prior to 7am due to historical evidence of inversions in the area.

10.2 Assessment of Impacts and Recommendations for Management

10.2.1 Operational Noise

Review of noise modelling indicates that the proposed quarrying operations involving mobile crushing plant may generate offsite noise levels of up to 4dB(A) above PNTL at receiver R2. It is recommended that a 5-metre earthen barrier is constructed out of the existing stockpiles in the south-east corner of the site to provide acoustic shielding to mobile equipment operating in the void. It is noted that the construction of the barrier may require additional design advice or other form of validation to confirm its effectiveness as a control measure. It is predicted that noise contributions from all operational activities will be below the PNTL during calm and prevailing conditions if the above mitigation measures are implemented.

It is apparent that the operation of the drill rig for pre blasting activities may lead minor to exceedances of up to 1dB(A) above the PNTL at receiver R2 when conducted in conjunction with the operation of fixed quarrying plant under calm conditions. This is considered a negligible residual impact and mitigation measures outlined in **Section 6.3** will aid in the reduction of any potential residual noise generated.

10.2.2 Maximum Noise Levels

Truck loading and stockpiling prior to 7am within the quarry was identified as the activity with greatest potential to generate maximum noise level impacts (sleep disturbance impacts). It is important to note that these impacts may only manifest where quarrying or stockpiling operations are required to take place during the night period. Notwithstanding, review of modelling results indicates that L_{AMax} noise levels at adjacent sensitive receivers will be less than the Maximum Noise Trigger Level. Adverse impacts are predicted to be unlikely as a result of the proposed modification, and detailed assessment of potential impact was not undertaken.

10.2.3 Road Traffic Noise

Review of noise modelling indicates that the proposed traffic noise generated for the Wave Hill quarry will be compliant with the day criteria associated with a sub-arterial road, under conditions in which maximum production of rate 2000 tonnes per day is conducted. It is expected that haulage will be generally conducted under average production rates of 1000 to 1500 tonnes of quarried material per

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day. This indicates that traffic noise associated with the Wave Hill quarry is predicted to be compliant at receiver locations under both average and peak operational conditions.

As the traffic management plan for this modification has not been finalised and further discussion with Council is required to determine the route through Narrabri, traffic noise impact assessment was restricted to analysis of the Wave Hill Road and Maules Creek Road section of the haul route (approximately 12km west of quarry).

As detailed route plans through the township of Narrabri were not available at the time of this assessment, haulage routes through the town of Narrabri, the following recommendations are provided to minimise adverse road noise impacts:

- Consultation with residents adjacent to the Haul Route;
- Developing an effective traffic management plan to ensure that drivers:
  - adhere to sign-posted speed limits (40km/h through school zone);
  - maintain and operate vehicles in a manner that does not generate excessive noise;
  - schedule haulage of product to maximise periods of respite;
  - contains a mechanism for monitoring adherence to the plan, and for responding to complaints;
- Where practical, utilise larger capacity vehicles to minimise the number of movements; and
- Operation of vehicles at speeds below signposted speeds (i.e. at 50km/h) in built up areas may provide opportunities to reduce levels of impact.

10.2.4 Blasting Impacts

Assessment of the site indicates that blasting is required as part of the extraction process. Criteria for both ground vibration and overpressure were adopted from the ANZEC guidelines for the purposes of assessing blast impacts. Assessment of preliminary blast design indicates that compliance with these guideline values is likely. Notwithstanding, it is recommended that monitoring of blasts be undertaken until such time that compliance can be demonstrated. It is also recommended that a strategy for notifying neighbours of planned blasts be developed and implemented, and a method for receiving, investigating and responding to complaints is provided.

10.2.5 Cumulative Impacts

Due to the vicinity of the nearby Boral quarry, cumulative impacts associated with operational noise, road traffic noise and blasting were assessed at receiver in the vicinity of the Wave Hill quarry. Assuming a worst case scenario, it was determined that cumulative impacts were unlikely to occur under operational conditions. Similarly, worst case cumulative road traffic noise contributions are not likely to exceed the day criteria at the Wave Hill receivers. Unlike operational impacts (which are typically continuous in nature), management of potential cumulative blast impacts may be effectively managed through a program of consultation between the two quarries to ensure that blasting is not undertaken at the same time.

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11. CONCLUSION

Advitech Environmental was engaged to prepare an assessment of potential noise impacts associated with the modification of the Wave Hill quarry. The modification is proposed to increase the annual extraction rate at the Wave Hill quarry from 200,000 tonnes per annum to 500,000 tonnes per annum in order to meet demand of the proposed inland rail project.

Project Tigger Noise Levels for adjacent receiving environments were reviewed, and the assessment conservatively adopted the most stringent criteria for the project area. Modelling of operational activities indicate that predicted $L_{Aeq,15minute}$ noise levels will likely be below the PNTL criteria under all operational conditions during calm and prevailing conditions, provided that mitigation controls associated with the formation of a 5 metre earthen bund from the existing stockpiles to the south east of the site is implemented. It is also recommended that if the operation of drill rig plant is to occur at the same time as fixed plant quarrying activities, that the drill rig should be positioned so that the front facing drilling component of the plant is not directed towards the south east. This will assist in reducing any negligible residual noise impacts that may be experienced at receiver R2.

The results of the sleep disturbance analysis indicate that the L_{Amax} noise levels would not exceed the sleep disturbance criterion at any receiver locations. Additionally, predicted $L_{Aeq,15\ minute}$ noise levels associated with site activities prior to 7am are not expected to exceed MNTL. As a result, stockpile maintenance and loading of trucks may be undertaken prior to 7:00 without expectation of adverse impact.

While adverse operational and blasting impacts are not expected, this activity may be audible at some locations given the characteristics of the receiving environment. It is thus recommended that measures be put in place to ensure the timely and effective response to any concerns raised by adjacent receivers. Cumulative blast impacts may be effectively managed through a program of consultation with any other quarries within development area that are undertaking blasting, to ensure that blasting is not undertaken at the same time.

Modelling indicates that road traffic noise generated by the development is likely to comply with the relevant criteria for both the day and night periods at all receivers adjacent to the proposed haulage route during standard operational periods and periods under peak demand.

It is predicted that cumulative impacts associated with the operation of existing quarries within the project site will comply with the recommended amenity noise levels. Assessment of conservative road traffic noise impacts indicate that both quarries are likely able to operate at similar haulage volumes without the prospect of adverse noise impacts.

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12. REFERENCES

The following information was used in the preparation of this report:

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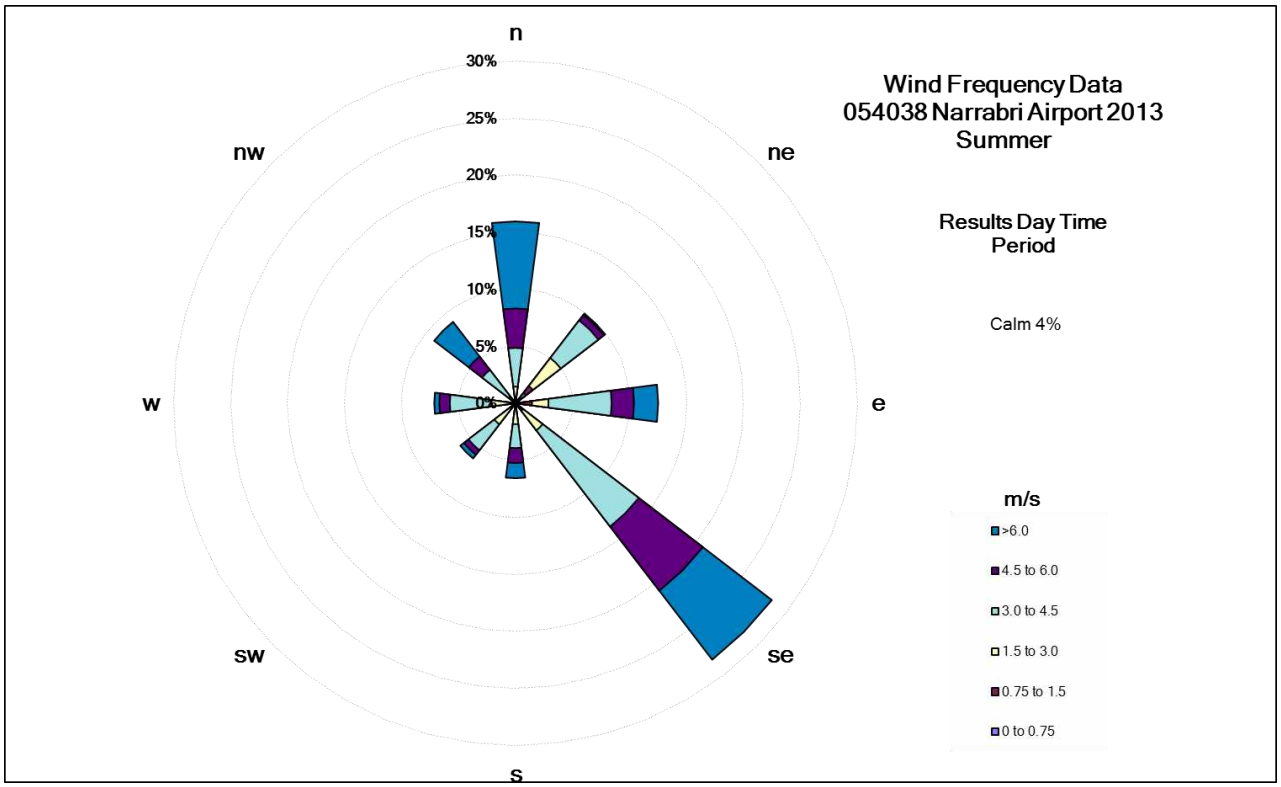
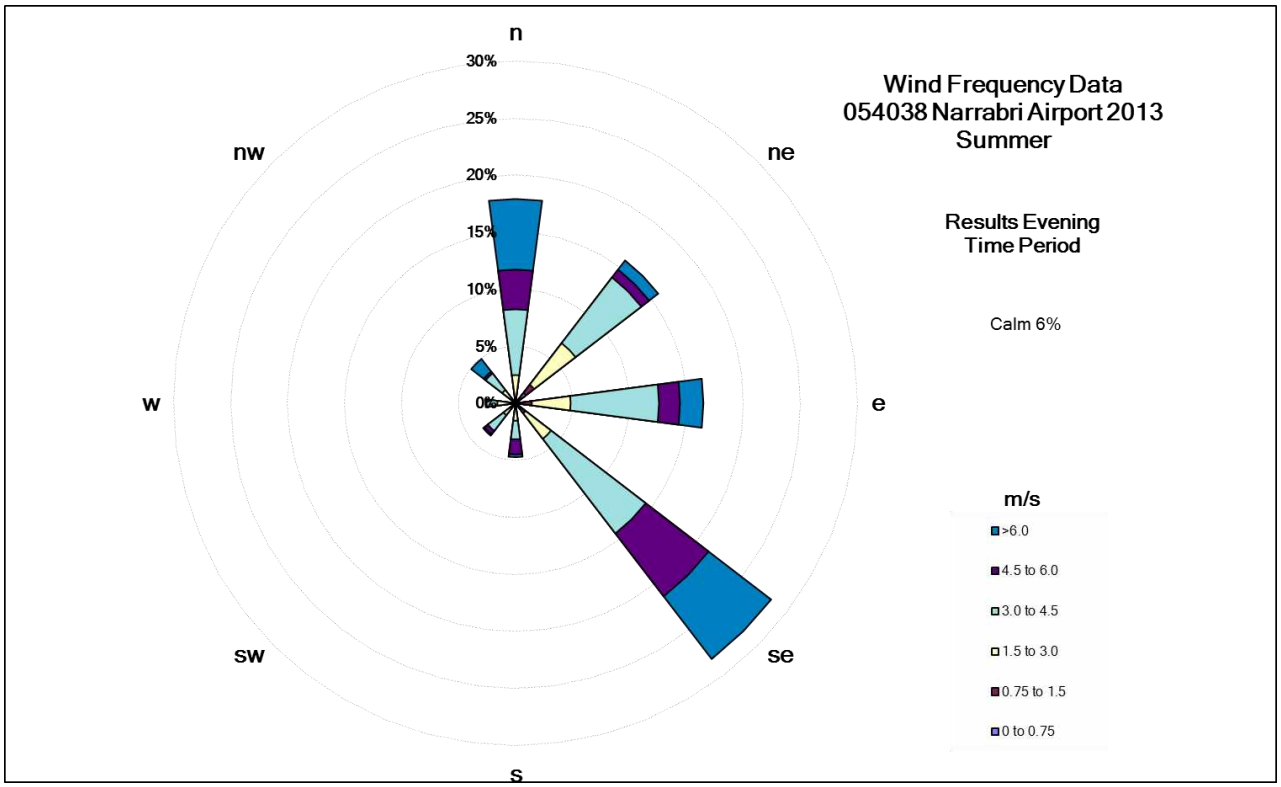
Appendix I Windrose Data

Narrabri Airport AWS (054038) 2013 Annual and Seasonal Wind Roses



Summer 2013 -Day (Calm 4%)



Summer 2013 -Evening (Calm 6%)

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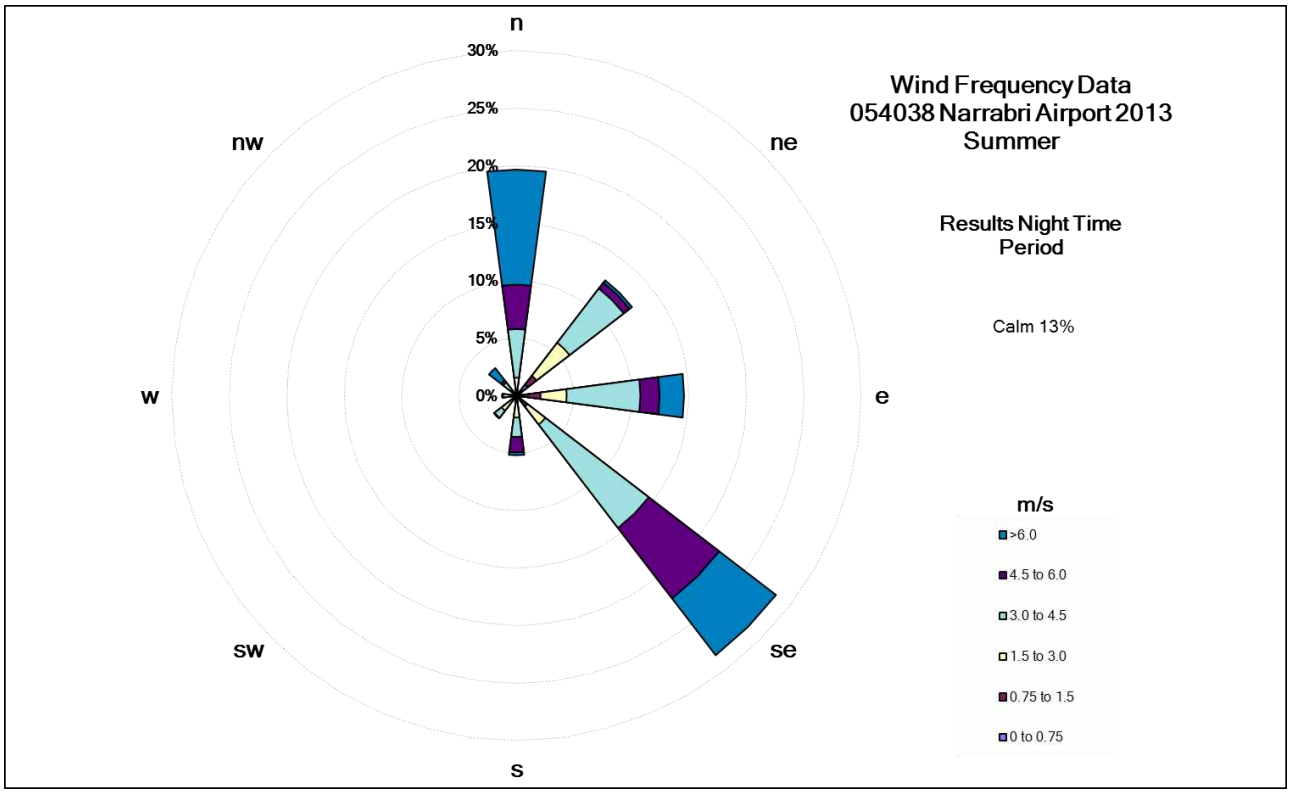
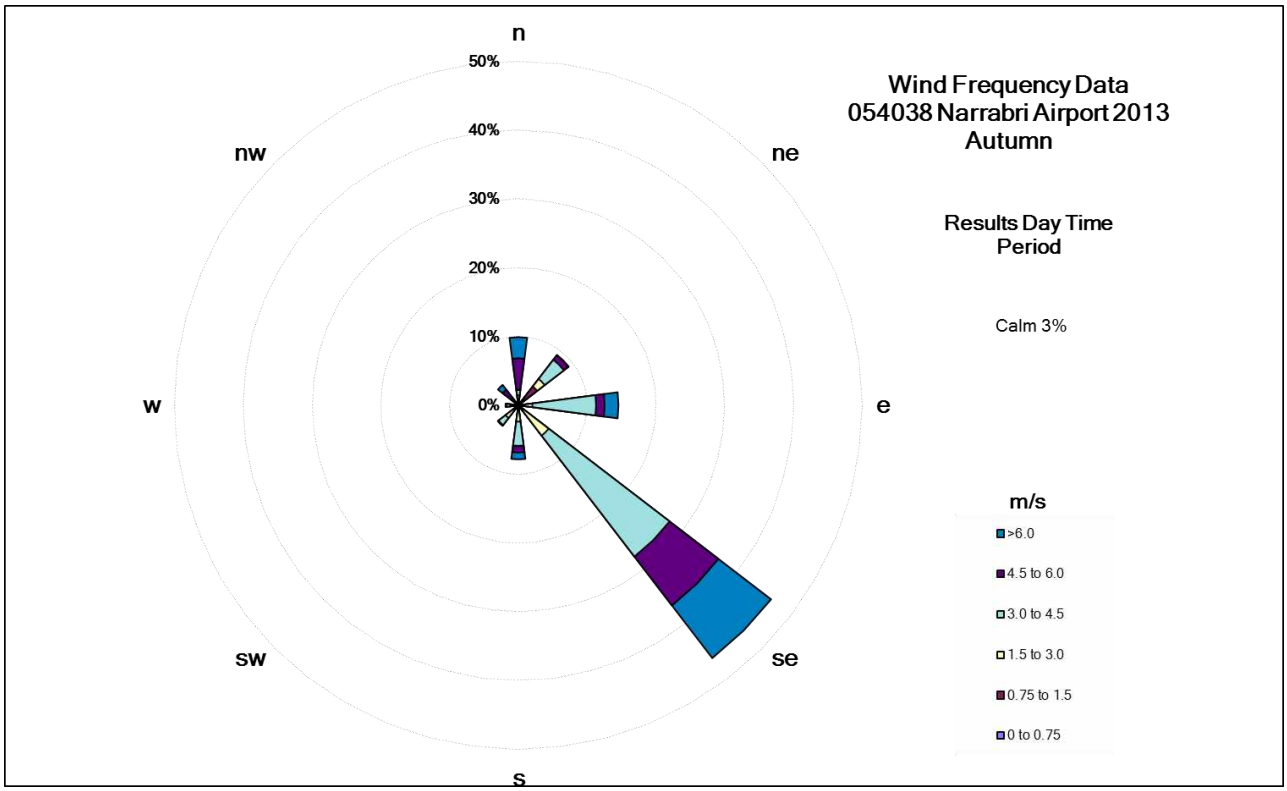


Summer 2013 -Night (Calm 13%)



Autumn 2013 -Day (Calm 3%)

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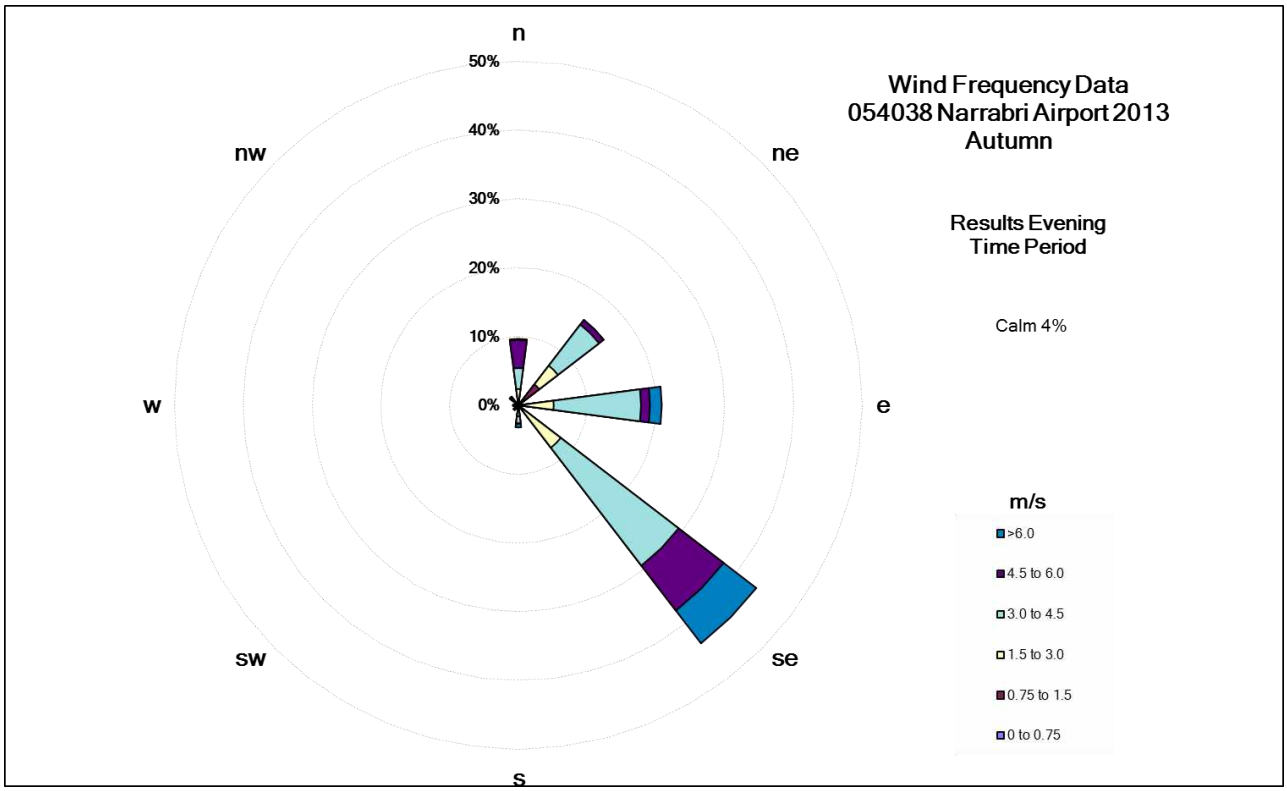
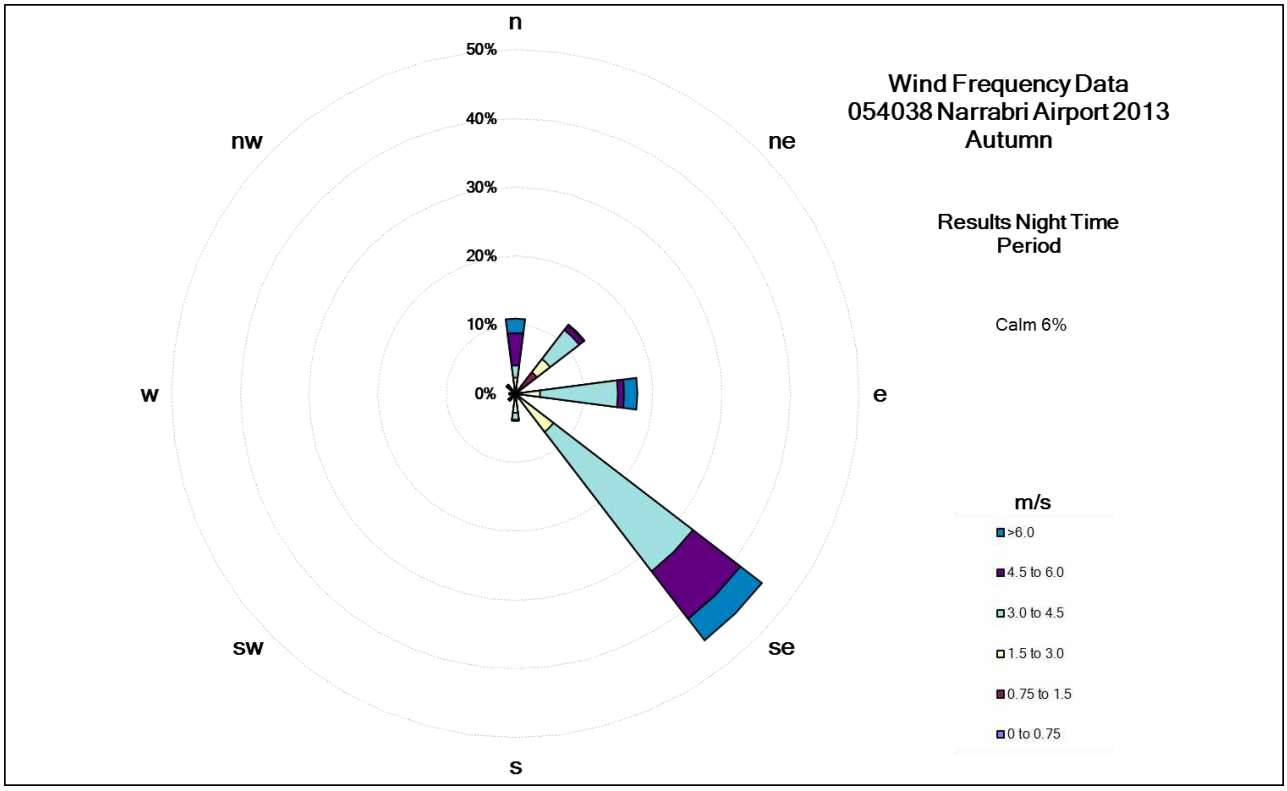


Autumn 2013 -Evening (Calm 4%)



Autumn 2013 -Night (Calm 6%)

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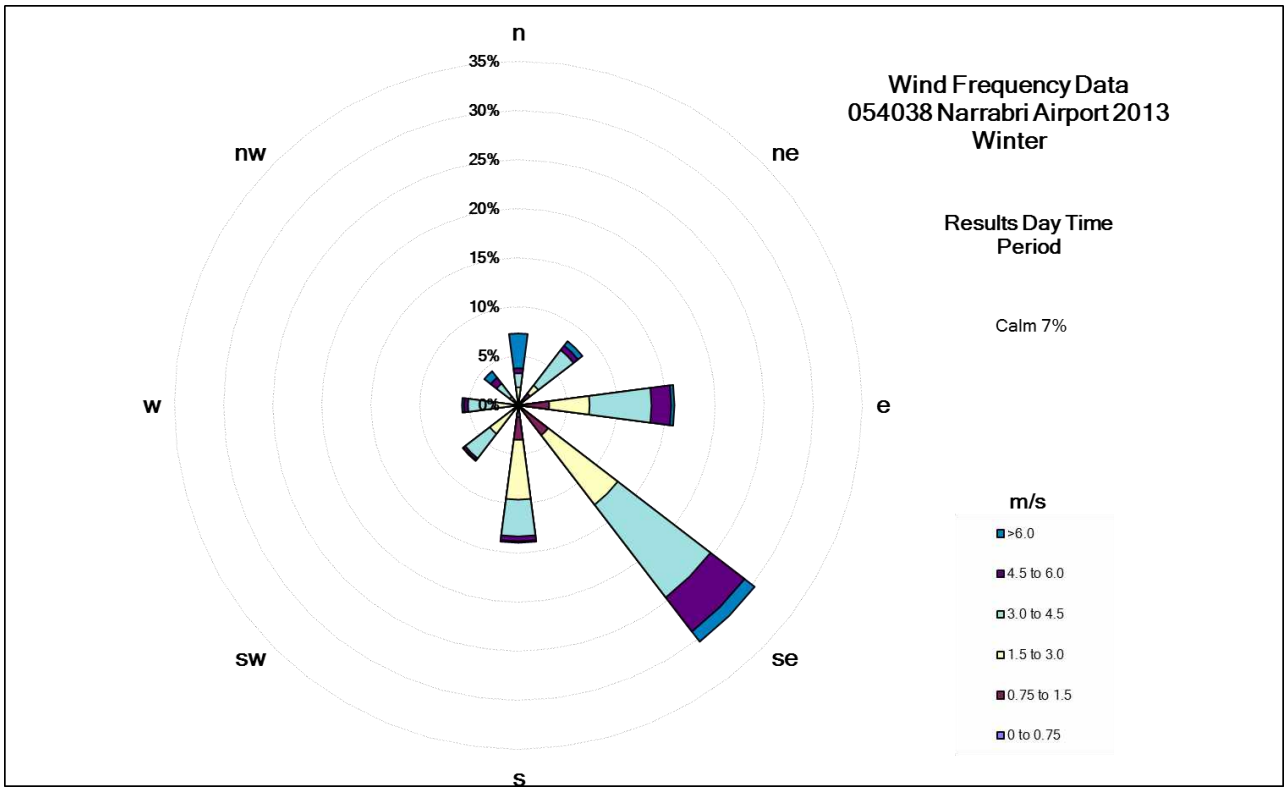
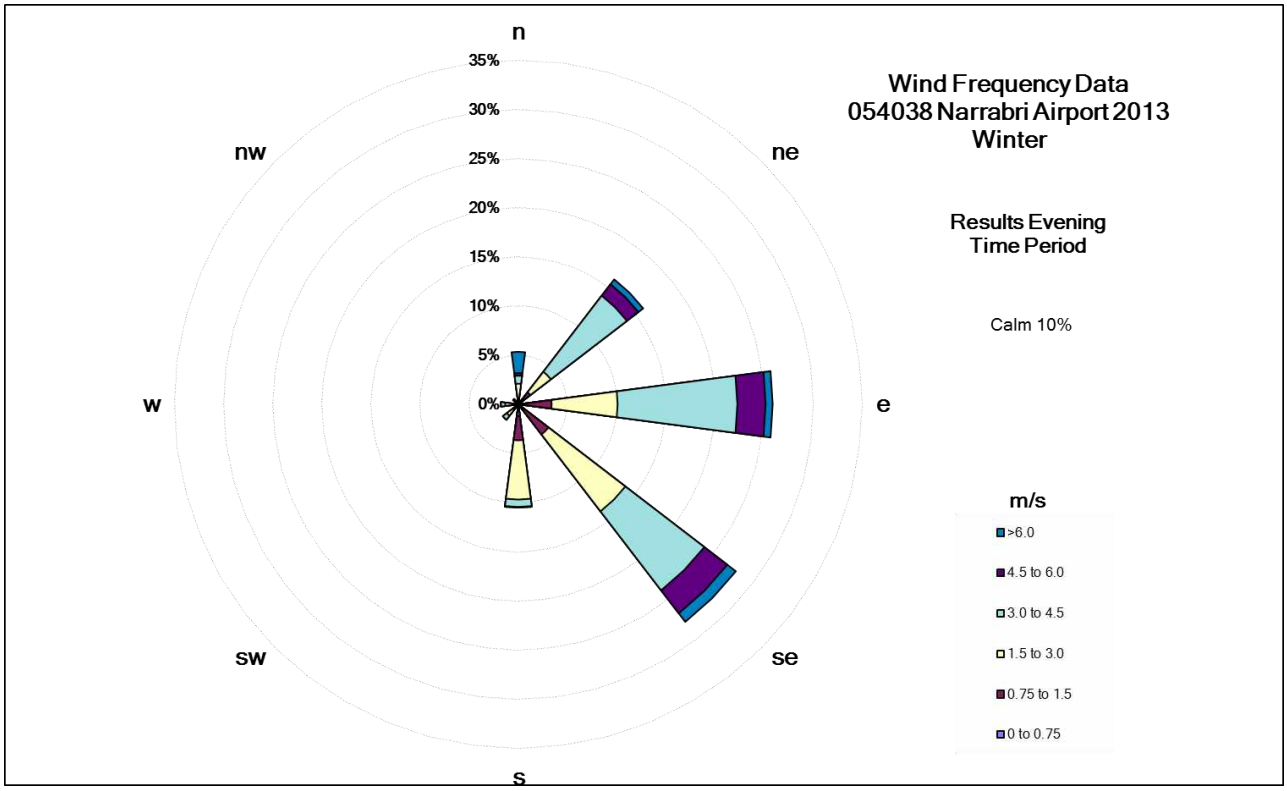


Winter 2013 -Day (Calm 7%)



Winter 2013 -Evening (Calm 10%)

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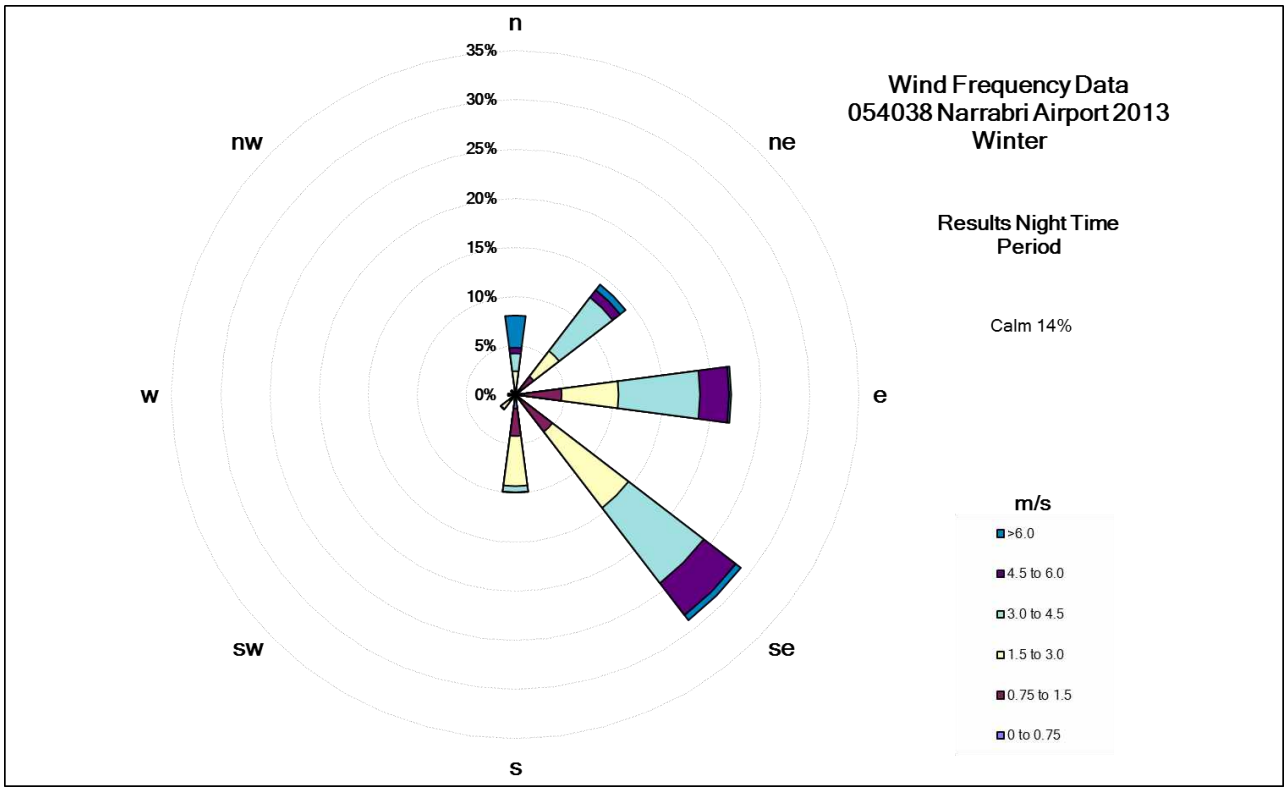
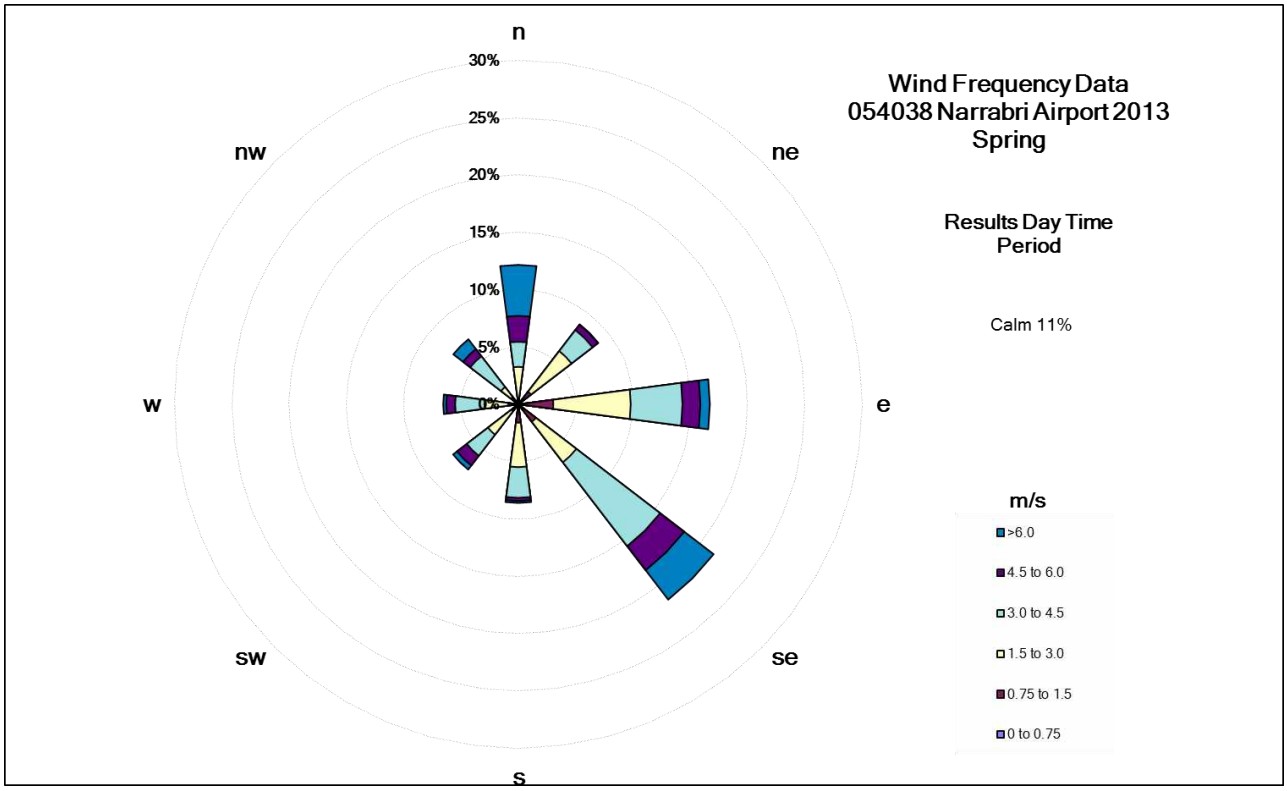


Winter 2013 -Night (Calm 14%)



Spring 2013 -Day (Calm 11%)

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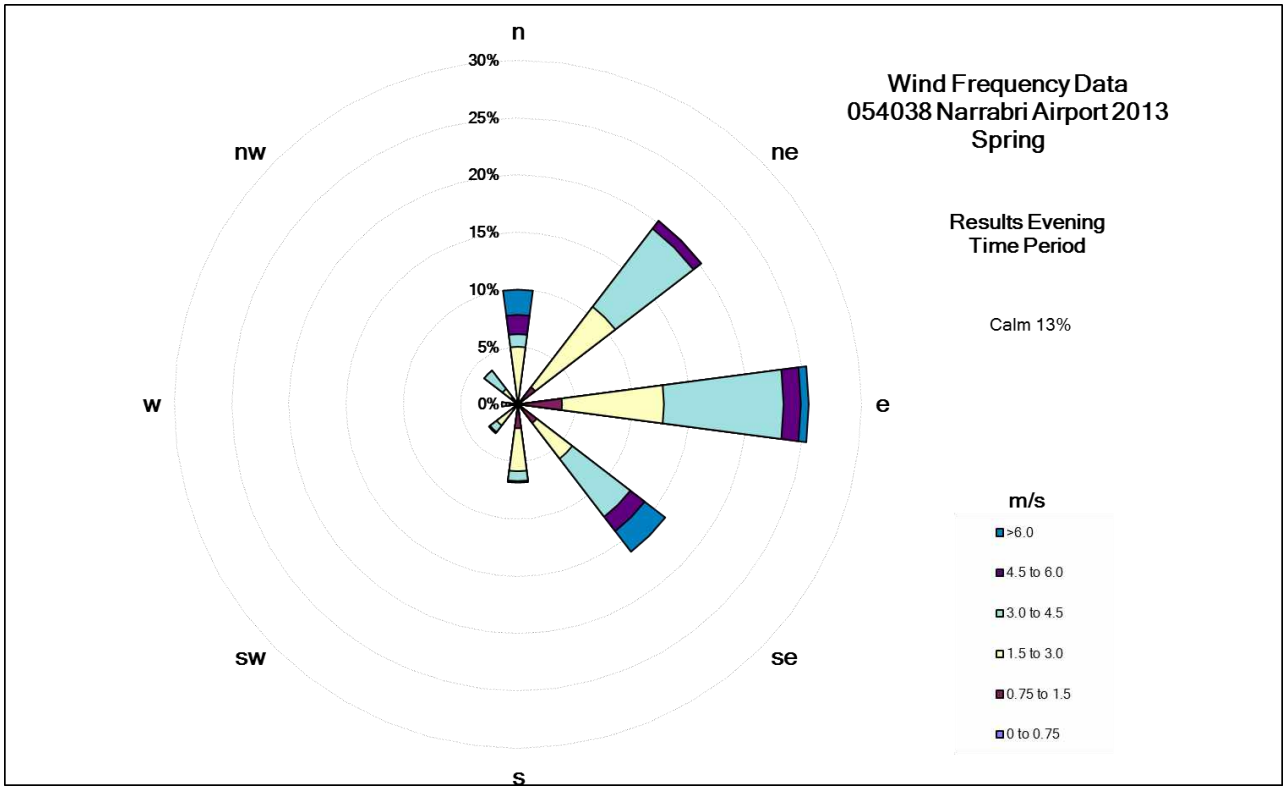
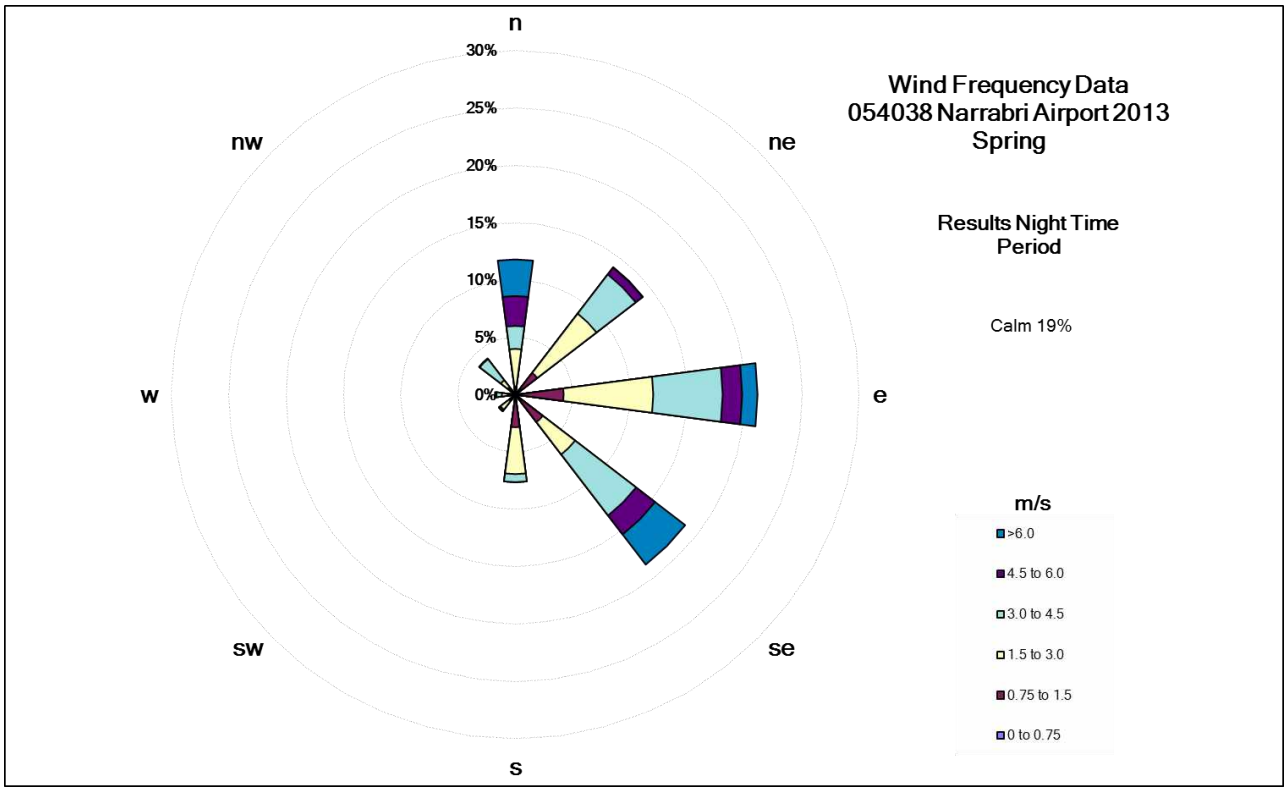


Spring 2013 -Evening (Calm 13%)



Spring 2013 -Night (Calm 19%)

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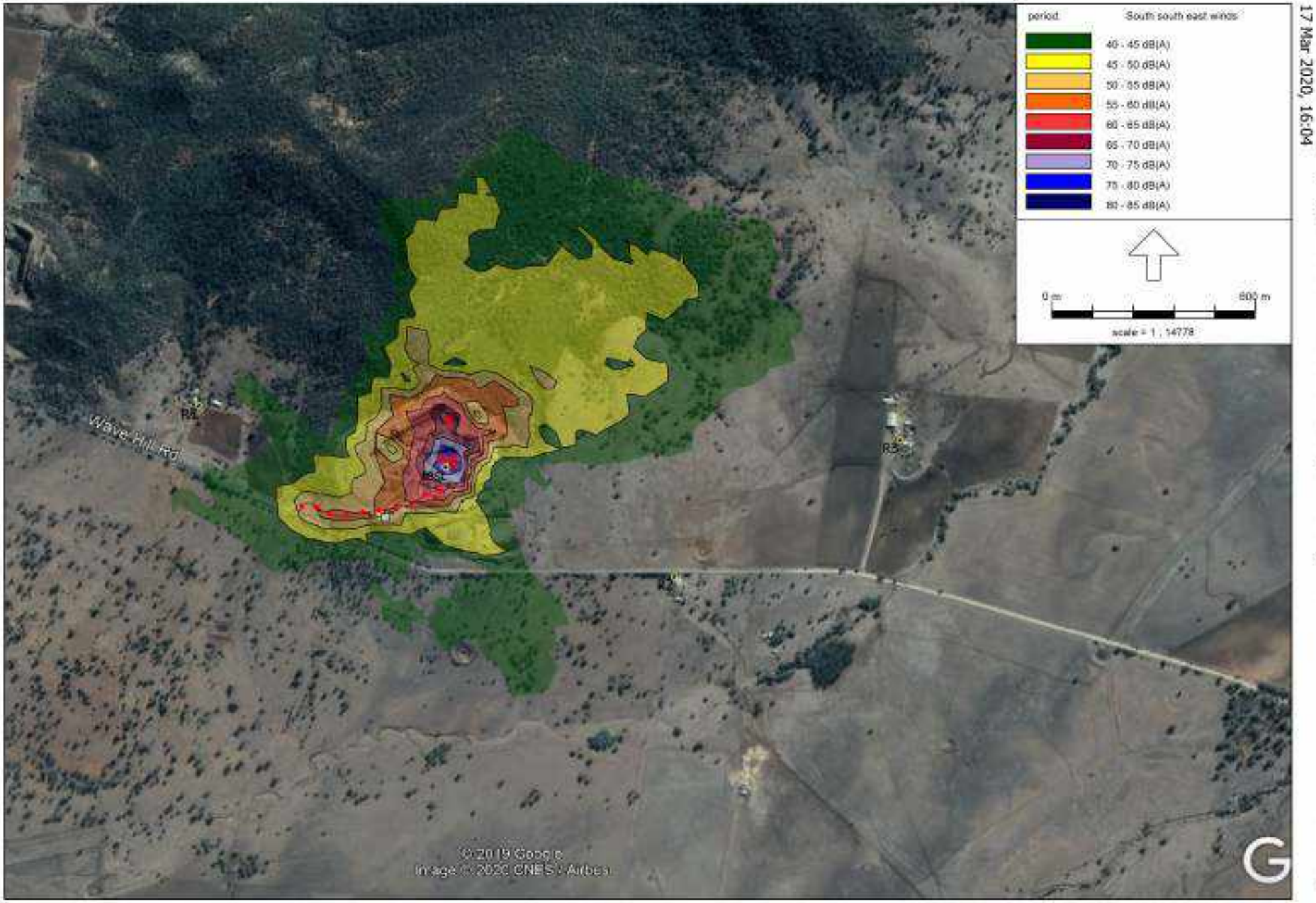
Appendix II Noise Contour Predictions

Wave Hill - Mobile Quarrying operations with consolidated stockpile Prevailing Winds

17 Mar 2020, 16:04



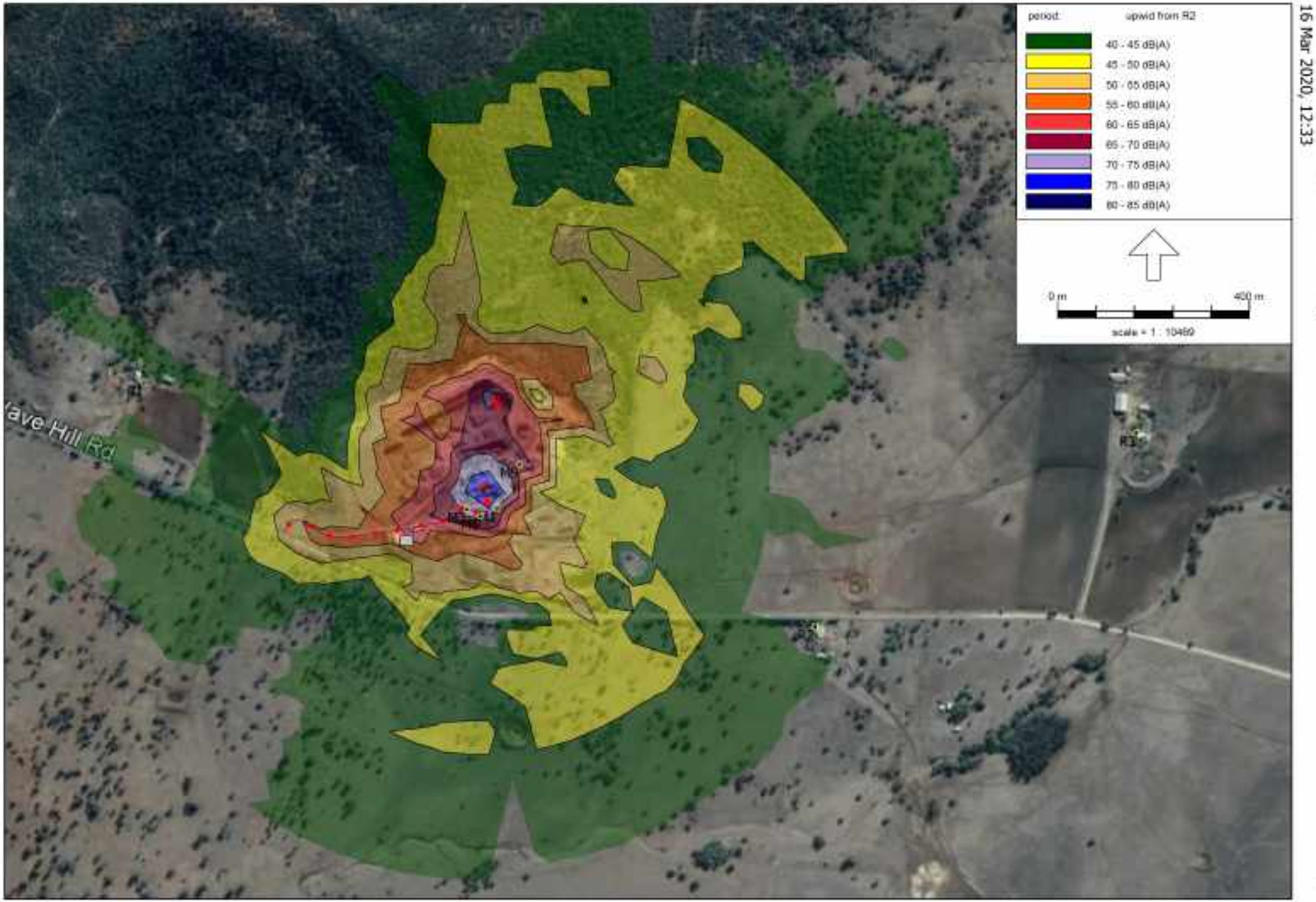
Industrial noise - ISO 9613 1/2 (1/3 Octave), [Wave Hill Quarry - Operations - Wave Hill - Mobile plant [BARRIER] , Predictor V8.11

Advitech Pty Ltd

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Wave Hill Fixed Plant Operations Prevailing Winds

16 Mar 2020, 12:33



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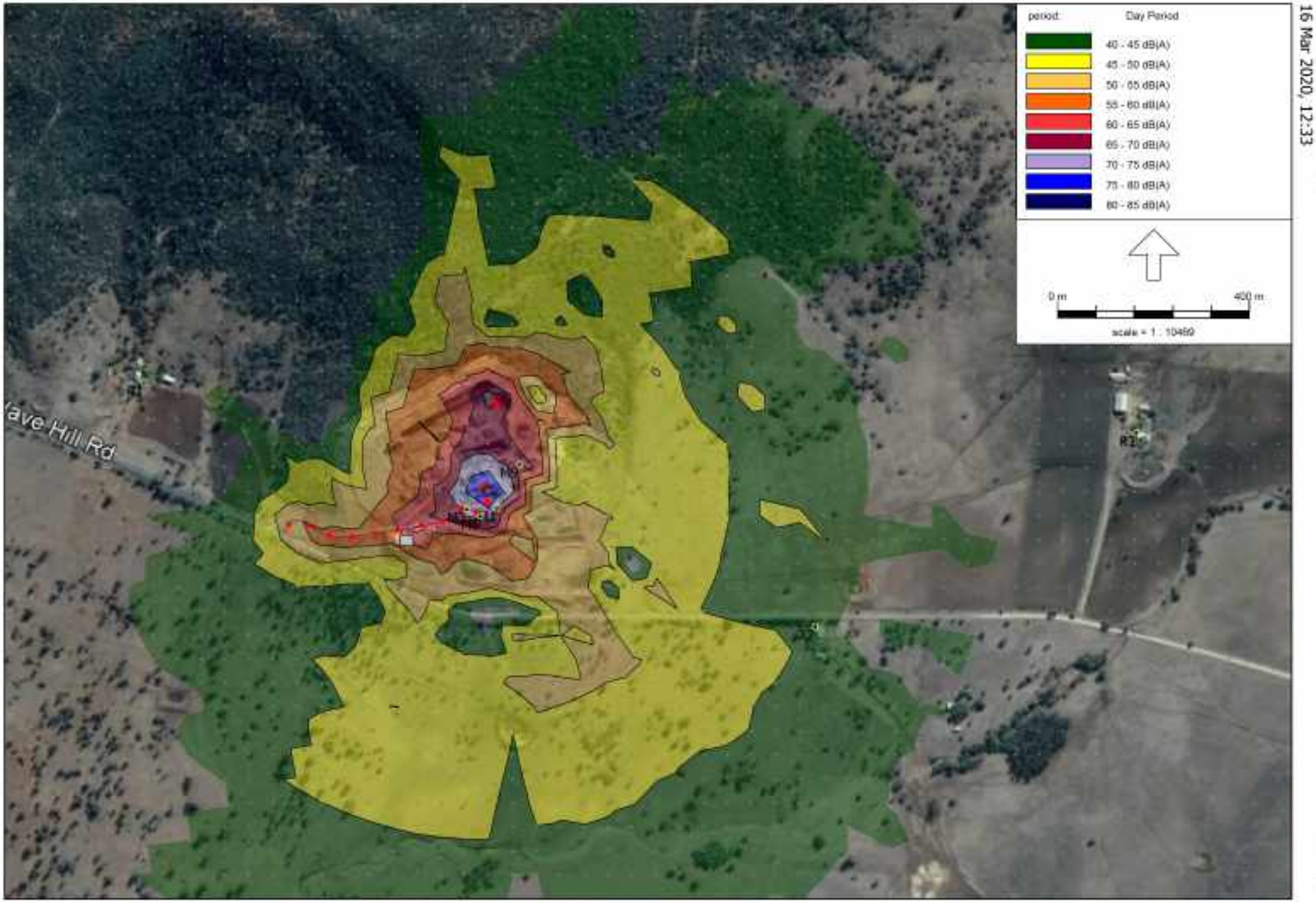
Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Wave Hill Fixed Plant Operations Calm

16 Mar 2020, 12:33



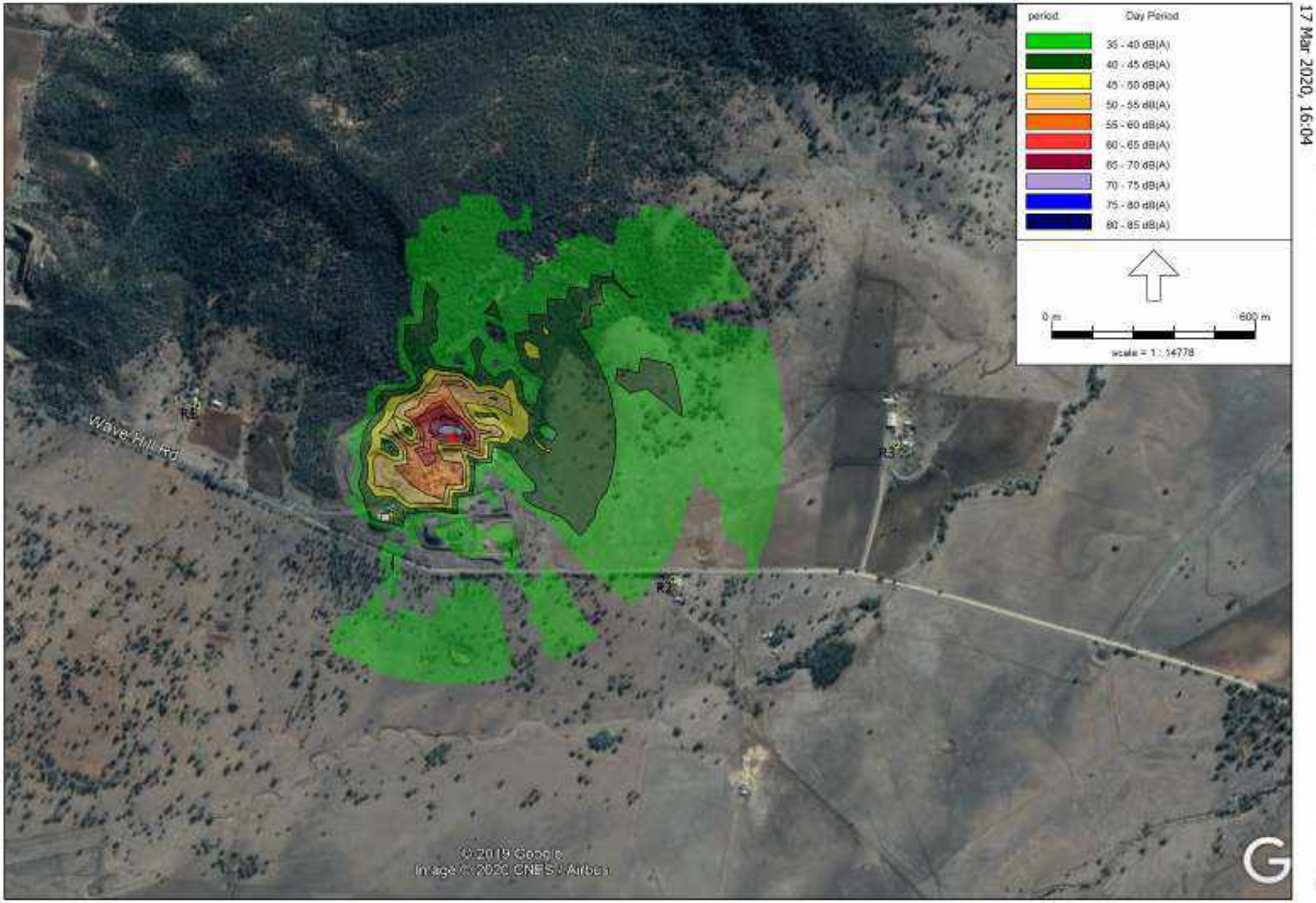
Advitech Pty Ltd

Industrial noise - ISO 9613 1/2 (1/3 Octave), [Wave Hill Quarry - Operations - Wave Hill Fixed Plant Operations] , Predictor V8.11

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Wave Hill - Drill rig Operations Calm

17 Mar 2020, 16:04



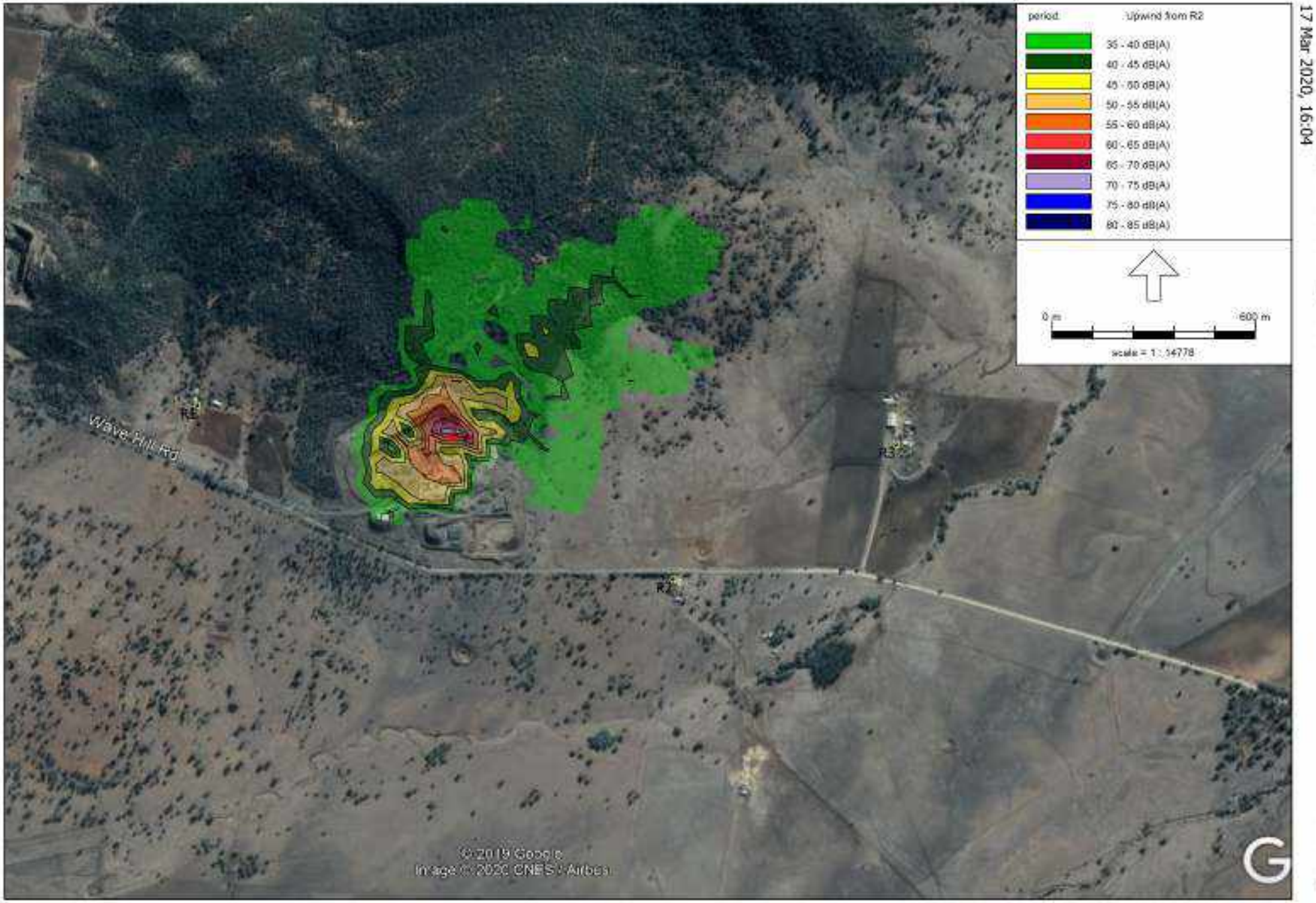
Industrial noise - ISO 9613 1/2 (1/3 Octave), [Wave Hill Quarry - Operations - Wave Hill - Drill rig Operations] , Predictor V8.11

Advitech Pty Ltd

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Wave Hill - Drill rig Operations Prevailing Winds

17 Mar 2020, 16:04

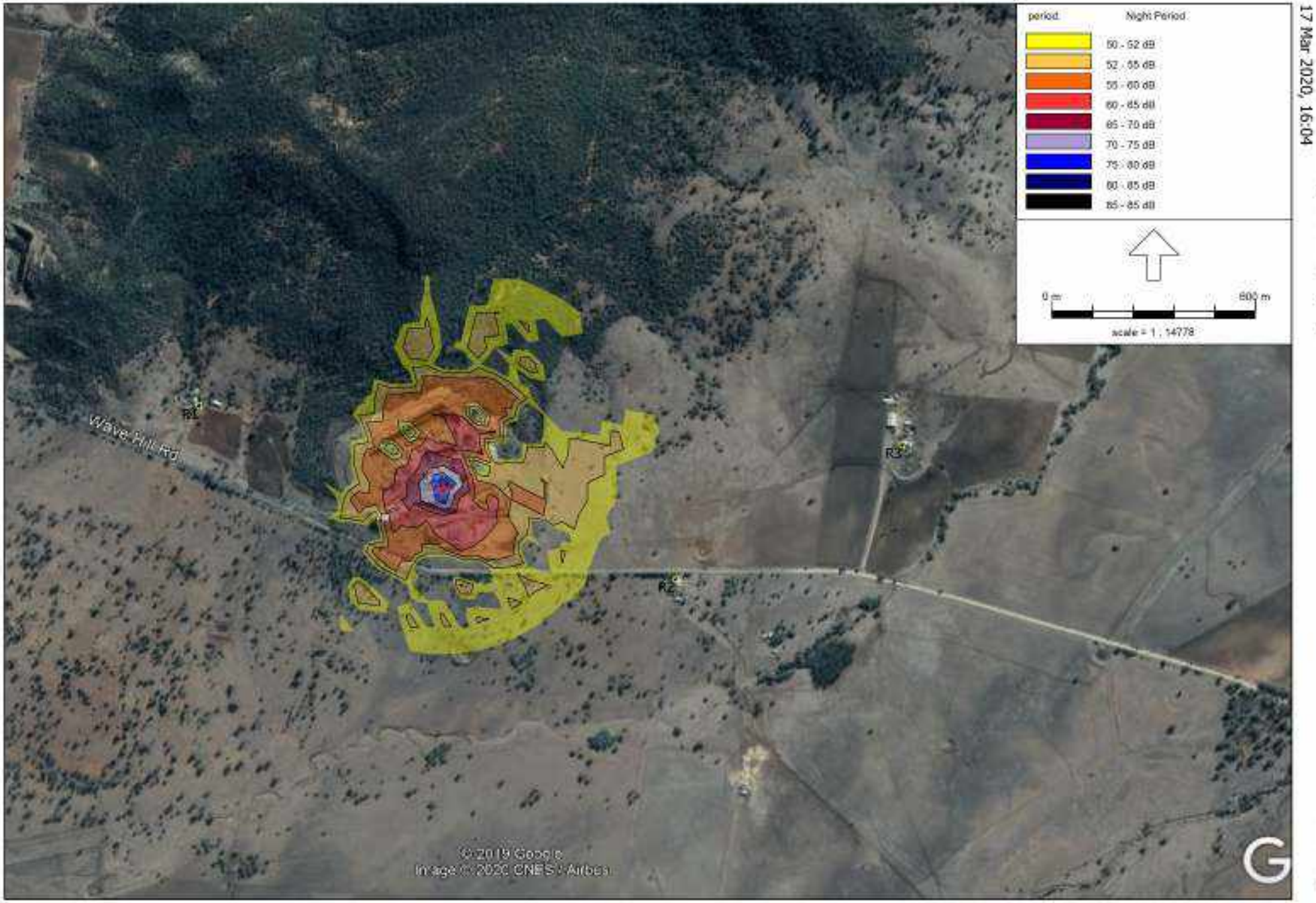


Industrial noise - ISO 9613 1/2 (1/3 Octave), [Wave Hill Quarry - Operations - Wave Hill - Drill rig Operations] , Predictor V8.11

Advitech Pty Ltd

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Wave Hill - LMax - loading and stockpiling Night
17 Mar 2020, 16:04

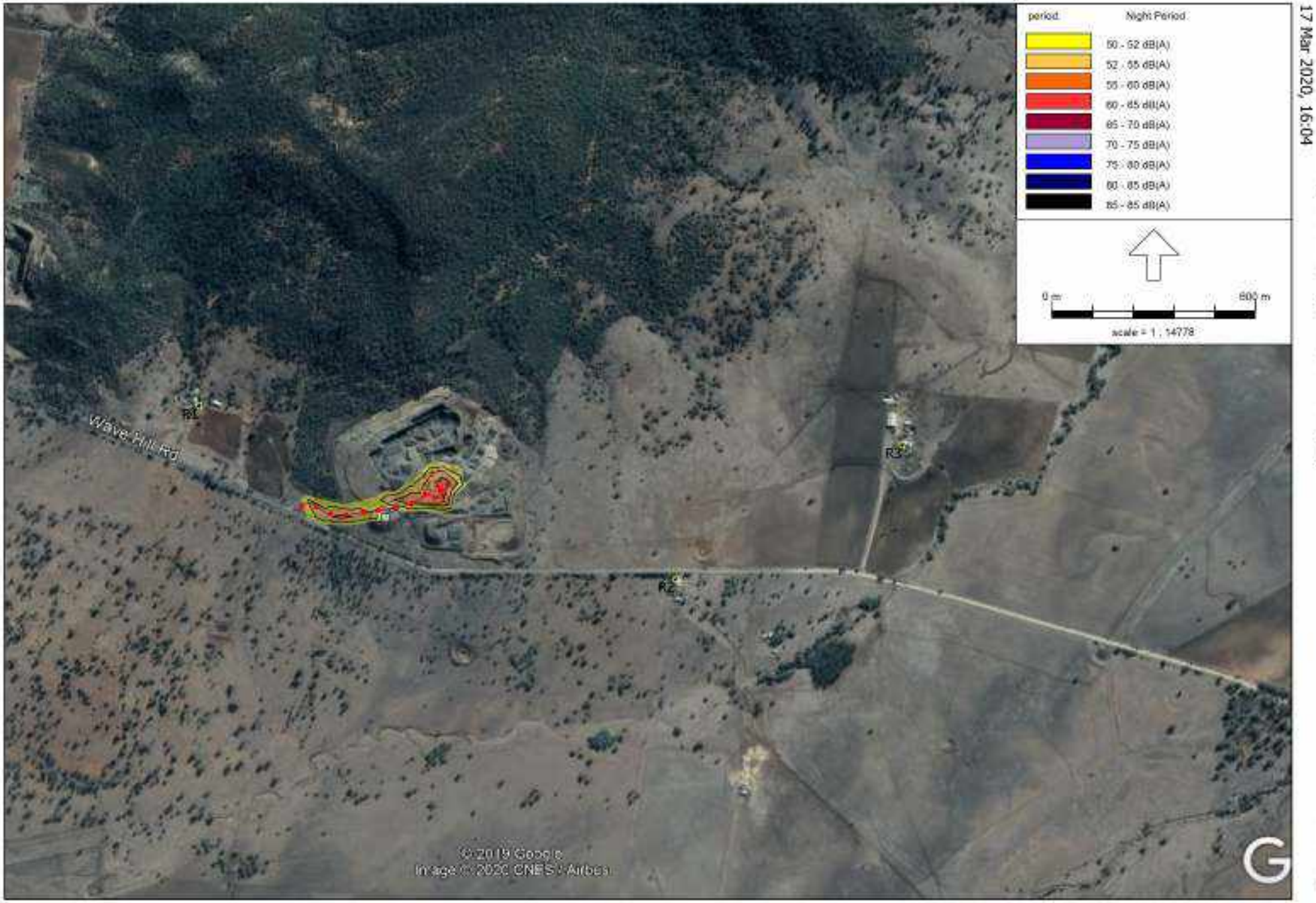


Industrial noise - ISO 9613-1/2 (1/3 Octave), [Wave Hill Quarry - Operations - Wave Hill - LMax] , Predictor V5.11

Advitech Pty Ltd

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Wave Hill - LMax - loading and stockpiling (LAeq 15 minute) Night
17 Mar 2020, 16:04



Industrial noise - ISO 9613-1/2 (1/3 Octave), [Wave Hill Quarry - Operations - Truck entry / stockpile ops - Night] , Predictor V8.11

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Appendix III Sound Power Level Analysis - Drill Rig and Calibration Certificates

Sound Power Level of Drill Rig

The sound power level is a measure of the rate at which sound energy is emitted from a source over a period of time. The sound power level can only be determined through calculation. The external noise level measurements, sound pressure level was recorded adjacent to the drill rig during typical drilling operations. The test area was a proposed excavation site in the north-east corner of the quarry. Apart from the ground, there were no reflective surfaces within 25 metres of the measurement positions. Noise measurements were taken at 5 to 7metres and height of 1.5 metres at 4 locations.
The formula for determining the sound power level of a source is:

$$L_W = L_p + \left|10 \cdot \log\left(\frac{Q}{4\pi \cdot r^2}\right)\right|$$

Where:
L_W = Sound Power Level
L_p = Sound Pressure Level
Q = Directivity Factor
r = Distance to Sound Source

The following factors were considered to calculate the sound power level of the drill rig:

- The average sound pressure level (L_p) recorded at the drill rig was: 92.5 dB(A) $L_{Aeq;}$
- The directivity factor (Q) is 2, given that the sound source is close to a flat surface; able to radiate acoustical energy to half of a sphere (hemi); and
- The distance to the sound source (r) at the time of recording was 5 metres for measurements at the right-hand side, left hand side and rear of the drill rig and 7 metres for measurements conducted at the front of the drill rig.

Based on the above formula the average sound power level (L_W) of the drill rig at the time of recording was calculated to be **115 dB(A)**. This is considered the dynamic sound power level, as the drill rig was undertaking typical drilling operations at the time of recording. Field sheets and a diagram indicating the locations of the measurements are provided below in **Figures A1** and **A2** below.

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Advitech SLM Measurement QMS Form

Save as following filename once report complete to both USB and Hard Drive

Filename *Wave Hill SWL measuremnrt Drill Rig* Form is **Complete**

Complete Checks

Work Order No. 1 — 0

Equipment	Rock Pilot Drill Rig - DR121
Client	JCLS
Location	Wave Hill Quarry
SLM Details	S/No. 60686
Measurement Type	SLM
Logger Step	1
Measurement date	23/01/2020
Operator	Louis Abell

Folder No. 20924 — 0

Job No. J0191228 — 0

Measurement title	Time (enter in 24hr)	Date (dd/mm/yyy)	Description	Distance to Plant (	Duration (min)	Lp	Lw
1996	13:25	23/01/2020	Drill Rig operation LHS Exhaust	5	3:13	94.2	116
1997	13:27	23/01/2020	Drill Rig operation In front of drill	7	2:09	91.4	117
1998	13:30	23/01/2020	Drill Rig Operation RHS	5	0:58	95.1	117
1999	13:32	23/01/2020	Drill Rig operation back	5	2:04	87.6	110
2000	13:35	23/01/2020	Drill Rig operation LHS Exhaust	5	1:29	94.3	116
2001	13:40	23/01/2020	Drill Rig operation In front of drill	7	1:02	91.6	117
2002	13:43	23/01/2020	Drill Rig Operation RHS	5	0:27	93.5	115
			Average			92.52857	115.428571

Figure A1: Drill rig measurement field record sheet

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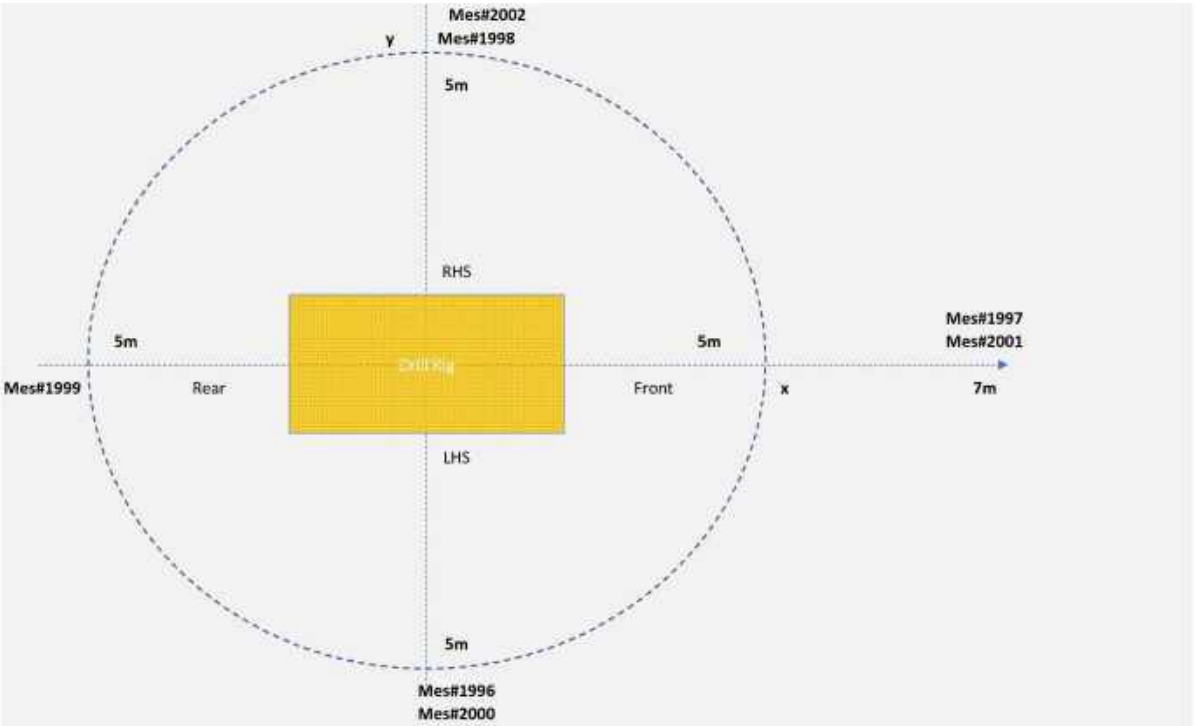

Notes:

Environmental conditions:

- windspeed shall not exceed 5m/s
- background noise shall be >6dB below equipment under test (preferably 10dB)
- air temp >5degC and <40degC
- no fog, frost, snow or rain

Operational conditions:

- Machine stationary and brakes applied
- engine operated in 'no load' condition at manufacturer specified rated speed
- stabilised operating temperatures reached before test commences

Measurement conditions:

- measurement duration on 15-30s once readings have stabilised
- no sound-reflecting obstacles within a 'distance from the source equal to 3 times the greatest distance from sound centre to lower measurement points'

Figure A2: Drill rig measurement locations diagram

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Details of operator attended monitoring equipment are provided in **Table A1.** A copy of calibration certificates is provided overleaf.

Table A1: Operator attended noise monitoring

Parameter	SLM
Sound Level Meter (SLM)	Svantek 971
SLM Serial Number	60686
SLM Calibration Date	16/5/2019
Field Calibrator	Svantek SV30A
Field Calibrator Serial Number	7906
Field Calibrator Calibration Date	15/7/2019
Frequency Weighting(s),(Response), Units	A, C, Lin (Fast), dB SPL

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 24705 & FILT 5190**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-971	**Serial No:**	60686
Microphone Type:	7052E	**Serial No:**	66701
Preamplifier Type:	SV18	**Serial No:**	62787
Filter Type:	1/3 Octave	**Serial No:**	60686
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Advitech Pty Ltd 7 Riverside Drive Mayfield West NSW 2304		
Ambient Pressure:	1012 hPa ±1.5 hPa		
Temperature:	24 °C ±2° C	**Relative Humidity:**	48% ±5%
Date of Calibration:	15/05/2019	**Issue Date:**	16/05/2019
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

CHECKED BY: **AUTHORISED SIGNATURE:**

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA

ACU-VIB
ELECTRONICS

HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 98806133 Fax: (02)98806233
Mobile: 0413 809808
web site: www.acu-vib.com.au

Accredited Lab. No. 9262
Acoustic and Vibration
Measurements

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 23933 & FILT 5178**

Equipment Description: Sound Level Meter

Manufacturer: Svantek

Model No: Svan-971 **Serial No:** 77606

Microphone Type: 7052E **Serial No:** 70851

Preamplifier Type: SV18 **Serial No:** 78287

Filter Type: 1/3 Octave **Serial No:** 77606

Comments: All tests passed for class 1.
(See over for details)

Owner: Novecom
7 Riverside Drive
Mayfield West NSW 2304

Ambient Pressure: 1000 hPa ±1.5 hPa

Temperature: 25 °C ±2° C **Relative Humidity:** 54% ±5%

Date of Calibration: 09/05/2019 **Issue Date:** 09/05/2019

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: JKB **AUTHORISED SIGNATURE:** Jack Riolt

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA

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ELECTRONICS

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Appendix 6: Land Use Conflict Risk Assessment

SMK
CONSULTANTS

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Land Use Conflict Risk Assessment

1 Introduction

SMK Consultants have been engaged by Johnstone Concrete and Landscape Supplies Pty Ltd to prepare a Land Use Conflict Risk Assessment (LUCRA). This assessment is to accompany an Environmental Impact Statement (EIS) in support of a development application made in respect of the existing Wave Hill Quarry located east of Narrabri in north-west NSW.

A LUCRA is an assessment method used to identify and assess the potential of future land use conflict to occur between neighbouring land uses. It enables a systematic, consistent and site-specific conflict assessment approach to land use planning and development assessment. The LUCRA aims to:

- accurately identify and address potential land use conflict issues and risk of occurrence before a new land use proceeds or a dispute arises;
- objectively assess the effect of a proposed land use on neighbouring land uses;
- increase the understanding of potential land use conflict to inform and complement development control and buffer requirements; and
- highlight or recommend strategies to help minimise the potential for land use conflicts to occur and contribute to the negotiation, proposal, implementation and evaluation of separation strategies.

In particular, this assessment will identity potential land use conflict relating to separation distances and management practices to minimise noise and dust from sensitive receptors.

1.1 Guidelines

This LUCRA is predominantly based on the “Living and Working in Rural Areas” handbook (Learmonth et al. 2007). Consideration has also been given to the “Land Use Conflict Risk Assessment Guide” (NSW DPI, 2011) and “Agriculture Issues for Extractive Industry Development” (NSW DPI, 2012).

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2 Method

In general terms the purpose of the LUCRA is to identify landuse compatibility and potential conflict between neighbouring landuse and the identification of conflict avoidance or mitigation measures.

In order to achieve those aims, a four-step assessment process is undertaken:

1. Information Gathering – The site's geophysical characteristics, the nature of the development proposed and the surrounding landuses are described.

2. Risk Level Evaluation – Each proposed activity is recorded and potential landuse conflict level is assessed. The higher the risk level, the more mitigation it will require.

3. Identification of Risk Mitigation Strategies – Management strategies are identified which can assist in lowering the risk of potential conflict.

4. Record Results – Key Issues, risk level and recommended management strategies are recorded and summarised.

3 Site Analysis

3.1 Location, Area and Zoning

The existing hard rock quarry is located on the property of "Wave Hill", including Lot 77 in Deposited Plan 75437 and Lot 89 in Deposited Plan 821255, located approximately 24 kilometres east of the township of Narrabri in north-west New South Wales. The property is located on the lower western slopes of the Nandewar Range. A locality and property plan have been included as Figures 1 and 2, respectively. The property, with a combined area of approximately 123 hectares, is located within the Local Government Area of the Narrabri Shire Council. This land is currently zoned RU1 'Primary Production' under the *Narrabri Local Environmental Plan 2012*.

The existing quarry is located in the southernmost section of the property, occupying an area of approximately 24 Hectares. The remainder of the property, to the north, supports native vegetation. The area adjoining the quarry footprint to the north, located on a gentler gradient, was historically cleared by previous quarry owners and presently consists of regrowth. The remainder of the site, with a steeper gradient of up to 60%, has retained remnant vegetation.

A parcel of Crown Land (Lot 88 DP 821255) is incorporated within the property boundary of the subject site. A registered trigonometrical site (TS6956) is located within this parcel of Crown Land.

3.2 Site History and Surrounding Land Use

The adjoining properties are all similarly zoned and have historically been utilised for dryland farming and grazing. Today, the main economic activity is mixed farming, with the cultivation of winter cereals. The rich clay soils produce high yielding crops with the generally reliable

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rainfall supplying sufficient soil moisture through the winter period. Most farms grow a rotation of winter and summer crops to maximize production and soil moisture utilisation. The crop rotations include extensive fallow periods and stubble retention, protecting the soil from erosion during summer storms. Cattle grazing is also common in the area.

Narrabri is a rural town with a population of 5,903 people (ABS, 2016), located approximately 24 kilometres west of the subject site. The town has a number of facilities, including general stores, schools, a post office, sporting facilities, swimming pools, caravan parks and camping grounds, a railway station and an airport. Narrabri is an agricultural centre, with the town servicing the cotton, wheat and livestock industries in the locality. The village relies on the surrounding rural community for the bulk of its income. The surrounding rural community utilises the village for its school, merchandise and sporting and social facilities.

3.3 Topography, Climate and Natural Features

Wave Hill is located in the north-west slopes and plains in an area described as the northern basalt subregion of the Brigalow Belt South Bioregion characterised by undulating hills traversed by numerous ephemeral streams. It consists of landscapes derived from both extensive basalt flows and quartz sandstones and consequently has very variable soils and vegetation depending on the local rock type or sediment source. The quarry site is located within the Gunnedah Basin, a sedimentary basin with a Palaeozoic basement of folded metasedimentary and volcanic rocks that outcrop around the southern and eastern margins.

The topography of the area slopes towards the extraction area. Four first order streams rise in the property to the north of the quarry site; two of which flow west and merge before converging with Barra Creek, while the other two streams flow in an easterly direction, eventually merging with Deriah Creek. The quarry site has a median elevation of 325m AHD, ranging between 275m and 375m AHD across the site. Narrabri's climate is best described as warm temperate. Rainfall is variable, with an annual average of 541mm and potential evaporation of 1,800mmm annually. The site experiences normal wind conditions in terms of direction and frequency.

3.4 Nearest Sensitive Receptors

Sensitive receptors in the area include rural dwellings. The distances of each receptor from the proposed development, as calculated from the closest edge of the proposed Quarry footprint, have been included as Table 1**Error! Reference source not found.**. The locations of sensitive receptors within a 1-kilometre radius of Wave Hill are presented in Figure 4. The closest township, Narrabri, is located 24 km to the west of Wave Hill Quarry. Given the distance, the township is not considered likely to be impacted by the Quarry operation. A smaller quarry (Boral Quarry), is also located 1km west of Wave Hill Quarry; this is not considered a sensitive receptor.

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Figure 1: Wave Hill Locality Plan

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Figure 2: Wave Hill Property Plan

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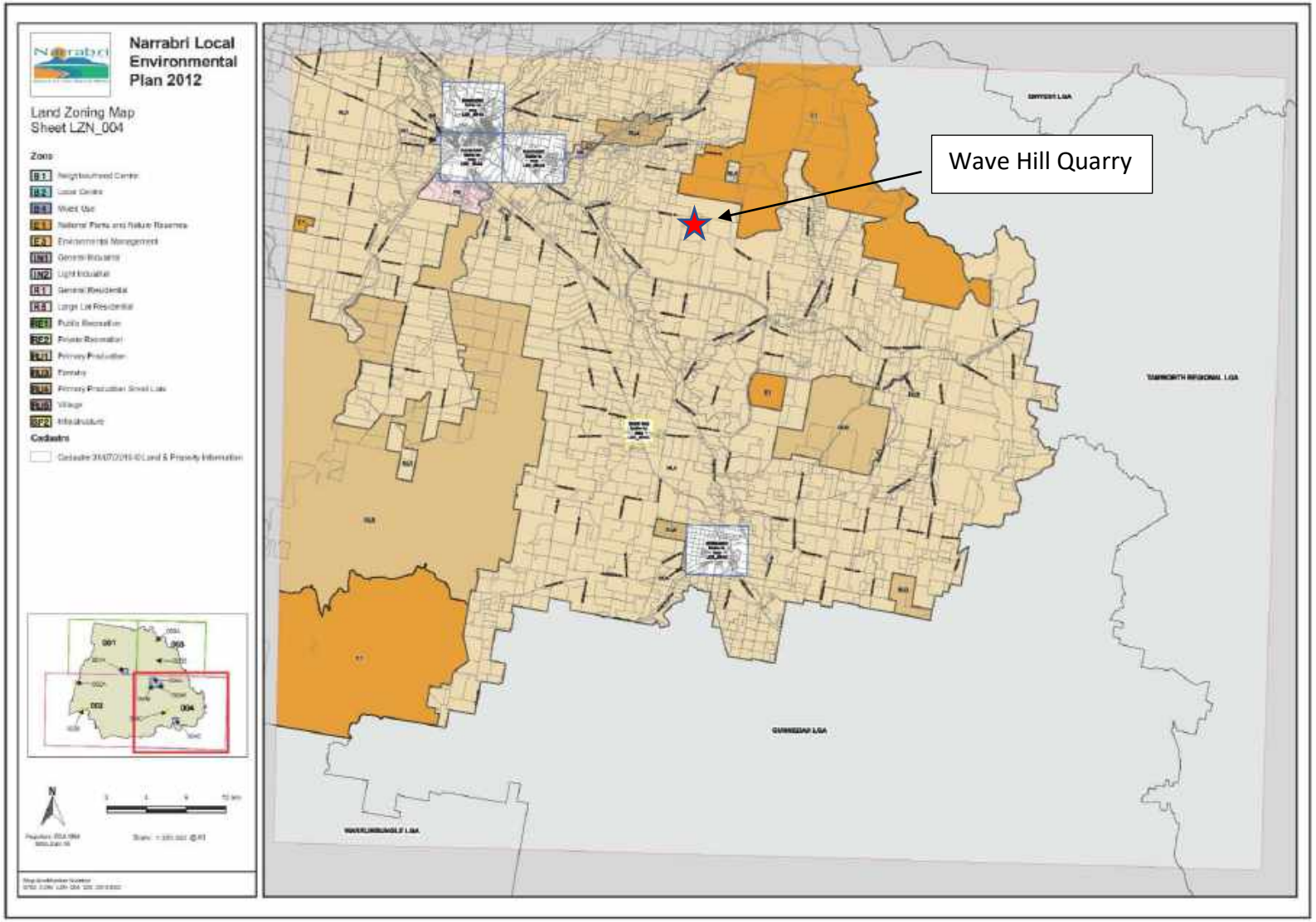

Figure 3: Land Zoning Map – Narrabri Shire Council LEP 2012

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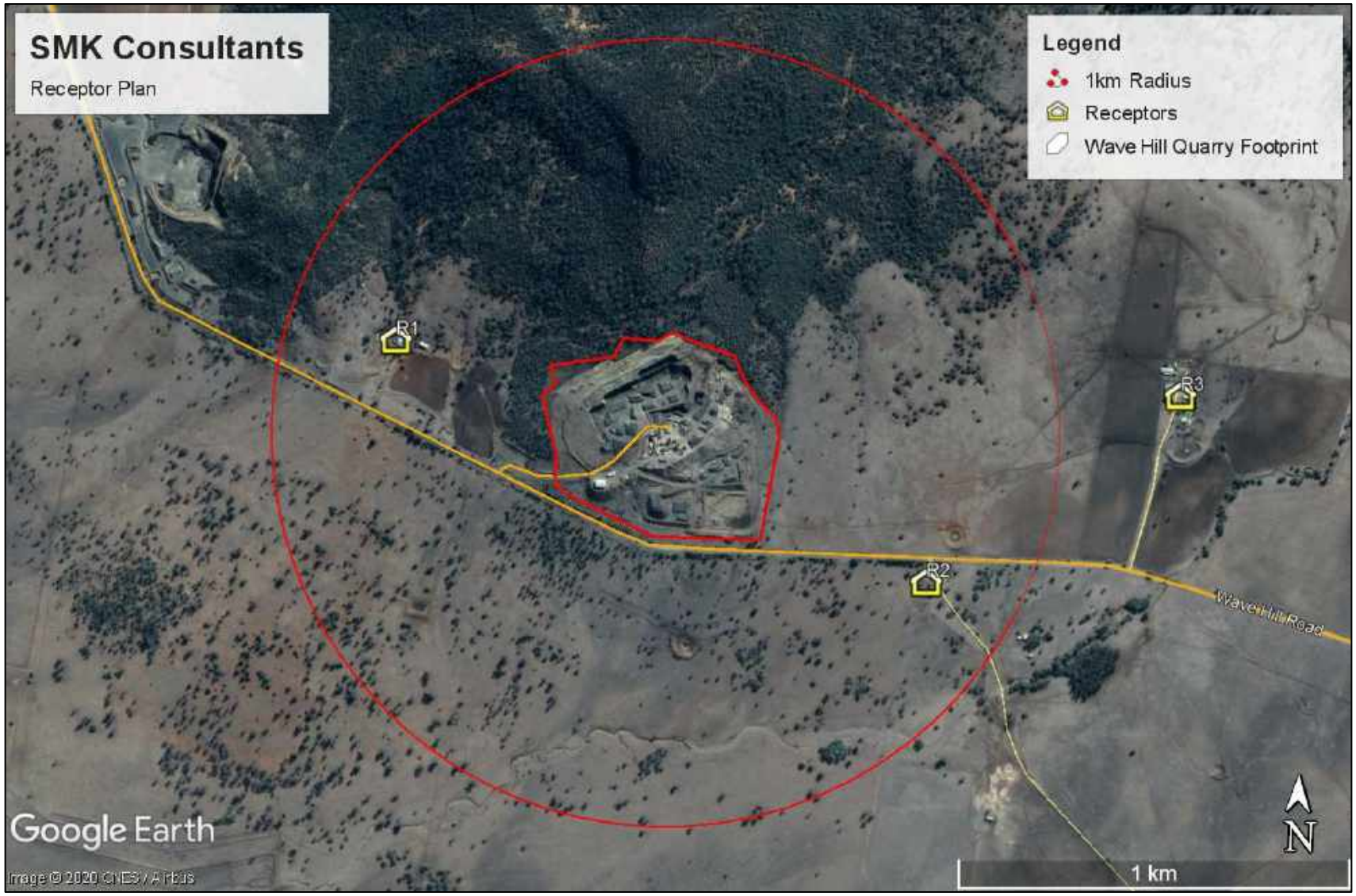

Figure 4: Sensitive Receptors in the Wave Hill Quarry Locality

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Table 1: Separation Distances from Sensitive Receptors

Receptor ID	Address	Receptor Type	Direction	Distance (km)
R1	'Glen Aston' 939 Wave Hill Road	Rural Dwelling	W	0.38
R2	'Brenowen' 1092 Wave Hill Road	Rural Dwelling	SE	0.43
R3	'Wave Hill' 1143 Wave Hill Road	Rural Dwelling	E	1.03
Narrabri		Rural Town	BW	23.5

3.5 Nature of the Land Use Change and Development Proposed

The proposed development involves an increase in the annual extraction limit of raw materials at Wave Hill Quarry to 500,000 tonnes per annum (from the current approved annual extraction limit of 200,000 tonnes/annum). A large proportion of the additional quarry material will be hauled from the quarry to the Narrabri area via the Wave Hill Road and the Old Gunnedah Road for delivery to the Inland Rail upgrade.

Initial quantities determined for the Inland Rail upgrade suggest a requirement for a minimum of 1,000,000 cubic metres of rail ballast material and potentially up to 500,000 tonnes of a manufactured dense graded basecourse (DGB) gravel for the reconstruction of the rail base beneath the ballast. This would be supplied over the 3-year construction period.

3.5.1 The Main Activities of the Proposed Development

Extraction activities from the proposed quarry have the potential to include:

- Extraction of material (via methods including blasting, drilling or mechanical methods such as hammer drills, bulldozers, excavators, front end loaders or hydraulic methods). Material may be temporarily stockpiled at the quarry;
- Processing on-site via portable equipment which involves screening and washing for the removal of unwanted material, crushing to reduce particle size, screening/sieving to separate materials into size fractions, blending of materials with other extractive materials to achieve required characteristics;
- Loading and transport (involving front end loaders, excavators and trucks); and
- Haulage of materials from the Quarry to project delivery points.

The Wave Hill Road provides the most suitable access to the Wave Hill quarry site. Materials will therefore be hauled from the site via Wave Hill Road and Maules Creek Road as required to delivery materials to infrastructure projects.

3.6 Scope of Potential Social Impacts

Identification of the scope of the potential social impact of the proposed development has been undertaken with regards to scoping methodology outlined in the Social Impact

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Assessment Guideline (2017) (SIA Guideline), published by the Department of Planning and Environment.

The social impact scoping assessment is presented in the associated Environmental Impact Statement. The results of the assessment indicate that the following matters are likely to experience negative social impacts in as a result of the proposed development in the absence of mitigation measures:

- Acoustic
- Health
- Safety
- Air
- Land, Water

These matters have each been assessed below with regards to their potential social impact, and management practices which will be implemented on site to control this impact. Overall, it is considered that each risk may be appropriately managed on site to reduce the social impact of the proposed development to an acceptable threshold.

4 Land Use Conflict Risk Assessment

4.1 LUCRA Matrix

Land Use Conflict Risk Assessment (LUCRA) is an appraisal system developed to identify the compatibility of land uses and assess the potential for land use conflict to occur between adjoining land uses.

The LUCRA process uses a "probability and consequence" risk ranking matrix to estimate the potential for land use conflict. Figure 5 shows the LUCRA table in its raw form.

Likely consequence from a dispute or conflict arising over the land use or activity	Likelihood of a dispute or conflict arising over the land use or activity.		
	Very likely	Likely	Unlikely
Major consequences & impacts likely	HIGH	HIGH	MEDIUM
Modest or periodic consequences & impacts likely	HIGH	MEDIUM	LOW
Minimal consequences & impacts likely	MEDIUM	LOW	LOW

Figure 5: Table 10 'Land Use Conflict Risk Assessment' in the Living and Working Rural Areas Handbook

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4.1.1 Risk Ranking

The consequences of a development on the environment, public health and amenity are assessed according to Table 2.

Table 2: Measure of Consequence

Level	Descriptor	Description
1	Severe	• Severe and/or permanent damage to the environment/ public health and/ or amenity • Irreversible • Neighbours are in prolonged dispute and legal action involved
2	Major	• Serious and/or long-term impact to the environment/public health and/or amenity • Long-term management implications • Neighbours are in serious dispute
3	Moderate	• Moderate and/or medium-term impact to the environment/ public health and/ or amenity • Some ongoing management disputes • Neighbours disputes occur
4	Minor	• Minor and/or short-term impact to the environment and/ or community • Can be effectively managed as a part of normal operations • Infrequent disputes between neighbours
5	Negligible	• Very minor impact to the environment and/ or community • Can be effectively managed as a part of normal operations • Neighbours disputes unlikely

The following table is used to score the likelihood of the consequence occurring:

Table 3: Probability Table

Level	Descriptor	Description
A	Almost certain	Common or repeating occurrence
B	Likely	Known to occur, or 'it has happened'
C	Possible	Could occur, or 'I've heard of it happening'
D	Unlikely	Could occur in some circumstances, but not likely to occur
E	Rare	Practically impossible

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The result is a risk rating matrix:

Table 4: Risk Ranking Matrix

PROBABILITY	A	B	C	D	E
Consequence					
1	25	24	22	19	15
2	23	21	18	14	10
3	20	17	13	9	6
4	16	12	8	5	3
5	11	7	4	2	1

Ranking is given before and after ameliorating measures are applied to mitigate the given activity impacts.

4.2 Risk Evaluation

This section is arranged as a schedule addressing a potential land use conflict in terms of:

- **Source of Potential Land Use Conflict –** identified in Table 4
- **Existing Risk –** what potential risks exist, without any mitigating measures at all; identified in Table 4
- **Risk Rating –** what is the risk level, as per the land use conflict risk assessment matrix; identified in Table 4
- **Mitigation Measures –** what can be done to reduce risks of land use conflict; identified in Section 4.3
- **Controlled Rating –** what is the risk level likely to be with mitigation measures in place; identified in Section 4.4

Table 5: Initial Risk Evaluation

Source	Identified Potential Conflict	Risk Ranking*
Dust from extraction and processing facilities	Dust generated by machinery, heavy vehicle movements or quarry activities may impact on neighbouring properties, particularly rural residences.	12
Noise from extraction and processing activities	Noise generated by machinery, heavy vehicle movements or quarry activities may impact on neighbouring properties, particularly rural residences.	12
Health and safety impacts as a result of workplace hazards on site	Injury of workers on site may undermine the Quarry's 'social licence' to operate within the region and result in disputes.	22

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Source	Identified Potential Conflict	Risk Ranking*
Environmental degradation as a result of quarry activities	Environmental harm as a result of the proposed development (such as through vegetation clearing, erosion from the site and sedimentation of waterways) may result in dispute between neighbours.	13
Traffic from heavy vehicles hauling materials	Additional heavy vehicle traffic on public roads, increasing safety between drivers, congestion and noise.	13

*Risk ranking as calculated prior to any mediation or management of risk.

4.3 Risk Reduction Controls

Potential conflicts have been targeted through the siting of the quarry and mitigation management proposals. The following management strategies and controls will be implemented to reduce the risk of identified sources causing conflict.

4.3.1 Dust Controls

A comprehensive suite of dust management controls will be implemented on site to limit dust generation from the quarry. These management practices are outlined in Table 6.

Table 6: Dust Mitigation Methods to be Adopted at Wave Hill Quarry

Potential Impact Site	Methods to Control Air Pollution
Roads	• Dust suppression by watering. • Covered loads when transporting and watering of haul roads. • Grading of roads. • Well-defined haul routes to minimise area of disturbance. • Speed limits (recommended 40km/h).
Wind Erosion of Exposed Materials and Stockpiles	• Dust suppression by watering. • Minimising areas of disturbance. • Progressive rehabilitation.
Crushing, Screening and Handling	• Ensure dust covers in place. • Ensure water sprays are activated for dust management.
Loading and Handling Materials	• Keep front-end loader bucket low when handling and transporting materials.
Trucks	• Dust suppression by watering. • Covered loads when transporting and watering of haul roads. • Ensure drivers abide by the Traffic Management Plan and Truck Driver Code of Conduct.
Monitoring and Proactive Management	• Monitor meteorological conditions. • Cease activity on dry windy days.

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Potential Impact Site	Methods to Control Air Pollution
	• In the event of increased dust production, increased dust suppression management measures, including by increasing watering rates, decreasing processing rates, slowing truck speeds and ensuring that dust housing protections remain in place. • Initiate Shut down procedures during periods of excessive dust generation or upon receipt of complaint and investigate and initiate additional controls.

The dust management practices outlined in Table 6 are consistent with best management practices for the prevention and/or minimisation of particulate matter from mining sites (as described in Donnelly *et al* 2011). It is considered that this suite of management methods will be sufficient to control excessive dust emissions from the quarry site.

4.3.2 Noise Controls

Noise impacts may occur in association with ongoing quarry operations.

One of the primary noise disturbances associated with the proposed increase in quarry throughput would be traffic noise, as raw materials are hauled from the quarry site. Noise management practices will be implemented on site during standard quarry operating conditions to minimise the impact of the quarry upon the amenity of the surrounding regions.

Management practices include:

- Implementing standard quarry operating hours of 6.00am to 6.00pm Monday to Saturday, with no work on Sundays or public holidays; and
- Fitting machinery with compliant mufflers, to minimise machinery noise as far as practicable.
- Ensuring that equipment and the plant are operated in a quiet and efficient manner.
- Scheduling high noise generating activities for less sensitive times of the day. For example: scheduling maintenance or plant downtime to coincide with more sensitive periods during early morning and late afternoon.
- Requesting truck drivers not to use engine brakes whilst entering/exiting the property.
- Carefully check all plant and equipment to ensure that they are correctly tuned and well maintained to meet manufacturers specifications.
- Conduct environmental noise awareness inductions for all contractor employees and subcontractors.
- Conduct ongoing on the job training for each specific job task.

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4.3.3 Buffers

The most effective means of preventing conflict is to plan for adequate separation between conflicting land uses. The recommended minimum buffers for extractive industries were included in Chapter 6 of the '*Living and Working in Rural Areas*' Handbook. The following table summarises the applicable buffer distances.

Table 7: Recommended Minimum Buffer Distances

Mining, Petroleum Production & Extractive Industries		
	Normal Operations (m)	**Blasting (m)**
Residential areas & urban development	500	1000
Rural dwellings	500	1000
Education facilities & pre-schools	500	1000
Rural tourist accommodation	500	1000
Watercourses & wetlands	SSD	SSD
Bores & wells	SSD	SSD
Potable water supply/catchment	SSD	SSD
Property boundary	SSD	SSD
Roads (public)	SSD	SSD

SSD: Site Specific Determination

The separation distances outlined represent existing best practice minimum buffer distances. These distances are considered to reduce the potential for land conflicts and protect the values of key environmental assets and rural production areas.

Blasting is required as part of extractive operations at Wave Hill Quarry, both the minimum buffer distances applying to normal operations and blasting listed in Table 7 therefore apply to nearby sensitive receptors. The closest homestead 'Glen Aston' (R1) on an adjoining property is located approximately 380m to the west of the quarry site and 720m to the west of the blasting site. The available separation distances are therefore lower than the minimum buffer distance requirements for normal operations and blasting outlined in Table 7. Similarly, sensitive receptor R2 'Brenowan', located south-east of the quarry, is closer to the quarry than the minimum recommended buffer distance for blasting, however it is over 600m away from the location of extractive activities within the quarry site, therefore exceeding minimum recommended distances for normal operations. The available separation distance between R3 'Wave Hill Residence' and the quarry exceeds minimum buffers listed in Table 7 for both quarrying activity types.

Detailed Air Quality Impact Assessments (AQIA) and Noise Impact Assessments (NIA) were carried out to determine the potential adverse impacts of the proposal on the identified sensitive receptors. Full copies of the assessments are included in Appendix 4 and Appendix 5. Both assessments include a range of mitigation measures to minimise potential adverse

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impacts resulting from quarry operations and blasting. The assessments conclude that provided these mitigations measures are appropriately implemented and efficiently monitored, the modification of Wave Hill quarry operations will not result in significant adverse impacts to the identified sensitive receptors in the vicinity of Wave Hill quarry.

Further, the quarry has been operating at this location for several decades. No complaints have been received relative to noise or dust impacts from quarry operations in the last 12 months, suggesting current mitigations measures are successfully managing adverse noise and dust impacts at current extraction rates. The Applicant recognises the importance of managing adverse impacts to the community, and is diligent in the implementation and monitoring of mitigation measures. It is expected that additional mitigation measures listed in the AQIA and NIA will continue to successfully manage off-site dust and noise emissions from the quarry.

Overall, provided that mitigation measures are appropriately implemented, it is considered that the proposed development is appropriately sited and has sufficient available separation distances to minimise the risk of land use conflict and adverse amenity impacts associated with the development.

4.3.4 Health and Safety Management Measures

The existing quarry has a comprehensive safety management system on site, known as the Mine Safety Management System. A Mine Safety Management System is an overarching management plan, which incorporates consideration of:

- Legislation;
- Regulations;
- Rules and Schemes prepared under legislation and regulations; and
- Codes, guidelines or standards which are used to manage and maintain a safe work environment.

Establishment of the management system is the responsibility of the Mine Operator. All employees, contractors and visitors to the site are required to comply with the management system to ensure that standards of workplace health and safety are maintained in accordance with best management practices.

These measures will continue to be implemented for the lifetime of quarry operations and are considered to be sufficient to ensure that the proposed development does not pose a risk to health and safety of peoples present within the site.

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4.3.5 Environmental Protection

Uncontrolled quarry activities have the potential to pose a risk to environmental values, primarily through potential groundwater impacts in the event of a shallow groundwater table and through erosion from the quarry site, resulting in sedimentation of the surrounding environment and waterways.

The development will adopt a suite of environmental management methods to reduce the impact of the proposed quarry. These are outlined in Table 8.

Table 8: Environmental Management Methods at Wave Hill Quarry

Potential Environmental Impact	Methods to Control Environmental Impact
Groundwater Impacts	• Include groundwater management as part of an EMP prepared for the site. • Maintain the quarry floor and extraction areas above the groundwater table. • If groundwater is proposed to be used separately to this application, the relevant permit and provision for use is obtained. • If groundwater is intercepted during excavation, cease work and discuss with relevant authorities (DPI Water) to identify appropriate mitigation measures.
Erosion and Sedimentation	• Review and update, if required, erosion and sediment control measures in the EMP. • Implement erosion and sediment control measures provided in the Soil and Water Management Plan (Appendix 10). • Implement temporary erosion and sediment control structures such as straw bales and silt fences to minimise the potential for sediment laden runoff to enter watercourses. • Collect runoff from working areas in sediment ponds. • Progressively stabilise and revegetate disturbed areas. • Regularly monitor and maintain all erosion, sedimentation and pollution control devices, particularly after any significant rainfall event, to ensure effective operation, especially until disturbed areas are stabilised and/or properly vegetated. • Water quality of surface runoff leaving the site should be occasionally monitored by visual inspection to ensure that

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Potential Environmental Impact	Methods to Control Environmental Impact
	the water discharged is not overly sediment laden, which would indicate an issue with the treatment system. • Well defined truck haulage routes to reduce the area requiring regular dust suppression demand (reduce water usage and dust impacts). • Water levels in the sediment basin to be regularly monitored, and water use adjusted to suit the various levels. • In the event of a chemical or sediment escape from site it would be cleaned up to a state which is no less than its condition prior to discharge. • Education of site personnel for the implementation of sediment and erosion control plans. • Use drains and diversion banks to direct clean stormwater away from disturbed areas, working areas or stockpiles. • Ensure storage of and use of hazardous materials (fuels) is in accordance with *National Code of Practice for the Storage and Handling of Workplace Dangerous Goods (2001).* • Maintain table drains to dissipate flow of rainfall runoff along drain and road areas.

4.3.6 Traffic from Heavy Vehicles Hauling Material

The increased traffic along the haulage route will be managed by implementing the following:

- A Traffic Management Plan detailing haulage routes, hours of operation, school zones, school bus safety measures and speed limits.
- A Truck Driver Code of Conduct including enforcement protocols.

Further, as additional noise along the haulage route cannot be avoided, the Proponent should consult with the community and advise of expected increased traffic movements, times, and length of the proposed operation.

4.4 Mitigated Risk Ratings

In accordance with the LUCRA Assessment Guide, the objective for mitigation is to lower the risk ranking score to 10 or below. The method of control and revised risk ranking for each identified potential conflict is summarised in Table 6.

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Table 9: Management Strategy – Update Following Noise Assessment Results

Identified Potential Conflict	Management Strategy (Method of Control)	Revised Risk Ranking	Performance Target
Dust generated by machinery, heavy vehicle movements or quarry activities may impact on neighbouring properties, particularly rural residences.	Listed in Section 4.3.1; 4.3.3	8	10
Noise generated by machinery, heavy vehicle movements or quarry activities may impact on neighbouring properties, particularly rural residences.	Listed in Section 4.3.2; 4.3.3	8	10
Health and safety impacts as a result of workplace hazards on site.	Listed in Section 4.3.4	9	10
Environmental harm as a result of the proposed development (such as sedimentation of waterways) may result in dispute between neighbours.	Listed in Section 4.3.5	5	10
Traffic from heavy vehicles hauling materials	Listed in Section 4.3.6	8	10

This target has been achieved with respect to the identified risks.

5 Results

This LUCRA has identified and assessed several potential sources of land use conflict. Sources of conflict include dust generation, noise emissions and potential environmental harm as a result of quarry activities.

Subject to appropriate risk mitigation measures being implemented through development controls and engineering/construction design, all potential land use conflict activities can be reduced to a “low” risk rating. Sources of potential conflict which will require mitigation are:

- Quarry dust and noise during construction and operation: This can be addressed through available separation distances and the implementation of an Environmental Management Plan.

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- Traffic Numbers and Noise: This can be addressed by ensuring employees adhere to the Traffic Management Plan, Truck Driver Code of Conduct, and management to consult with the local community.
- Health and safety: This may be protected by implementing a comprehensive Mine Safety Management System and ensuring that all personnel on site are aware of, and comply with, the requirements of the Management System.
- Environmental protection issues: These can be addressed through appropriate site assessment, rehabilitation measures, stormwater management and sediment and erosion controls.

The proposed mitigation measures are specific, easily understood, easily designed and relatively easy to implement. With these measures in place the potential for land use conflict will be unlikely and of minimal consequence.

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6 Conclusions and Recommendations

The land use conflict risk assessment has identified potential sources of land use conflict and has proposed a series of management strategies to minimise the impact of these activities. Risk mitigation strategies include:

- Implementation of mitigation and management strategies to minimise noise and dust emissions;
- Implementation of a Mine Safety Management System to ensure protection of the health and safety of employees and visitors on site;
- Ensuring that extraction activities will not result in interception of groundwater resources;
- Implementing erosion and sediment control measures to minimise environmental impacts; and
- Implementation of the site rehabilitation plan (Appendix 11) to ensure the long-term protection of environmental resources.

Overall, adoption of risk management strategies have resulted in a minor risk of the occurrence of land use conflict. On the basis that the risks are able to be adequately mitigated it is recommended that the proposed development proceeds, subject to the implementation of the recommended mitigation measures.

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Appendix 7: Matters of National Environmental Significance

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EPBC Protected Matters Assessment

1 Development Background

Wave Hill quarry is located approximately 24 kilometres east of Narrabri and is currently approved to extract 200,000 tonne of basalt per annum. The proposed development would involve increasing the annual extraction limit of the quarry to 500,000 tonne per annum. The current development footprint has an area of approximately 24Ha and it is not proposed to alter the existing footprint of the quarry. Increased extraction rates will instead be achieved by intensifying the rate of extractive activities at the site.

The approved extraction rate is currently sufficient to meet background demand for construction materials within the region. However, construction of the Inland Rail Project will result in the demand for construction materials significantly increasing within the near future; it is anticipated that initial orders for materials for the Inland Rail Projects near Narrabri will be placed within the next 12-month period. The proposal will therefore enable Wave Hill quarry to supply materials to the Inland Rail Project, without compromising the availability of materials to existing industries throughout the region.

The subject site was historically cleared of native vegetation. Presently, the quarry footprint mostly comprises of an open quarry site, which has been subject to development and excavations associated with the operation of Wave Hill Quarry. Regrowth (shrubs and grassy vegetation) remain in a small section to the east of the development which to date remains unimpacted by the existing development. This vegetation is not considered to have provide a high-value habitat area relative to remnant vegetation in the vicinity of the site, and it unlikely to be modified during the course of quarry operations. It is therefore considered that no additional removal or modification of native vegetation will take place as part of the proposal.

1.1 Development Footprint Delineation

The following definitions are used throughout this report to refer to locations in the proposal area:

- The ‘subject site’ describes all areas that would be directly impacted by the works. This includes the footprint of the quarry;
- The ‘study area’ includes the site and the areas adjacent that may be indirectly impacted by the proposed works. This includes the property described as Lot 89 in DP 821255 and Lot 77 in DP 754937;
- The ‘search area’ refers to a 10-kilometre area surrounding the proposal for the purpose of database searches.

The potential construction impacts of the development are predicted to be minimal. The subject site is located on land which has historically been cleared of native vegetation. No clearing will take place, nor will the existing footprint of Wave Hill Quarry be extended as part of the proposal.

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Wave Hill quarry employs a suite of environmental protection measures, including controlled drainage measures to divert clean runoff away from the quarry site, and internal drainage and sediment capture measures within the quarry site to prevent erosion from the site and ensure runoff does not contaminate offsite areas or waterways. The site further undertakes weed and pest control measures to control biosecurity risks and ensure that the site does not function as a source of invasive species for the wider area.

Therefore, the off-site impacts of the development are limited and the area of impact associated with the proposal is limited to the subject site (i.e. the quarry footprint). Figure 1 shows the existing footprint and layout of Wave Hill Quarry.

Figure 1: Existing and Proposed Boundary of Wave Hill Quarry

2 Matters of National Significance

The EPBC Act requires consideration of the effect of an action on the following 7 Matters of National Environmental Significance (MNES):

- World Heritage Properties
- National Heritage Places
- Ramsar wetlands of international importance
- Nationally threatened species and communities

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- Migratory species protected under international agreements
- Nuclear actions, including uranium mining, and
- The Commonwealth marine environment.

The impact of an action on these matters is assessed under the criteria specified in: Matters of National Environmental Significance – Significant Impact Guidelines 1.1 (DoE 2013).

2.1 Consideration of EPBC Matters

A search was undertaken using the EPBC Protected Matters Search Tool (PMST) (DoEE 2017) to generate a list of World Heritage Properties, National Heritage Places, Ramsar wetlands and nationally threatened species, communities and migratory species protected under international agreements that may occur on or within the region surrounding the proposed development (Figure 1).

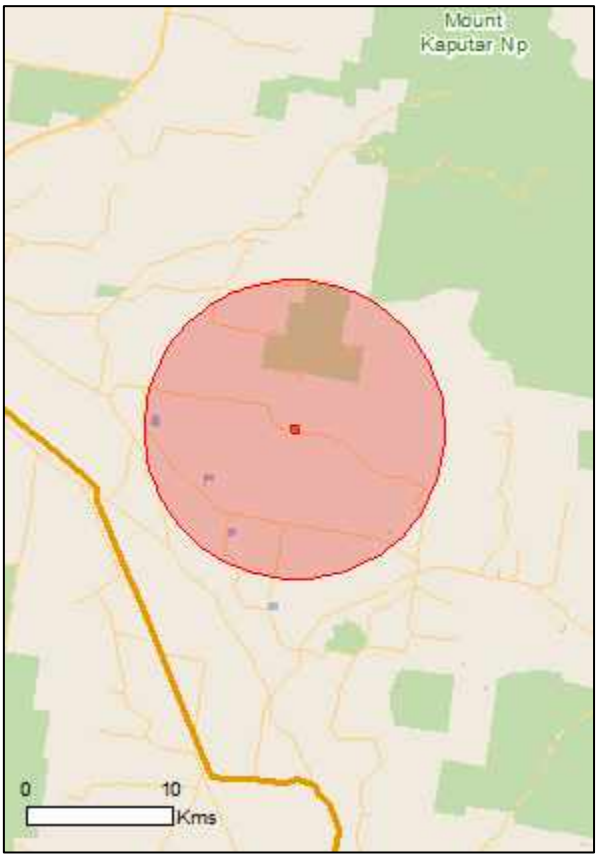

Figure 1: Region searched for MNES using the EPBC PMST.

2.1.1 Results of Database Search

The EPBC PMST does not list any World Heritage Properties or National Heritage Places on or within the search area. Additionally, the closest downstream wetland identified by the PMST is at a minimum distance of 1,100km; given the distance involved and the relatively small-scale nature of the project, wetlands are not considered to be at risk from the proposal. The proposal is therefore not considered to impact on these matters. Further, the proposal does

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not involve nuclear actions or impact on the marine environment; consequently, these matters are also not relevant to this assessment.

The PMST identified a range of threatened ecological communities which have the potential to be present within the region. However, none of the ecological communities identified by the PMST are present within the development footprint. Therefore, the development is not considered to pose a risk to threatened ecological communities.

Nationally threatened species and migratory species protected under international agreements have been initially defined within the search area outlined in Figure 1 using the PMST. These species are listed in Tables 1 and 2.

Table 1: Threatened flora and fauna species predicted or known to occur on the proposal area

Category	Scientific Name	Common Name	Legal Status
Birds	*Anthochaera phrygia*	Regent Honeyeater	Critically Endangered
	Calidris ferruginea	Curlew Sandpiper	Critically Endangered; Listed Migratory (Bonn, CAMBA, JAMBA, ROKAMBA); Listed Marine
	Erythrotriorchis radiatus	Red Goshawk	Vulnerable
	Grantiella picta	Painted Honeyeater	Vulnerable
	Lathamus discolor	Swift Parrot	Critically Endangered
	Leipoa ocellata	Malleefowl	Vulnerable
	Polytelis swainsonii	Superb Parrot	Vulnerable
	Rostratula australis	Australian Painted Snipe	Endangered as *Rostratula* australis; Listed Marine as *Rostratula benghalensis* (sensu lato)
Mammals	*Chalinolobus dwyeri*	Large-eared Pied Bat, Large Pied Bat	Vulnerable
	Dasyurus maculatus maculatus (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered
	Nyctophilus corbeni	Corben's Long-eared Bat, South-eastern Long-eared Bat	Vulnerable
	Petauroides volans	Greater Glider	Vulnerable
	Petrogale penicillata	Brush-tailed Rock-wallaby	Vulnerable
	Phascolarctos cinereus (combined populations of NSW, QLD & ACT)	Koala (combined populations of NSW, QLD & ACT)	Vulnerable

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Category	Scientific Name	Common Name	Legal Status
	Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable
Fish	*Maccullochella peelii*	Murray Cod	Vulnerable
Reptiles	*Anomalopus mackayi*	Five-clawed Worm-skink, Long-legged Worm-skink	Vulnerable
	Uvidicolus sphyrurus	Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko	Vulnerable
Plants	*Androcalva procumbens*		Vulnerable
	Cadellia pentastylis	Ooline	Vulnerable
	Dichanthium setosum	Bluegrass	Vulnerable
	Philotheca ericifolia		Vulnerable
	Thesium australe	Austral Toadflax, Toadflax	Vulnerable
	Tylophora linearis		Endangered

CAMBA = China Australia Migratory Bird Agreement; JAMBA = Japan Australia Migratory Bird Agreement; ROKAMBA = Republic of Korea Australia Migratory Bird Agreement; Bonn = Convention on the Conservation of Migratory Species of Wild Animals

Table 2: Migratory species predicted to occur on the proposal area

Category	Scientific Name	Common Name	Legal Status
Migratory Marine Birds	*Apus pacificus*	Fork-Tailed Swift	Listed Migratory (CAMBA, JAMBA, ROKAMBA); Listed Marine
Migratory Terrestrial Species	*Hirundapus caudacutus*	White-throated Needletail	Listed Migratory (CAMBA, JAMBA); Listed Marine as *Hirundapus caudacutus* Listed Migratory (ROKAMBA) as *Chaetura caudacuta*
	Motacilla flava	Yellow Wagtail	Listed Migratory (CAMBA, JAMBA, ROKAMBA); Listed Marine
	Myiagra cyanoleuca	Satin Flycatcher	Listed Migratory (Bonn); Listed Marine
	Rhipidura rufifrons	Rufous Fantail	Listed Migratory (Bonn); Listed Marine
Migratory Wetland Species	*Actitis hypoleucos*	Common Sandpiper	Listed Migratory (Bonn, CAMBA, JAMBA); Listed Marine as *Actitis hypoleucos* Listed Migratory (ROKAMBA) as *Tringa hypoleucos*
	Calidris acuminata	Sharp-tailed Sandpiper	Listed Migratory (Bonn, CAMBA, JAMBA, ROKAMBA); Listed Marine
	Calidris ferruginea	Curlew Sandpiper	Critically Endangered; Listed Migratory (Bonn, JAMBA, ROKAMBA); Listed Marine

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Category	Scientific Name	Common Name	Legal Status
	Calidris melanotos	Pectoral Sandpiper	Critically Endangered; Listed Migratory (Bonn, CAMBA, JAMBA, ROKAMBA); Listed Marine
	Gallinago hardwickii	Latham's Snipe, Japanese Snipe	Listed Migratory (Bonn, JAMBA, ROKAMBA); Listed Marine

CAMBA = China Australia Migratory Bird Agreement; JAMBA = Japan Australia Migratory Bird Agreement; ROKAMBA = Republic of Korea Australia Migratory Bird Agreement; Bonn = Convention on the Conservation of Migratory Species of Wild Animals

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3 Assessment of Significance

3.1 Vulnerable Species

An action has, or will have, or is likely to have a significant impact on a vulnerable species if it does, will or is likely to:

- ***Lead to a long-term decrease in the size of an important population of species***

The subject site has historically been subject to clearing and it is currently utilised as an active quarry site. The subject site has an area of approximately 24Ha and the majority of this land area has been subject to extractive activities and associated development such as internal road construction and the formation of stockpiles. Small sections of the site along the eastern and southern boundaries, which have not been excavated, support regrowth. This habitat is considered to be of limited value to threatened species given the habitat condition and extent of human activity and noise disturbance which occur on an ongoing basis on the site.

An extensive, contiguous tract of similar and/or higher-quality remnant vegetation associated with Mount Kaputar is present to the north of the subject site. It is deemed that any vulnerable species in the locality would opt to occupy these relatively undisturbed and high-quality habitat areas rather than the subject site. It is therefore considered that, given the fact that no clearing will take place and that higher-quality habitat is widely available in the locality, the proposal would not impact vulnerable species or lead to a decrease in the size of an important population of species.

- ***Reduce the area of occupancy of an important population***

It is considered that no vulnerable species are currently utilising the subject site, which is an active quarry site. Given that the footprint of the proposal will remain identical to that of the existing development, the disturbance associated with the development is therefore not considered to pose a risk to the long-term survival of any threatened species or ecological community within the locality.

- ***Fragment an existing important population into two or more populations***

The proposed development will not involve any additional land clearing, and therefore will not isolate or fragment any areas of habitat. Removal of vegetation, if it occurs, will be limited to the removal of regrowth within the northern section of the existing quarry footprint.

- ***Adversely affect habitat critical to the survival of a species***

The majority of the subject site has been stripped of groundcover in association with the construction and operation of Wave Hill Quarry. Areas retaining groundcover are not considered to be important habitat for any of the listed vulnerable species. There is therefore no risk of direct adverse impacts to these species. Further, management plans, including an Onsite Environmental Management Plan and Erosion Sediment Control Plan, are currently implemented on the site, and will continue to do so throughout the lifetime of the project. The implementation of these management plans will minimise the risk of any off-site or indirect impacts which may occur in association with the proposed development.

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- ***Disrupt the breeding cycle of an important population***

There are no key habitat features which would support the breeding cycles of vulnerable species within the subject site. Therefore, the proposed development is not considered to pose a risk to breeding cycles of vulnerable species populations within the locality.

Habitat features within the locality which are considered to support the breeding cycles of vulnerable species include riparian areas and tree hollows provided by mature trees in the wider locality. No clearing will be associated with the proposed development, and erosion and sediment control measures will be implemented to minimise the risk to surface watercourses and their associated habitats.

- ***Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***

There will be no habitat clearing or modification associated with the proposal. The development is therefore not predicted to result in a decline of vulnerable species populations within the region.

- ***Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***

Weed seeds may be carried onto and distributed by vehicles entering and exiting the Quarry. Construction machinery may also transport weed seeds onto and off the Quarry site. Weed management strategies will be implemented through the Onsite Environmental Management Plan (OEMP) to minimise the risk of weed establishment and proliferation as a result of construction activities on site. Examples of weed management strategies include adoption of proper hygiene procedures to minimise the potential for seed transport onto and off the work site.

- ***Introduce disease that may cause the species to decline, or***

The operation of a quarry is not considered a disease risk.

- ***Interfere substantially with the recovery of the species***

Ensuring the recovery of a species generally involves the protection and enhancement of existing populations and habitat, by preventing further clearing and modification of native vegetation communities and protecting water quality values.

The proposal does not involve clearing or modification of native vegetation, and environmental management plans will be in place to ensure that the potential impact of the proposed development on the surrounding environment, including water quality values, is

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minimised. The proposal is therefore not considered to pose a significant risk to the recovery of fauna or flora species within the locality.

3.2 Critically Endangered and Endangered Species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- ***Lead to a long-term decrease in the size of a population***
- ***Reduce the area of occupancy of the species***
- ***Fragment an existing population into two or more populations***
- ***Adversely affect habitat critical to the survival of a species***
- ***Disrupt the breeding cycle of a population***
- ***Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***
- ***Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat***
- ***Introduce disease that may cause the species to decline, or***
- ***Interfere substantially with the recovery of the species***

As detailed in previous sections of this report, the proposal does not involve any clearing or vegetation modification, as the land area to be disturbed consists of an active quarry. Whilst vegetated sections of the site (i.e. a small, disjunct area of regrowth to the east of the quarry) may offer marginal foraging habitat to some species, the site is not considered to be of conservation significance to any identified threatened species. The proposal will not result in habitat fragmentation, and measures will be implemented to minimise the risk of spreading of invasive species.

Overall, the proposed development is not considered to pose a risk to critically endangered or endangered species.

3.3 Critically Endangered and Endangered Ecological Communities

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:

- ***Reduce the extent of an ecological community***
- ***Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines***
- ***Adversely affect habitat critical to the survival of an ecological community***
- ***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***

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- ***Cause 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***
- ***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, or***
- ***Interfere with the recovery of an ecological community***

The zone of potential impact of this proposal is limited to the subject site, i.e. the footprint of the existing development. There are no critically endangered or endangered communities within this footprint, and the habitat area to be affected is minimal and highly degraded. An Onsite Environmental Management Plan will be implemented throughout the lifetime of the proposal, such that any off-site and indirect impacts will be minimised Therefore, the proposed development will not impact upon threatened ecological communities which may be present within the region.

3.4 Listed Migratory Species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- ***Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for migratory species***

Important habitat for a migratory species is defined as habitat which is:

- Utilised by migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Of critical importance to the species at particular life cycle stages, and/or
- Utilised by a migratory species which is at the limit of the species range, and/or
- Within an area where the species is declining.

The definition of an ecologically significant proportion of a migratory species varies depending on the characteristics of each species. Factors which should be considered in determining an ecologically significant proportion include the species' population status, genetic distinctiveness and species specific behavioural patterns (such as site fidelity and dispersal rates).

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Migratory species would likely utilise trees within the study area for foraging or roosting during migration. No clearing will occur in association with the proposed development. The subject site does not incorporate important habitat for migratory species, as the habitat is considered unsuitable and does not offer key habitat features such as fresh water or mature trees which may be utilised by these species during migration.

- ***Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or***

The proposed development is unlikely to impact upon important habitat for migratory species, provided appropriate mitigation measures are implemented to minimise the spread and/or establishment of weed species.

- ***Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species***

The proposal is not considered a risk to the lifecycle of the listed migratory species.

3.5 Assessment of Significance Conclusions

The proposal entails a licence application to increase of the annual extraction limit of raw material on Wave Hill Quarry to 500,000 tonne/year. Wave Hill Quarry is currently licensed to extract up to 200,000 tonne/year. Activities associated with the proposal would not differ from current ongoing extractive activities at the quarry. The site will be rehabilitated to a condition that is suitable for agricultural use upon completion of the development, and no clearing of vegetation will take place in association with the proposed development.

4 Conclusion

It is the conclusion of this assessment that there will be no significant long-term impacts on any listed ecological community, threatened or migratory species of national environmental significance as a consequence of the proposed development, providing:

- No clearing of native vegetation occurs during the operation of the development;
- The existing footprint of the site is not altered or extended;
- The design and management of the quarry is in accordance with best management practices and relevant guidelines; and
- Appropriate mitigation measures are implemented throughout the construction and operation of the quarry.

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5 References

DoE (2013) *Matters of National Environmental – Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999.* Department of the Environment

DoEE Protected Matters Search Tool (accessed 2017). Department of the Environment and Energy Website: http://www.environment.gov.au/epbc/protected-matters-search-tool

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Appendix 8: Test of Significance

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NSW Biodiversity Act 2016 – Test of Significance

1 Introduction

SMK Consultants Pty Limited (trading as SMK Consultants) was engaged by Johnstone Concrete and Landscape Supplies Pty Ltd (the Applicant) to prepare an Environmental Impact Statement (EIS) for the increased annual extraction limit of raw materials at Wave Hill Quarry to 500,000 tonnes per annum. This Test of Significance provides supporting information for the EIS.

This report addresses the following points, listed under Section 7.2 of the Biodiversity Conservation Act 2016 (BC Act), in order to determine whether the development is likely to significantly affect threatened species:

1) Whether the development is likely to significantly affect threatened species or ecological communities, or their habitats;
2) Whether the development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity value; and
3) Whether the development is to be carried out in a declared area of outstanding biodiversity value.

Wave Hill quarry is located approximately 24km east of Narrabri and is currently approved to extract 200,000 tonne of basalt per annum. The proposed development is to increase the annual extraction limit for the quarry to 500,000 tonne per annum. The approved extraction rate is currently sufficient to meet background demand for construction materials within the region. However, construction of the Inland Rail Project will result in a significant increase in demand for construction materials in the near future; it is anticipated that initial orders for materials for the Inland Rail Projects near Narrabri will be placed within the next 12 month period. The proposal will therefore enable Wave Hill quarry to supply materials to the Inland Rail Project, without compromising the availability of materials to existing industries throughout the region.

2 Legislative Context

Section 7.2 of the *Biodiversity Conservation Act 2016* (BC Act) requires that the significance of the impact of a development on threatened species and endangered ecological communities is assessed using a five-part test known as a Test of Significance. Where a significant impact is likely to occur, a Species Impact Statement (SIS) must be prepared in accordance with the Director-General's requirements or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM).

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The Test of Significance in this report has been prepared in accordance with requirements under Section 7.3 of the BC Act. It includes an assessment of the development against five parameters to determine whether there is likely to be a significant effect on the threatened species, ecological communities, or their habitats, which are recorded at or likely to occur at the site. The assessment has been conducted in accordance with the Threatened Species Test of Significance Guidelines (OEH 2018). It investigates the effects of the development proposal on threatened species, populations and ecological communities, as listed under the BC Act, pursuant to Section 1.7 of the *Environmental Planning & Assessment Act 1979* (EPA Act).

Section 7.2. of the BC Act also requires the determination of whether the developments exceeds the Biodiversity Offsets Scheme (BOS) threshold, and whether the development is to be carried out in a declared area of outstanding biodiversity value.

3 Proposed Project Details

The proposal extends over Lot 77 in Deposited Plan 754937 and Lot 89 in Deposited Plan 821255. The site is located in a rural area approximately 24 kilometres east of the town of Narrabri in the Narrabri Shire. The locality of the proposed development site is shown in Figure 1.

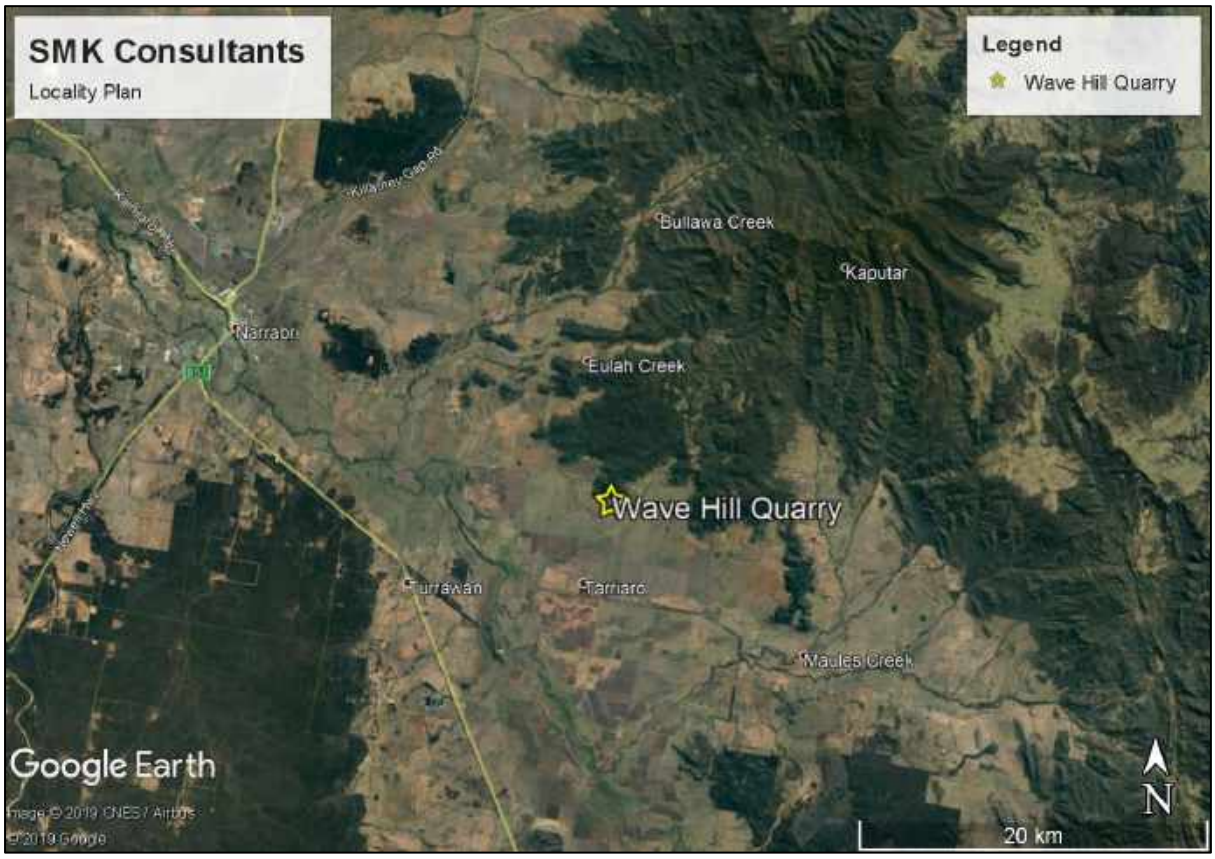

Figure 1: Wave Hill Quarry Locality Plan

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There are extensive areas of remnant vegetation in the region. These are principally associated with Mount Kaputar, and a large proportion of this vegetation is protected under National Park and State Conservation Area designations. The landscape of the region consists of hills surrounded by extensive plains.

The majority of the Lots consist of regrowth and dry vine thicket forest. The southern section of the Lot has been cleared and is currently utilised for extractive activities associated with Wave Hill Quarry. The access route to the Wave Hill Quarry is from Wave Hill Road and there is an internal sealed road within the Quarry footprint.

The current footprint of the quarry extends over approximately 24 Ha. Within the subject site, vegetation is mostly confined to small patches of scrubby regrowth to the east of the active quarry. Vegetation was assessed as being disturbed and in low condition, having relatively low structure and function attributes. This regrowth will not be impacted by the proposed development. It is therefore considered that no additional clearing is required as part of the proposed project.

Vegetation adjoining the north of subject site in the study area has previously been disturbed, as evidenced by areas of regrowth forest and old fence lines associated with historic pastoral use of the property. Higher slopes retain remnant vegetation. Species composition is consistent with 'PCT 147 – Mock Olive – Wilga – Peach Bush – Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion'. Species recorded in the canopy layer in the contiguous vegetation to the north of the site include Quinine (*Alstonia constricta*), She-oak (*Casuarina cristata*), White Cypress Pine (*Callytris glaucophylla*), and White wood (*Atalaya hemiglauca*). The understorey layer includes species such as Budda (*Eremophila mitchellii*), Sticky Wallaby Bush (*Beyeria viscosa*), Western Silver Wattle (*Acacia decora*), and Fragrant Saltbush (*Rhagodia parabolica*). Grasses such as Purple Wiregrass (*Aristida ramose*), Slender Bamboo Grass (*Austrostipa verticillate*) and White Speargrass (*Aristida leptopoda*) are found in the herb layer. Exotic species such as Prickly pear (*Opuntia* sp.), Maltese Cockspur (*Centaurea melitensis*) and *Tribulus terrestris* were also recorded.

3.1 Study Area and Site Delineation

The following definitions are used throughout this report to refer to locations in the proposal area:

- The 'subject site' describes all areas that would be directly impacted by the works. This includes the approved footprint of the existing quarry;
- The 'study area' includes the site and the areas adjacent that may be indirectly impacted by the proposed works. This includes the property described as Lot 89 in DP 821255 and Lot 77 in DP 754937;

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- The 'search area' refers to a 10-kilometre area surrounding the proposal for the purpose of database searches.

The potential construction impacts of the development are predicted to be minimal. The subject site is located on land which has historically been cleared of native vegetation. No additional clearing will take place as a result of the proposal and the site will be rehabilitated to a condition that is suitable for agricultural use upon completion of the development.

Wave Hill quarry employs a suite of environmental protection measures, including controlled drainage measures to divert clean runoff away from the quarry site, and internal drainage and sediment capture measures within the quarry site to prevent erosion from the site and ensure runoff does not contaminate offsite areas or waterways. The site further undertakes weed control measures to control biosecurity risks and ensure that the site does not function as a source of invasive species for the wider area. Therefore, the off-site impacts of the development are limited. The impact footprint of the proposal is consequently considered to be limited to the subject site. Figure 2 shows the footprint of the proposed development. It is noted that this footprint corresponds to that of the existing development and that the footprint will not be extended as part of the proposal.

Figure 2: Existing and Proposed Boundary of Wave Hill Quarry

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4 Biodiversity Offset Scheme Thresholds

The Biodiversity Offsets Scheme (BOS) Threshold establishes a risk-based approach to identifying developments that are likely to have a significant impact on biodiversity. The *Biodiversity Conservation Regulation 2017* sets out threshold levels for when the BOS will be triggered.

Table 1: Results of the Biodiversity Offset Scheme (BOS) Entry Threshold Report

		BAM Required?
Project area	24 ha	
Minimum lot size Method	LEP	
Minimum Lot	100 ha	
Area threshold	1 ha	
Area of native vegetation to be disturbed	0 ha	No
Impact on Biodiversity Values Land Map	No	No

No clearing will take place as part of the proposed development. The proposed development therefore does not exceed the BOS thresholds and does not require a BDAR. However, the proposed project is still required to be assessed to determine whether the development is "likely to significantly affect threatened species" as determined under the test in Section 7.3 of the *Biodiversity Conservation Act 2016*. This assessment is provided in the sections below.

5 Assessment of Potential Presence of Threatened Species

A search of the National Parks and Wildlife Atlas of NSW Wildlife (BioNet) identified species with recorded sightings within a 10km radius of the proposed development site. The complete search result for listed species is presented in Appendix A.

The project site is located with the Liverpool Plains subregion of the Brigalow Belt South Bioregion. A broader search for species, populations and communities that may occur within the locality of the development site was therefore conducted through investigating known and predicted species' distributions within the Brigalow Belt South Bioregion (Liverpool Plains subregion). A copy of the search results for listed species is presented in Appendix B.

Species were considered with regards to their known distribution and habitat requirements, to assess whether the site is likely to serve as suitable habitat. Each species was assigned a rating based on their likelihood to occur within the subject site. The 'likelihood of occurrence' categories are detailed in Table 2. The habitat assessment is provided in Appendix B. Species assigned with a rating of 'Moderate' or higher and are considered potentially impacted by the proposed works have been considered further under relevant legislation in the section entitled 'Test of significance – Assessment of Criteria and Discussion'.

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Table 2: Likelihood of Occurrence Criteria

Likelihood Rating	Criteria
Known	The species was recorded within the study area during site surveys.
High	It is likely that a species would inhabit or utilise habitat within the subject site. Criteria for this category may include: • Species recently and/or regularly recorded in contiguous or nearby habitat; • High quality habitat types or resources present within study area; • Species is known or likely to maintain a resident population surrounding the study area; and • Species is known or likely to visit during migration or seasonal availability of resources.
Moderate	Potential habitat for a species occurs within the subject site. Criteria for this category may include: • Species previously recorded in contiguous habitat albeit not recently (>10 years); • Poor quality, depauperate or modified habitat types and/or resources • present within study area; • Species has potential to utilise habitat during migration or seasonal availability of resources; and • Cryptic flora species with potential habitat available within the subject site that have not been seasonally targeted by surveys.
Low	It is unlikely that the species inhabits the area and would likely be considered a transient visitor if ever encountered. Criteria for this category may include: • The subject site or study area lacks specific habitat types or resources required by the species; • The subject site is beyond the current distribution of the species or is isolated from known populations; • Non-cryptic flora species that were found to be absent during targeted surveys; and • The subject site only contains common habitat which would not be considered important for the local survival of a threatened species.
Unlikely	The habitat within subject site and study area is unsuitable for the species.

The following species, populations and communities have the potential to occur within the local area and have been considered in this Test of Significance.

Table 3: Results of BioNet Atlas Search

Scientific Name	Common Name	Legal Status	Records
Alectura lathami	Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions	BC ACT: E,P	10
Circus assimilis	Spotted Harrier	BC Act: V, P	27
Hieraaetus morphnoides	Little Eagle	BC Act: V, P	23

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Scientific Name	Common Name	Legal Status	Records
Lophoictinia isura	Square-tailed Kite	BC Act: V,P,3	12
Falco subniger	Black Falcon	BC Act: V, P	15
Neophema pulchella	Turquoise Parrot	BC Act: V,P,3	100
Ninox strenua	Powerful Owl	BC Act: V,P,3	P
Tyto novaehollandiae	Masked Owl	BC Act: V,P,3	13
Chthonicola sagittata	Speckled Warbler	BC Act: V, P	321
Artamus cyanopterus cyanopterus	Dusky Woodswallow	BC Act: V,P	84
Petroica phoenicea	Flame Robin	BC Act: V, P	3
Stagonopleura guttata	Diamond Firetail	BC Act: V,P	29
Dasyurus maculatus	Spotted-tailed Quoll	BC Act: V,P	20
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	BC Act: V,P	219
Chalinolobus dwyeri	Large-eared Pied Bat	BC Act: V,P	42
Chalinolobus picatus	Little Pied Bat	BC Act - V	6
Nyctophilus corbeni	Corben's Long-eared Bat	BC Act: V,P	48
Vespadelus troughtoni	Eastern Cave Bat	BC Act: V,P,2	61

[1]Number of BioNet Atlas records in selected area. Status Abbreviations: Vulnerable (V), Endangered (E), Protected (P), and Sensitivity Classes 2 and 3 (Sensitive Species Data Policy) (2) (3).

5.1 Test of Significance - Assessment of Criteria and Discussion

The following is to be considered for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a) in the case of a threatened species, whether the proposed development or activity 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,

A viable local population of a threatened terrestrial flora or fauna species in this assessment is defined as a population that occurs within the study area and the connected habitat to the north, east and west of the proposed development.

Flora Species

Bluegrass

The site inspection did not reveal the presence of a local population of Bluegrass. The cryptic nature of some threatened species, however, is such that the species may not have been visible during the time of the site visit, and therefore it must be assumed that viable populations of threatened flora species may be present within the region in accordance with the precautionary principle.

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Potential habitat for the listed species is present on the site. The development has some disjunct areas of land to the east and south of gravel stockpile areas which have not been impacted the current development. These habitat areas have historically been cleared and subject to grazing; they now support degraded vegetation with limited regrowth (to the east of the quarry). Extensive areas of similar disturbed habitat are present to the south and east of the property. Should Bluegrass be present within the development footprint, the species may be displaced in the short-term. However, given that adjoining vegetation retains the potential to support this species, it is considered that the risk of a viable population being placed at risk of extinction is minimal.

Bats

Yellow-bellied Sheath-tail Bat, Large-eared Pied Bat, Little Pied Bat, Eastern Cave Bat, Large Bent-winged Bat

The above mentioned bat species may use the project area for foraging on occasion, however given the lack optimal foraging habitat within the subject site and the extensive areas of higher quality forest habitat in the locality, it is unlikely that the subject site is regularly or heavily utilised by the species. Additionally, there is no roosting and/or breeding habitat within the proposed development footprint.

The risk to these bat species from the development is therefore limited to the loss of sub-optimal foraging habitat. It is therefore considered that no viable local population of any threatened species will be placed at risk of extinction as a result of the proposed development.

Woodland Species

Australian Brush-turkey, Turquoise Parrot, Speckled Warbler, Flame Robin, Diamond Firetail, Dusky Woodswallow

Habitat loss and/or degradation as a result of clearing, increased weed invasion, under-shrubbing and “tidying up”, are all significant threats for these species. There is no woodland habitat within the subject site, thus the above-mentioned species are not at risk of any direct impact.

Natural habitat remaining within the subject site consists of low-quality scrub and open habitat, which has been subject to clearing and agricultural activities such as grazing. Moreover, vegetated areas are adjacent to an active quarry, which is a source of noise pollution. It is therefore considered that habitat within the development footprint constitutes sub-optimal habitat and would be used on an irregular basis, at best, by woodland species.

Given that higher-quality vegetation retains the potential to support these species to the north of the subject site, the above-mentioned woodland species are therefore not at risk of

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extinction from impacts associated with the proposed development. It is further noted that the proposal will not result in any additional clearing or removal of vegetation

Birds of Prey

Spotted Harrier, Little Eagle, Square-tailed Kite, Black Falcon, Powerful Owl, Masked Owl

Birds of prey usually have relatively large home ranges, and it is highly unlikely that the small area of degraded vegetation within the subject site forms an important component of the home range of these species. These birds are also highly dependent upon mature overstorey trees and/or hollow bearing trees for nesting and provision of hunting perches. They are also dependent upon the presence of prey species. The vegetation present at the subject site is degraded and consists of scattered shrubs, immature trees and modified grassland and as such provides limited habitat for prey species.

The vegetation within the Wave Hill Quarry footprint has poor structural and species diversity, and will not be impacted by the proposal. The study area comprises a relatively large and contiguous areas of higher quality forest habitat, which would sustain viable local populations of the above-mentioned species. It is therefore considered that there will be no direct impacts to birds of prey, and that any indirect impacts would not be significant.

Mammals

Spotted-tail Quoll

The subject site does not provide optimal habitat for the Spot-tailed Quoll, which uses tree hollows or rocky outcrops cliff faces as den sites. However, given the proximity of the subject site to higher quality native forest habitat, it is possible that the species transits through vegetated areas within the subject site on occasion. Any short-term displacement or disturbance incurred as a result of the quarry operation would not result in a significant impact to the species. It is therefore considered that there is no risk of a viable population being placed at risk of extinction.

No population of listed threatened species was identified within the subject site and minimal indirect impacts are expected to occur off site. It is therefore considered that no viable local population of any threatened species will be placed at risk of extinction as a result of the proposed development. Additionally, as the site is surrounded by areas of similar and/or higher-quality native vegetation, local populations of fauna species will have the ability to access or preference these surrounding areas. Therefore, it is considered unlikely that any local population of threatened species within the study area will be placed at risk of extinction.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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(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 does not support an endangered ecological community or critically endangered ecological community. The development proposal is therefore considered unlikely to impact on the extent or composition of any of the listed endangered or critically endangered ecological communities.

c) 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 proposed development or activity, 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,

No additional vegetation will be removed or modified relative to the existing development and its approved footprint as part of the current proposal. The proposal involves increasing the annual extraction limit of the Wave Hill Quarry from 200,000 to 500,000 tonnes per annum. The footprint of the development will not be altered, and it is therefore considered that the proposal will not have any novel or additional impacts on populations of threatened species relative to the existing development. Furthermore, the subject site does not currently support habitat deemed to be important for any threatened species or population, and it is surrounded by higher quality remnant vegetation.

The proposal is therefore not considered to remove, modify, fragment or isolate habitat essential for the survival of a threatened species within the area. No endangered ecological community will be removed, modified or fragmented as part of the proposed works.

d) whether the proposed development is likely to have an adverse effect on critical any declared area of outstanding biodiversity value (either directly or indirectly):

The development proposal is not located in or near an area of outstanding biodiversity value. Therefore, no areas of outstanding biodiversity value will be adversely affected (either directly or indirectly) by the proposed development.

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e) whether the proposed development or activity is or is part of a key threatening process or is likely or increase the impact of a key threatening process.

Invasion of Native Plant Communities by Exotic Perennial Grasses

Exotic perennial grasses may be present within the grassed areas of the subject site. The risk posed to native plant communities is that these perennial grasses would spread into areas with better quality native groundcover. Seeds of exotic perennial grasses and others weeds may be carried onto and distributed by vehicles entering and exiting the Quarry. Construction machinery may also transport weed seeds onto and off the Quarry site.

Weed management strategies will be implemented through the Onsite Environmental Management Plan (OEMP) to minimise the risk of weed establishment and proliferation as a result of extractive activities on site. Examples of weed management strategies include adoption of proper hygiene procedures to minimise the potential for seed transport onto and off the work site. Any weed species listed under the Biosecurity Act 2015 should also be actively controlled throughout the operation of the Wave Hill quarry.

Provided safeguards regarding weed management are implemented, the proposed works are unlikely to result in increased weed incursion. The proposed works are therefore considered unlikely to increase the impact of any key threatening processes.

6 Conclusion

The proposed project entails the increase of the annual extraction limit of the Wave Hill Quarry to 500,000 tonne of raw material per annum (from an existing limit of 200,000 tonne/annum). The quarry is located on Lot 89 in Deposited Plan 821255 and Lot 77 in Deposited Plan 754937, approximately 24 kilometres east of the township of Narrabri in Narrabri Shire.

The proposal was assessed using the Test of Significance in accordance with the BC Act for the site which determined that given that no vegetation clearing will take place as part of the proposed development, the project is not likely to significantly affect threatened species, ecological communities, or their habitats.

This assessment has determined that the potential adverse impacts of the proposed development on threatened species, populations or communities is considered minimal and no further investigation in the form of a Species Impact Statement is required.

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7 References

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Appendix A: Bionet Threatened Species, Populations and Communities Search Results for a 10-kilometre radius from the Subject Site

Scientific Name	Common Name	Legal Status	Local Records
Alectura lathami	Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions	BC ACT: E,P	5
Circus assimilis	Spotted Harrier	BC Act: V,P	1
Hieraaetus morphnoides	Little Eagle	BC Act: V,P	1
Neophema pulchella	Turquoise Parrot	BC Act: V,P, 3	2
Ninox connivens	Barking Owl	BC Act: V,P, 3	1
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	BC Act: V,P	1
Chthonicola sagittata	Speckled Warbler	BC Act: V,P	4
Artamus cyanopterus cyanopterus	Dusky Woodswallow	BC Act: V,P	3
Petaurus norfolcensis	Squirrel Glider	BC Act: V,P	1
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	BC Act: V,P	4
Chalinolobus dwyeri	Large-eared Pied Bat	BC Act: V,P EPBC Act: V	3
Nyctophilus corbeni	Corben's Long-eared Bat	BC Act: V,P EPBC Act: V	2
Vespadelus troughtoni	Eastern Cave Bat	BC Act: V,P,2	1
Cadellia pentastylis	Ooline	BC Act: V EPBC Act: V	22

[1]Number of OEH Wildlife Atlas records within 10km of Subject Site.

Status Abbreviations: Vulnerable (V), Protected (P), Endangered (E, E1), and Sensitivity Class 2, 3 [Sensitive Species Data Policy] (2) (3)

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Appendix B: Bionet Threatened Species, Populations and Communities Search Results for Brigalow Belt South Bioregion (Northern Basalts IBRA Subregion)

Note:

The following definitions are used throughout the table below to refer to locations in the proposal area:

- The 'subject site' describes all areas that would be directly impacted by the works. This includes the access route and the footprint of the proposed dwelling as well as a 10 metre buffer/Asset Protection Zone around the proposed development footprint.
- The 'study area' includes the site and the areas adjacent that may be indirectly impacted by the proposed works;
- The 'search area' refers to a 10-kilometre area surrounding the proposal for the purpose of database searches.

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Aves					
Alectura lathami Australian Brush-turkey	BC Act – E2	Largely coastal distribution from Cape York south as far as the Illawarra in NSW. Occurs in forested and wooded areas of tropical and warm-temperate districts, particularly above 300 m to at least 1200 m altitude. A population of the Australian Brush-turkey is known from the Nandewar and Brigalow Belt South Bioregions. The majority of records are from Mount Kaputar National Park and nearby Deriah State Forest, with a smaller cluster of records from Warialda State Forest. In NSW the inland vegetation type preferred by the Australian Brush-turkey is a dry rainforest community that is found within the Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions Endangered Ecological Community.	10	**Moderate** There are 5 records of this species in the local area. There is potential habitat for the species within and immediately adjacent to the subject site; the species is therefore considered in this assessment.	Yes
Leipoa ocellate Malleefowl	BC Act – E1	The stronghold for this species in NSW is the mallee in the south west centred on Mallee Cliffs NP and extending east to near Balranald and scattered records as far north as Mungo NP. Predominantly inhabits mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Less frequently found in other eucalypt woodlands,	1	**Unlikely** The are no mallee communities within the subject site. Malleefowl are therefore unlikely to be found at the subject site.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		such as Inland Grey Box, Ironbark or Bimble Box Woodlands with thick understorey, or in other woodlands such dominated by Mulga or native Cypress Pine species.			
Anseranas semipalmata Magpie Goose	BC Act – V	Since the 1980s there have been an increasing number of records in central and northern NSW. Vagrants can follow food sources to south-eastern NSW. Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. The species' activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off;	K	**Unlikely** The are no wetlands within or adjacent to the subject site; the species is therefore not expected to occur at this location and is not considered in this assessment.	No
Oxyura australis Blue-billed Duck	BC Act - V	Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Feeds on the bottom of swamps and will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. It is widespread in NSW, but most common in the southern Murray-Darling Basin area.	1	**Unlikely** There is no suitable habitat in the subject site or in its vicinity.	No
Stictonetta naevosa Freckled Duck	BC Act - V	Prefers permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	4	**Unlikely** There is no suitable habitat in the subject site or in its vicinity.	No
Ephippiorhynchus asiaticus Black-necked Stork	BC Act – E1	Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	2	**Unlikely** There is no suitable habitat in the subject site or in its vicinity.	No
Botaurus poiciloptilus Australasian Bittern	BC Act – E1	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. nests are built in secluded places in densely-vegetated wetlands on a platform of reeds.	P	**Unlikely** There is no suitable habitat in the subject site or in its vicinity.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Circus assimilis Spotted Harrier	BC Act - V	In New South Wales, this species is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region. Primarily inhabits woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands	27	**Moderate** This species may hunt throughout the subject site, given the availability of suitable habitat nearby and the species' relatively large home range.	Yes
Haliaeetus leucogaster White-bellied Sea-Eagle	BC Act - V	The White-bellied Sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.	3	**Unlikely** There is no suitable habitat in the subject site or in its vicinity.	No
Hamirostra melanosternon Black-breasted Buzzard	BC Act - V	The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts. Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands. Breeds from August to October near water in a tall tree.	3	**Low** The site is considered unsuitable due to higher rainfall levels than that with which the species is associated. Mean annual rainfall in the locality exceeds 650mm (1891-2019). (BOM, Station 053030)	No
Hieraaetus morphnoides Little Eagle	BC Act - V	The Little Eagle is found throughout the Australian mainland. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	23	**Moderate** This species may hunt throughout the subject site, given the availability of suitable habitat nearby and the species' relatively large home range. There is also 1 record for this species in the search area.	Yes

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Lophoictinia isura Square-tailed Kite	BC Act - V	In NSW, the species is a regular resident in the north, north-east and along the major west-flowing river systems. Found in a variety of timbered habitats including dry woodlands and open forests. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km.	12	**Moderate** This species may hunt throughout the subject site, given the availability of suitable habitat nearby and the species' relatively large home range.	Yes
Falco hypoleucos Grey Falcon	BC Act – E1	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	2	**Low** Optimal habitat for this species is not present in the subject site or its vicinity. The species is therefore not considered in this assessment.	No
Falco subniger Black Falcon	BC Act - V	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres.	15	**Moderate** This species may hunt throughout the subject site, given the availability of suitable habitat nearby and the species' relatively large home range.	Yes
Grus rubicunda Brolga	BC Act - V	Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged. They feed using their heavy straight bill as a 'crowbar' to probe the ground or turn it over, primarily on sedge roots and tubers. The nest comprises a platform of grasses and sticks, augmented with mud, on an island or in the water.	1	**Low** The subject site is not considered important for this species given its dependence on wetlands, a habitat absent from the site and its vicinity.	No
Ardeotis australis Australian Bustard	BC Act – E1	The Australian Bustard mainly occurs in inland Australia and is now scarce or absent from southern and south-eastern Australia. In NSW, they are mainly found in the north-west corner and less often recorded in the lower western and central west plains regions. Occasional	1	**Low** The subject site is not considered important for this species due to a paucity of suitable habitat.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		vagrants are still seen as far east as the western slopes and Riverine plain. The species mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams.			
Burhinus grallarius Bush Stone-curlew	BC Act – E1	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nests on the ground in a scrape or small bare patch.	3	**Low** Woodland habitat in the vicinity of the site consists of dense, rather than open, vegetation. The structure of vegetation within the subject site is more open, as a result of clearing. It is therefore considered unlikely that Bush-stone Curlew would utilise the site.	No
Rostratula australis Australian Painted Snipe	BC Act – E1	In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	1	**Low** The subject site is not considered important for this species due to a lack of suitable habitat in the locality.	No
Limosa limosa Black-tailed Godwit	BC Act - V	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the coast, and inland. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps.	P	**Low** The subject site is not considered important for this species due to a lack of suitable habitat in the subject site and its vicinity.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Calyptorhynchus lathami Glossy Black-Cockatoo	BC Act - V	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak and Forest Sheoak are important foods. Inland populations feed on a wide range of sheoak. Belah is also utilised and may be a critical food source for some populations.	14	**Low** There subject site is outside of the species' range and is therefore not considered important habitat for the species.	No
Glossopsitta pusilla Little Lorikeet	BC Act - V	Forages primarily in the canopy of open Eucalyptus forest and woodland. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Roosts in treetops, often distant from feeding areas. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m).	156	**Low** The site is not considered important habitat due to a paucity of suitable habitat. There is no forest woodland habitat within the development boundaries.	No
Lathamus discolor *Swift Parrot*	BC Act – E1	In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Forest Red Gum, Mugga Ironbark, and White Box. Breed in Tasmania from September to January.	5	**Low** The species is not included in this assessment due to a paucity of suitable habitat.	No
Neophema pulchella Turquoise Parrot	BC Act - V	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December.	100	**Moderate** The subject site adjoins woodland habitat and there are 2 records for this species within the search area. The species is therefore considered in this assessment.	Yes

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Polytelis swainsonii Superb Parrot	BC Act - V	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The species inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. Also eaten are fruits, berries, nectar, buds, flowers, insects and grain.	3	**Unlikely** There is no woodland habitat within the subject site. It is therefore not considered important habitat for the species.	No
Ninox connivens *Barking Owl*	BC Act - V	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils.	42	**Unlikely** There is no woodland/forest habitat within the subject site and the site was historically wholly cleared. This species is therefore considered in this assessment.	No
Ninox strenua *Powerful Owl*	BC Act - V	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats.	P	**Moderate** There are large tracts of forest adjacent to the subject site. The Powerful Owl, if present in the locality, may hunt in open habitat on the edges of the subject site. This species is therefore considered in this assessment.	Yes
Tyto longimembris *Eastern Grass Owl*	BC Act - V	Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They always breed on the ground. Nests are found in	2	**Unlikely** There is no suitable/optimal habitat for this species within the subject site. The species is therefore unlikely	No

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		trodden grass, and often accessed by tunnels through vegetation. In NSW, the species is more likely to be resident in the north-east. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues.		to be present on the subject site not considered in this assessment.	
Tyto novaehollandiae Masked Owl	BC Act - V	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides.	13	**Moderate** The species may hunt on the vegetated areas of the subject site, which is adjacent to open forest.	Yes
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	BC Act - V	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. When foraging in trees and on the ground, they peck and probe for insects, mostly ants, amongst the litter, tussocks and fallen timber, and along trunks and lateral branches. Hollows in standing dead or live trees and tree stumps are essential for nesting.	198	**Unlikely** There is no suitable habitat for the species within the subject site; the species is therefore considered in this assessment.	No
Chthonicola sagittata Speckled Warbler	BC Act - V	The Speckled Warbler has a patchy distribution throughout the eastern half of NSW. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes	321	**Moderate** There are four records of the species in the search area. The species may, at times, forage in grassed areas on the edges of the subject site. This species is therefore considered in this assessment.	Yes

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		and trees. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter.			
Anthochaera phrygia Regent Honeyeater	BC Act - V	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany. The species breeds between July and January in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River Sheoak.	4	**Unlikely** The subject site is not considered important habitat for this species, due to a paucity of suitably diverse habitat. Key foraging species were not observed within the subject site.	No
Certhionyx variegatus Pied Honeyeater	BC Act - V	Widespread throughout acacia, mallee and spinifex scrubs of arid and semi-arid Australia. Occasionally occurs further east, on the slopes and plains and the Hunter Valley, typically during periods of drought. Pied Honeyeater inhabits wattle shrub, primarily Mulga (*Acacia aneura*), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering. It feeds on nectar, and is highly nomadic, following the erratic flowering of shrubs; can be locally common at times.	1	**Unlikely** The subject site is not considered important habitat for this species, due to a paucity of suitable habitat.	No
Epthianura albifrons White-fronted Chat	BC Act - V	In NSW, this species occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. It is a gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground.	1	**Unlikely** The subject site is does not support suitable habitat for this species and is not located in a region which supports significant populations of the species. It is not considered	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
				important habitat for White-fronted Chat.	
Grantiella picta Painted Honeyeater	BC Act - V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. Inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*.	17	**Unlikely** The subject site is not considered important habitat given the paucity of suitable habitat, including foraging habitat, in the subject site.	No
Melithreptus gularis gularis Black-chinned Honeyeater	BC Act - V	The Black-chinned Honeyeater has two subspecies, with only the nominate (*gularis*) occurring in NSW where it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares.	4	**Unlikely** Woodland habitat within the subject site consists of edge habitat and a small number of trees. It is unlikely that this habitat area constitutes an important part of the Black-chinned Honeyeaters range.	No
Pomatostomus temporalis temporalis Grey-crowned Babbler (eastern subspecies)	BC Act - V	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses.	316	**Unlikely** There is no suitable habitat for the species within the subject site; the species is therefore not considered in this assessment.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Daphoenositta chrysoptera Varied Sittella	BC Act - V	Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy.	59	**Unlikely** The subject site is not considered important habitat for the species given the paucity of suitable habitat.	No
Artamus cyanopterus cyanopterus Dusky Woodswallow	BC Act - V	Primarily inhabit 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. Primarily eats invertebrates, mainly insects, which are captured whilst hovering or sallying above the canopy or over water. Most breeding activity occurs on the western slopes of the Great Dividing Range.	84	**High** The species was observed in adjacent habitat during a site assessment. Dusky Woodswallow is therefore considered in this assessment.	Yes
Melanodryas cucullata cucullata Hooded Robin (south-eastern form)	BC Act - V	The south-eastern form (subspecies *cucullata*) is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies *picata*. Two other subspecies occur outside NSW. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	22	**Low** There is insufficient structural diversity on the subject site to support the species. The subject site is therefore not considered important habitat for the species.	No
Petroica boodang Scarlet Robin	BC Act - V	In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions.	K	**Unlikely** Given the low occurrence of the species in the Liverpool Plains subregion and the fact that the subject site only consists of edge habitat, it is considered unlikely to be important habitat for the species.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Petroica phoenicea Flame Robin	BC Act – V	In NSW, the Flame Robin breeds in upland areas and in winter, many birds move to the inland slopes and plains. It breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. The species prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense.	3	**Moderate** Habitat along the northern boundaries of the subject site could be potentially used by the species, which prefers clearing. The species is therefore considered in this assessment.	Yes
Stagonopleura guttata Diamond Firetail	BC Act - V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Prefers clearings or areas with open understoreys. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	29	**Moderate** Habitat along the northern boundaries of the subject site could be potentially used by the species, which prefers clearing. The species is therefore considered in this assessment.	Yes
Mammalia					
Dasyurus maculatus Spotted-tail Quoll	BC Act - V	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges of 200-500 hectares, while males occupy very large home ranges from 500 to over 4000 hectares.	20	**Moderate** Given its large home range and the fact that it is found across a large range of habitat types, the species may sometimes occur within the subject site.	Yes
Phascogale tapoatafa Brush-tailed Phascogale	BC Act - V	In NSW, the species is mainly found east of the Great Dividing Range although there are occasional records west of the divide. It prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter and also inhabits heath, swamps, rainforest and wet sclerophyll forest.	P	**Unlikely** The species is rarely recorded in the locality of the subject site, and being edge habitat, it is unlikely that the habitat area within the site is of importance to the species.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Sminthopsis macroura Stripe-faced Dunnart	BC Act - V	Occur Throughout much of inland central and northern Australia, extending into central and northern NSW. Found in native dry grasslands and low dry shrublands, often along drainage lines where food and shelter resources tend to be better. They shelter in cracks in the soil, in grass tussocks or under rocks and logs.	P	**Unlikely** There is no suitable habitat for the species on the site. Striped-faced Dunnart is therefore not considered in this assessment.	No
Phascolarctos cinereus Koala	BC Act - V	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	1453	**Unlikely** The species depends on woodland/forested habitat for its survival. The subject site does not contain such habitat and is therefore not considered important habitat for the species.	No
Cercartetus nanus Eastern Pygmy-possum	BC Act - V	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes.	3	**Unlikely** In NSW, the species is typically found in rainforest, a habitat which is not present in or near the subject site. This species is therefore considered in this assessment.	No
Petaurus australis Yellow-bellied Glider	BC Act - V	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. It occurs in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Feeds primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein.	P	**Low** There are no known records of the species in the locality or in the Liverpool Plains subregion. It is therefore not considered that the subject type provides important habitat for the species.	No

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Petaurus norfolcensis Squirrel Glider	BC Act - V	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or *Acacia* midstorey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of *Acacia* gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	17	**Low** The subject site is not considered important habitat for the species, due a paucity of suitable habitat in the area.	No
Aepyprymnus rufescens Rufous Bettong	BC Act - V	The original range from Coen in north Queensland to central Victoria has been reduced to a patchy distribution from Cooktown, Queensland, to north-eastern NSW as far south as Mt Royal National Park. In NSW it has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts. Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter.	P	**Low** The subject site is not considered important habitat given the low occurrence of the species in inland areas and the paucity of suitable habitat on the subject site.	No
Lagorchestes leporides Eastern Hare-wallaby	BC Act – E4	The species is presumed extinct in NSW. The Eastern Hare-wallaby preferred habitat that consisted of open plains and grasslands.	1	**Low** The species is presumed extinct in NSW.	No
Macropus dorsalis Black-striped Wallaby	BC Act – E1	From the Townsville area in Queensland to northern NSW where it occurs on both sides of the Great Divide. On the north west slopes of NSW it occurs in Brigalow remnants to south of Narrabri. Preferred habitat is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. On the north west slopes, associated with dense vegetation, including brigalow, ooline and semi-evergreen vine thicket.	4	**Low** The subject site does not have suitable habitat. There is no Brigalow on the subject site. The species is not considered in this assessment.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Onychogalea fraenata Bridled Nailtail Wallaby	BC Act – E4	The species is presumed extinct in NSW. The Bridled Nail-tail Wallaby previously occupied Acacia shrubland and grassy woodland in semi-arid regions of eastern Australia.	1	**Low** The species is presumed extinct in NSW.	No
Petrogale penicillate Brush-tailed Rock-wallaby	BC Act – E1	In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. The species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. It browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	11	**Low** The subject site is not considered important habitat for the species, due a paucity of suitable habitat in the area.	No
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	BC Act - V	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	219	**Moderate** There are 4 records for this species in the search area. The species is a generalist and occurs over most habitat types, it is therefore considered in this assessment.	Yes
Micronomus norfolkensis Eastern Coastal Free-tailed Bat	BC Act - V	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. It occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	3	**Low** The subject site is outside of the species' range, and the Eastern Coastal Free-tailed Bat is therefore not expected to occur within the subject site.	No
Chalinolobus dwyeri Large-eared Pied Bat	BC Act - V	Found mainly in areas with extensive cliffs and caves. It is generally rare with a very patchy distribution in NSW. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features.	42	**High** The species was observed in adjacent habitat during a site assessment. Furthermore, potential breeding habitat (caves and sandstone outcrops) was identified for this species uphill of the development.	Yes

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				The species is therefore considered in this assessment.	
Chalinolobus nigrogriseus Hoary Wattled Bat	BC Act - V	In north east NSW it extends from Port Macquarie in the south, north to the Queensland border. The species has been recorded as far west as Armidale and Ashford. In NSW the Hoary Wattled Bat occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum are common. Because it flies fast below the canopy level, forests with naturally sparse understorey layers may provide the best habitat.	1	**Low** The subject site is outside of the species' known range. The Hoary Wattled Bat is therefore not considered in this assessment.	No
Chalinolobus picatus Little Pied Bat	BC Act - V	Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Feeds on moths and possibly other flying invertebrates.	6	**Moderate** Potential breeding habitat (caves and sandstone outcrops) was identified for this species uphill of the development. The species is therefore considered in this assessment.	Yes
Nyctophilus corbeni Corben's Long-eared Bat	BC Act - V	Inhabits a variety of vegetation types, including mallee, bulloke and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation. Roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground.	48	**Unlikely** There is no woodland habitat within the subject site. It is therefore not considered important habitat for the species.	No
Vespadelus troughtoni Eastern Cave Bat	BC Act - V	A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings. Occasionally found along cliff-lines in wet eucalypt forest and rainforest. Little is understood of its feeding or breeding requirements or behaviour.	61	**Moderate** Potential breeding habitat (caves and sandstone outcrops) was identified for this species uphill of the development. The species is	Yes

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				therefore considered in this assessment.	
Conilurus albipes White-footed Tree-rat	BC Act – E4	This species is presumed extinct in NSW. The White-footed Tree-rat was known to inhabit open forest woodlands and grassy ecosystems in Victoria. Habitat information is not known for other states in which the species occurred.	2	**Low** The species is now presumed extinct in NSW.	No
Pseudomys gouldii Gould's Mouse	BC Act – E4	This species is presumed extinct in NSW. Sightings of live animals and reports of subfossil remains indicate that Gould's Mouse was formerly distributed throughout south-west Western Australia, eastern South Australia and New South Wales.	1	**Low** The species is now presumed extinct in NSW.	No
Pseudomys pilligaensis Pilliga Mouse	BC Act - V	The species' distribution is restricted to the Pilliga region of New South Wales. Within the Pilliga region this species is largely restricted to low-nutrient deep sand soils which are recognised as supporting a distinctive vegetation type referred to as the Pilliga Scrub.	P	**Low** The subject site is outside of the species' known distribution, and there is not suitable habitat for the species within the site.	No
Rattus villosissimus Long-haired Rat	BC Act - V	The species has been recorded over vast areas of western NSW and is sustained in mesic, densely vegetated sites. Strongholds are north-west of NSW, with plagues spreading south and east along river channels. Otherwise, the species is found in scattered localities in low numbers.	1	**Unlikely** The species is not considered in this assessment due to a paucity of suitable habitat – there is no dense, mesic vegetation within the subject site.	No
Miniopterus orianae oceanensis Large Bent-winged Bat	BC Act - V	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Hunt in forested areas, catching moths and other flying insects above the tree tops. The species is sustained in mesic, densely vegetated sites. During plagues can be found in virtually all inland habitats.	2	**Moderate** Potential breeding habitat (caves and sandstone outcrops) was identified for this species uphill of the development. The species is therefore considered in this assessment.	Yes
Reptilia					

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Uvidicolus sphyrurus Border Thick-tailed Gecko	BC Act - V	Found only on the tablelands and slopes of northern NSW. Most common in the granite country of the New England Tablelands. Occurs at sites ranging from 500 to 1100 m elevation. Populations are mostly fragmented, with over 50 discrete sites currently known that are separated by at least 2 km. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey.	1	**Unlikely** The subject site is not considered important for this species given its low altitude (370m) and a paucity of suitable habitat.	No
Aprasia parapulchella Pink-tailed Legless Lizard	BC Act - V	The Pink-tailed Legless Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks.	2	**Low** The subject site is located on the north-western slopes and is therefore outside of the species' known range. The species is not considered in this assessment.	No
Hoplocephalus bitorquatus Pale-headed Snake	BC Act - V	A patchy distribution from north-east Queensland to the north-eastern quarter of NSW. In NSW it has historically been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes, and from the north coast from Queensland to Sydney. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas.	23	**Low** The subject site is not considered important habitat for the species given the paucity of suitable habitat within the subject site. The site is on the edge of dry forest and there are no watercourses nearby.	No
Flora					
Tylophora linearis	BC Act – V	Grows in dry scrubland that may have a eucalypt, *Callitris glaucophylla* and/or *Allocasuarina luehmannii* overtopping the scrub, in the Barraba, Mendooran, Temora and West Wyalong districts.	458	**Low** The subject site is not considered important habitat for the species as it is outside the species' range.	No
Lepidium aschersonii	BC Act – V	Not widespread, occurring in the marginal central-western slopes and north-western plains regions of NSW (and	46	**Low**	No

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Spiny Peppercress		potentially the south western plains). Found on ridges of gilgai clays dominated by Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*), Buloke (*Allocasuarina luehmanii*) and Grey Box (*Eucalyptus microcarpa*). Often the understorey is dominated by introduced plants. The species grows as a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter. Plant numbers decrease with increasing overstorey density, and plants were not found where the Brigalow canopy cover exceeded about 60%. The species is often described as a "weed" where it dominates paddocks. An apparent increase in numbers during drought conditions has also been observed. The species is reported to be salt tolerant and also grows well under dry conditions.		The subject site is not considered important habitat for the species due to a lack of suitable habitat.	
Cyperus conicus	BC Act – E1	Occurs rarely in the Pilliga area of NSW and is also found across the tropics in in Qld, WA and the NT, including central deserts north of Alice Springs. Grows in open woodland on sandy soil.	P	**Low** The subject site is not considered important for this species as it is outside the species' range.	No
Bertya opponens Coolabah Bertya	BC Act – V	This plant is currently known from only four scattered sites in NSW: one from private property near Coolabah in western NSW and two to the south of Narrabri on the North West Slopes, including the largest population in Jacks Creek State Forest. The fourth population was known from private property near Cobar. Coolabah Bertya occurs in a range of habitats including stony mallee ridges and cypress pine forest on red soils. The wide variation in habitat type between the populations makes the identification of critical habitat very difficult.	1	**Low** The subject site is not considered important for this species as the species has a very restricted range and the subject site is outside of this range.	No
Desmodium campylocaulon Creeping Tick-trefoil	BC Act – E1	The species occurs chiefly in the Collarenebri and Moree districts in the north-western plains of NSW. Creeping Tick-Trefoil is confined to clay soils, usually with *Astrebla* and *Iseilema* species. In NSW *Desmodium campylocaulon*	1	**Unlikely** Soils on the subject site consist of black loams and do not comprise suitable habitat for Creeping Tick-	No

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		grows on cracking black soils in the Narrabri, Moree and Walgett local government areas. The species is said to be hardy, but grazed where sheep have regular access. Plants are strongly stoloniferous and well-cropped by cattle.		trefoil. The species is not included in this assessment.	
Swainsona murrayana Slender Darling Pea	BC Act – V	Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated.	2	**Unlikely** The species is closely associated with clay soils which are not present on the subject site. The subject site is therefore not considered important habitat for the species.	No
Dichanthium setosum Bluegrass	BC Act – V	Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland. Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture.	19	**Moderate** There is potential habitat for the species within the subject site, and the species is therefore included in this assessment.	Yes
Digitaria porrecta Finger Panic Grass	BC Act – E1	In NSW, the most frequently recorded associated tree species are *Eucalyptus albens* and *Acacia pendula*. Common associated grasses and forbs in NSW sites include *Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum* and *Neptunia gracilis*. Occurs on native grassland, woodlands or open forest with a grassy understorey, on richer soils.	76	**Unlikely** There is no woodland or open forest habitat within the subject site. The site has been subject to historical clearing and disturbance in the form of grazing. Grassed areas are not considered to constitute native grassland. It is therefore considered unlikely that the species would occur within the subject site.	No
Polygala linariifolia Native Milkwort	BC Act – E1	North from Copeton Dam and the Warialda area to southern Queensland. The species has been recorded from	1	**Low**	No

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		the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of *Eucalyptus caleyi, Eucalyptus dealbata* and *Callitris*, and in yellow podsolic soil on granite in layered open forest.		The subject site is outside of the species' range.	
Pomaderris queenslandica Scant Pomaderris	BC Act – E1	Widely scattered but not common in north-east NSW and in Queensland. It is known from several locations on the NSW north coast and a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolata. Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	10	**Low** The subject site is not considered important habitat for the species due to the lack of suitable habitat.	No
Philotheca ericifolia	BC Act – Not Listed	Known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW. The records are scattered over a range of over 400 km between West Wyalong and the Pilliga Scrub. Site localities include Pilliga East State Forest, Goonoo State Forest, Hervey Range, Wingen Maid Nature Reserve, Toongi, Denman, Rylestone district and Kandos Weir. Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops.	P	**Low** The subject site is outside of the species' range.	No
Zieria odorifera subsp. copelandii	BC Act – E4	*Zieria odorifera* subsp. *copelandii* is endemic to New South Wales. Its distribution is very highly restricted, known only from a single population in Mount Kaputar National Park near Narrabri. The number of mature individuals is estimated to be extremely low with surveys in 2012 and 2014 locating 15 individuals over an area of 1 hectare.	P	**Low** The subject site is outside of the species' range. While the subject site is in the vicinity of Mount Kaputar National Park, it is not within the boundary of the Park. The species' extremely restricted distribution leads to the conclusion that the subject site is not important for the species.	No
Thesium australe Austral Toadflax	BC Act – V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern	2	**Low**	No

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		Tablelands. Occurs in grassland or grassy woodland, often found in damp sites in association with Kangaroo Grass (*Themeda triandra*).		The subject site is unlikely to support the species given the paucity of suitable habitat.	
Cadellia pentastylis Ooline	BC Act – V	Occurs along the western edge of the North West Slopes from north of Gunnedah to west of Tenterfield. Also occurs in Queensland. Ooline is a medium-sized spreading tree usually about 10 m tall, and rarely to 25 m. It forms a closed or open canopy mixing with eucalypt and cypress pine species.	79	**Low** The species was not recorded on the site during site inspection. The site has been subject to clearing and disturbance and is not considered important habitat for the species.	No
Communities					
Artesian Springs Ecological Community in the Great Artesian Basin	BC Act – E4	Naturally restricted to the artesian springs of the Great Artesian Basin in north-western NSW. The springs occur where artesian water emerges at the surface through fault-lines in the overlying rock and produce mounds from the salts and sediments as the water evaporates. The vegetation within the community frequently consists of sedges or similar vegetation, however, trees and shrubs may be adjacent to the springs or nearby.	P	**Low** There are no artesian springs within or in the vicinity of the subject site.	No
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	BC Act – E3	The Brigalow community is a low woodland or forest community dominated by Brigalow (*Acacia harpophylla*), with pockets of Belah (*Casuarina cristata*) and Poplar Box (*Eucalyptus populnea subsp. bimbil*). Scattered remnants on the North West Slopes and Plains and Darling River Plains in NSW. This community has been extensively cleared for agriculture, with most surviving remnants along roadsides and paddock edges.	K	**Low** An appraisal of the woodland/forest habitat within and immediately adjacent to the subject site did not reveal the presence of this EEC.	No
Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South Bioregions	BC Act – E3	The Ooline community is an unusual and distinctive forest community with the canopy dominated by the tree Ooline (*Cadellia pentastylis*). The understorey is made up of a range of shrubs, such as Wattles (*Acacia* spp.), and grasses. Extensively cleared and now known from only seven main locations on the North West Slopes in NSW, between	K	**Low** An appraisal of the woodland/forest habitat within and immediately adjacent to the subject site did not reveal the presence of this EEC.	No

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		Narrabri and the Queensland border, and also in Queensland.			
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	BC Act – E3	Tall woodland or open forest dominated by Fuzzy Box *Eucalyptus conica*, often with Grey Box *Eucalyptus microcarpa*, Yellow Box *Eucalyptus melliodora*, or Kurrajong *Brachychiton populneus*. Buloke *Allocasuarina luehmannii* is common in places. Shrubs are generally sparse, and the groundcover moderately dense, although this will vary with season. Occurs in the Alluvial soils of the South West Slopes, Brigalow Belt South and Darling Riverine Plains Bioregions.	K	**Low** An appraisal of the woodland/forest habitat within and immediately adjacent to the subject site did not reveal the presence of this EEC.	No
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	BC Act – E3	Inland Grey Box Woodland includes those woodlands in which the most characteristic tree species, *Eucalyptus microcarpa* (Inland Grey Box), is often found in association with *E. populnea* subsp. *bimbi*l (Bimble or Poplar Box), *Callitris glaucophylla* (White Cypress Pine), *Brachychiton populneus* (Kurrajong*), Allocasuarina luehmannii* (Bulloak) or *E. melliodora* (Yellow Box), and sometimes with *E. albens* (White Box). Shrubs are typically sparse or absent, although this component can be diverse and may be locally common, especially in drier western portions of the community. A variable ground layer of grass and herbaceous species is present at most sites. At severely disturbed sites the ground layer may be absent. The community generally occurs as an open woodland 15–25 m tall but in some locations the overstorey may be absent as a result of past clearing or thinning, leaving only an understorey.	K	**Low** An appraisal of the woodland/forest habitat within and immediately adjacent to the subject site did not reveal the presence of this EEC.	No
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-	BC Act – E3	This ecological community is scattered across the eastern parts of the alluvial plains of the Murray-Darling river system. Typically, it occurs on red-brown earths and heavy textured grey and brown alluvial soils within a climatic belt receiving between 375 and 500 mm mean annual rainfall.	K	**Low** An appraisal of the woodland/forest habitat within and immediately adjacent to the subject site did not reveal the presence of this EEC.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Darling Depression, Riverina and NSW South Western Slopes bioregions		The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history. The tree layer grows up to a height of about 10 metres and invariably includes *Acacia pendula* (Weeping Myall or Boree) as one of the dominant species or the only tree species present.			
Native Vegetation on Cracking Clay Soils of the Liverpool Plains	BC Act – E3	This community is located around Coonabarabran, Gunnedah, Murrurundi, Narrabri, Tamworth and Quirindi, on the North West Slopes and Plains of NSW. The vast majority of this vegetation community has been converted through agriculture and no examples are within conservation reserves. Most surviving remnants of the community are on Travelling Stock Routes.	K	**Low** An appraisal of the woodland/forest habitat within and immediately adjacent to the subject site did not reveal the presence of this EEC.	No
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	BC Act – E3	A low, dense form of dry rainforest generally less than 10 m high, made up of vines and rainforest trees as well as some shrubs. The main canopy is dominated by rainforest species such as Red Olive Plum (*Cassine australis* var. *angustifolia*), Wilga (*Geijera parvifolia*) Native Olive (*Notelaea microcarpa* var. *microcarpa*) and Peach Bush (*Ehretia membranifolia*), with taller eucalypts and cypress pines from surrounding woodland vegetation emerging above the main canopy.	K	**Low** An appraisal of the woodland/forest habitat within and immediately adjacent to the subject site did not reveal the presence of this EEC.	No
White Box Yellow Box Blakely's Red Gum Woodland	BC Act – E3	White Box Yellow Box Blakely's Red Gum Woodland is an open woodland, in which the most obvious species are one or more of the following: White *Box Eucalyptus albens*, Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi*. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. Shrubs	K	**Low** An appraisal of the woodland/forest habitat within and immediately adjacent to the subject site did not reveal the presence of this EEC.	No

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Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		are generally sparse or absent, though they may be locally common. Remnants generally occur on fertile lower parts of the landscape where resources such as water and nutrients are abundant.			

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Appendix 9: Traffic Impact Assessment

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Traffic Impact Assessment

1 Introduction

The following provides a Traffic Impact Assessment for the proposed expansion of Wave Hill Quarry. This assessment has been prepared in response to requirements under the *Environmental Planning and Assessment Act 1979* based on the Secretary's Environmental Assessment Requirements (SEARs).

1.1 Aims and Objectives

This assessment aims to identify the likely impact of the proposed development upon the wider road network of the region. Impacts considered include impacts to the road network itself (road condition), the functionality of the road network (road safety and traffic volumes) and amenity impacts of changes to the road network (traffic noise). The assessment also outlines traffic considerations with regard to the design of the quarry (adequacy of on-site parking provision, internal traffic circulation and site access to the public road network).

The proposed objectives for Wave Hill Quarry are to:

- Ensure the delivery of aggregate materials from the quarry can be achieved in an efficient and financially competitive manner;
- Minimise the impact on roads used as haul routes; and
- Minimise traffic conflict with other road users.

2 Background

The Wave Hill quarry commenced operations in the mid-1980's with the original approval being issued in about 1987. A survey of the available basalt resource indicated the potential for between 3 and 5 million tonnes of high-quality material available on this site with the current infrastructure in place.

Wave Hill currently holds development approval (DA60-2013) for the extraction of up to 200,000 tonne of material per year. The issue date of this approval is June 2014.

At present, the quarry supplies processed basalt from Wave Hill to the proponent's ready mixed concrete, pre-coated bitumen and landscape business on the eastern edge of Narrabri in addition to a range of construction sites, rail ballast and roadworks being undertaken by Council, Transport NSW and a range of private developments within the Narrabri region.

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The Inland Rail project is planned to commence in late 2020 and intends to source gravel and ballast material from local quarries that are capable of supplying suitable material. The rail project requires a range of gravel materials including road base and rail ballast. The initial section proposed will extend from Narrabri to North Star. Wave Hill quarry is currently targeted by contractors as a source of hard rock material for this project. The quantity of material to be hauled from Wave Hill is uncertain as no contracts have been issued due to the fact that final contracts are incomplete. Preliminary estimates suggest up to 300,000 tonne of gravel material will be sourced from the Narrabri region for the Narrabri to Bellata section of the track. Other quarries being targeted for this material include a quarry located in the Gunnedah Shire and quarries further to the north within the Moree Plains and Gwydir Shires. The Rail contractors have requested that all quarries suppling gravel to the Inland Rail project have approval to despatch up to 500,000 tonne of quarry material per year. Several other established and proposed quarries are vying for supply contracts and therefore the expectation is that each quarry that obtains an approval will share part of the supply contract. Other suppliers will haul material through the Shire, but the quarry sites will be located outside of the Shire.

The second stage of the Inland Rail project will involve construction of the line between Narrabri and Narromine. The source of gravel for this section is yet to be determined but some may be delivered from Wave Hill if transport costs are competitive with gravel materials from the southern and central sector of this stage of the Inland Rail.

Other regional projects include regular upgrades of the Newell and Kamilaroi Highways in addition to local roadwork undertaken by Councils.

3 Existing Operations

Wave Hill quarry has an existing crushing capacity in the order of 2,000 tonnes per day. At present quarry material is crushed and stockpiled onsite for a range of projects. The proposed expansion of annual production from the facility will involve more continuous crushing at the same daily rate from the currently approved quarry footprint. Stockpiled material would then be delivered to ongoing projects (Council, Transport NSW, private works) in addition to the contracts obtained for Inland Rail.

Transport from the quarry generally occurs in campaigns involving regular deliveries to projects within the surrounding Shire and larger campaigns for deliveries to larger projects such as significant road upgrades.

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At present, JCLS utilise a range of truck combinations to haul material from the quarry. This includes trucks hauling material through the Narrabri town area via Old Gunnedah Road. Trucks include semi-trailers and Truck & Dog (PBS) combinations. Truck and dog combinations must not exceed a total length of 19m. These trucks are accepted for deliveries at most work sites and carry a payload of up to 38 tonnes.

The current development approval does not identify a limit on truck numbers other than the annual extraction limit. It was estimated that the extraction of up to 200,000 tonnes per annum would result in an Average Annual Daily Traffic (AADT) of 34 one-way truck movements (17 trucks) per day. This is based on the following table.

Table 1: Calculation of average annual truck movements from Wave Hill Quarry for 200,000 tonnes of gravel material

Description	Parameter
Annual Production Limit	200,000 tonnes
Truck capacity	38 tonnes
Number of truck movements (1-way) required per annum	5,263 trucks
Potential available working days	307
Average trucks per day	17
AADT	34
Average product moved per day	646 tonnes
Peak movement for 2,000 tonnes per day	53
Peak AADT	106

An average truck movement takes approximately two hours to deliver and then return to the quarry. The quarry can start despatching trucks at 7:00am and the last truck must leave by 6:00pm Monday-Friday with the last truck departing at 5.30pm on Saturdays. During a peak haul period, this allows 11 hours to despatch 2,000 tonne and 12-hours to deliver loads. Allowing for a 38-tonne tare load, up to 53-truck movements occur to and from the quarry for delivery of 2,000 tonnes or the rounded off equivalent of 5-truck movements to and from the quarry per hour.

At maximum quarry production AADT generated by the quarry would be in the order of 34 trucks based on average annual production or 106 trucks based on a peak daily delivery of 2,000 tonnes. This would be equivalent to 3.1 and 9.6 truck movements per hour, respectively, based on an 11-hour day for truck movements.

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The Quarry has a Voluntary Planning Agreement in place with Council which involved funding arrangements for the upgrade of sections of Wave Hill Road to a sealed condition and payment of a contribution levy per tonne for road maintenance on selected roads.
Discussions with Council has resulted in agreements to limit truck sizes and operation times through the Narrabri town area. The alternative haul route approved by Council is via Turrawan Road. This is generally utilised for gravel projects to the east of Turrawan. Truck size on Turrawan Road is limited to the same size of truck that is approved for travel through Narrabri. At present, the quarry is not approved to use road trains or extended truck and dog combinations with three trailers.

4 Proposed Traffic Generation

It is expected that Wave Hill Quarry will be able to provide a cost competitive product to the Inland Rail Project between Narrabri and Bellata. The current proposal for Inland Rail involves deliveries to various stockpiles via the Newell Highway as the rail runs parallel to the highway. This JCLS proposal involves delivery of product at an average rate of 2,000 tonnes per day using the most efficient truck size that is permissible along the haul route. It is expected that on occasions, daily deliveries in excess of 2,000 tonne may be required.

The expansion on annual haulage of materials from Wave Hill Quarry will aim to have a peak daily despatch rate of 2,000 tonnes. This includes current contracts for daily deliveries into the Narrabri town region and deliveries of gravel material to larger projects such as the Inland Rail proposal. The Inland Rail proposal may involve up to 300,000 tonne of gravel from local suppliers over an 18-month period.

The truck movements from Wave Hill Quarry will be limited to daily production from the equipment onsite. The Proponent has advised that no additional crushing equipment will be installed to meet larger contracts. The intention is to utilise existing capacity which is limited to an average of 2,000 tonnes to be processed per 11-hour day, 6-days per week.

The following table presents a summary of predicted heavy traffic movements for existing and proposed quarry operations.

Table 2: Existing and Proposed Average Heavy Traffic Movements

Truck size	Load Weight	Existing Average Movements per day	Proposed Average Movements per day
Annual Extractions		200,000 tonnes	500,000 tonnes
Working days available		307	307

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Truck size	Load Weight	Existing Average Movements per day	Proposed Average Movements per day
Truck and Dog	38-tonnes	17	17
Road Train	60-tonnes	0	16
Daily Tonnage moved		646	1629
AADT		34	66
Movement per hour (11-hour day)		3.1	6

Table 3: Peak Truck Movements for 2,000 tonnes per day

Truck size	Load Weight	Existing Average Movements per day	Proposed Average Movements per day
Daily peak despatch		2,000 tonnes	2,000 tonnes
Truck and Dog	38-tonnes	53	6
Road Train	60-tonnes	0	30
AADT		106	72
Movement per hour (11-hour day)		9.6	6.5

The proposed development will involve doubling of average annual truck movements from Wave Hill if the full 500,000 tonnes of material is moved each year. The calculation allows for an increase is truck loads and therefore traffic is not increased proportionally. The larger trucks would not be approved to travel through Narrabri on existing haul routes and would therefore use purpose-built roads to access local Highways.

In peak periods, the proposed haul route changes will allow the use of larger trucks and therefore larger truck loads. Peak truck activity at present would generate an AADT of up to 106 vehicle movements along the haul routes. By utilising alternative haul routes, peak AADT would be 68-percent of the existing potential maximum AADT. The assumption used in this calculation is that some of the despatched material would continue to be hauled by the existing truck units carrying approximately 38-tonnes. If all gravel was despatched in road trains for a peak campaign day, the peak daily AADT would be reduced to 62-percent of current truck numbers. This could potentially occur for the larger projects, such as Inland Rail. However, an allowance of 6-truck movements for supply of material to the JCLS enterprise within Narrabri has been retained in Table 3.

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5 Existing Road Conditions

5.1 Description of the Existing Quarry Haul Routes

The quarry received development approval to expand the original footprint and annual production to 200,000 tonnes in 2013. All major works required to be installed for this approval were completed after the approval was issued. This included bitumen sealing of part of Wave Hill Road and the entrance to the quarry between Wave Hill Road and the weighbridge at the quarry for dust suppression and noise reduction purposes relating the amenity and safety of an adjoining landowner and other road users.

One section remains to be sealed as part of the agreement with Council. This involves linking the existing bitumen seal between Boral quarry and the end of the bitumen from Waroi over approximately 1.5 km. Construction of this section of bitumen has been agreed to by the applicant and Council.

The agreed haul routes from this quarry include through Narrabri town streets and Turrawan Road. Both routes have truck size limits due to road width and geometry at specific intersections, in addition to operations during school hours through Narrabri. Wave Hill Quarry traffic cannot use Wave Hill Road to the east of the site without Council approval relating to small local projects. Once trucks access either the Newell or Kamilaroi Highways, haulage routes then become limited to the same as all other heavy vehicles.

Trucks used by the quarry at present are limited to 19m articulated and PBS vehicles at CML.

5.1.1 Site Access on Local Council Roads

The access road between the Wave Hill weighbridge area and Wave Hill Road has been bitumen sealed in accordance with Council requirements. The purpose of this was to reduce dust and reduce any traffic conflict for trucks entering Wave Hill Road from the quarry. The following image provides a recent photograph of the intersection. It has been designed and constructed in accordance with Council requirements.

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Figure 1: Entrance to Wave Hill Quarry from Wave Hill Road (2020)

The current development approval restricts any truck movements from the quarry to turn left onto Wave Hill Road other than local projects where Council permission for use of this road is obtained. The bitumen extends from approximately 50m east of the Wave Hill Quarry entrance to the intersection into the Boral Quarry to the west.

Trucks from the quarry travel along Wave Hill Road and then turn right onto Maules Creek Road for a distance of approximately 2.6 km before reaching Old Gunnedah Road (SR10). The intersection of Maules Creek Road and Wave Hill Road consists of a wide intersection designed by Council to cater for trucks. The section of Wave Hill Road was utilised by three quarries, mainly Waroi (Council quarry now closed), Boral Quarry (not currently active to full extraction limit) and Wave Hill Quarry. The majority of traffic from Wave Hill Road turns right onto Maules Creek road as can be identified in the following Figure 2 by the presence of loose gravel in the left turning corner.

Figure 2: Wave Hill Road intersection onto Maules Creek Road

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Truck travel along Maules Creek road to the Old Gunnedah Road. The intersection of Old Gunnedah and Maules Creek road is a divided intersection to cater for larger trucks and to encourage vehicles to approach the intersection at a right angle when turning right toward Narrabri.

Figure 3: Maules Creek Road intersection onto Old Gunnedah Road

At this point, the majority of existing Wave Hill traffic turns right toward Narrabri. Some material is hauled toward Turrawan and therefore turns left.

At present, Council is undertaking a significant upgrade of the bridge over the Namoi River onto Turrawan Road (SR61), with the expectation that truck traffic will be encouraged to travel to Turrawan to link with the Kamilaroi Highway in preference to traversing through the Narrabri town area onto the Newell Highway. Subject to weather, the bridge work is expected to be completed by July 2020.

The current approved haul routes allow Wave Hill Quarry trucks to turn left or right onto Old Gunnedah Road. Due to the current restrictions on Turrawan Road, most quarry trucks turn toward Narrabri to link with the Newell or Kamilaroi Highways.

These haul roads from the quarry to the edge of Narrabri have a 100 km/h speed limit. The majority of trucks do not reach this speed. The only narrow section of SR10 is considered to be the Bullawa Creek bridge which has a pavement width of 6.8m. The remainder of the road has a general width of between 7.1m and 7.2m subject to minor edge wear and tear.

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Figure 4: Bullawa Creek bridge – deck width of 6.8m

Old Gunnedah Road has an 80 km/h speed limit between Arnold Street and the JCLS concrete batching works. Speed is reduced to 50 km/h once trucks enter Narrabri past Arnold Street.

The majority of SR61 has a pavement width of between 6.8m and 7.2m. Council has advised that this will be the subject of an upgrade so that the road is approved for road trains. The minimum width is therefore to be extended to 7.2m. The work is presently extending along SR61 to the Kamilaroi Highway to ensure road width is satisfactory for larger trucks, including road trains. The intersection of Turrawan Road and the Kamilaroi Highway is currently being reconstructed to Transport NSW standards to allow road train access onto and off the Highway. This will be an identified heavy haulage route for quarry material and other heavy vehicles. The work is being undertaken to reduce the requirement for large trucks to enter the eastern side of Narrabri and then travelling through residential parts of Narrabri to avoid the main street precinct.

5.2 Trucks within Narrabri

Quarry trucks are permitted to travel through Narrabri to access the Newell Highway. Wave Hill trucks continue to utilise both Tibbereena and Barwan Streets through Narrabri. Tibbereena Street has a traffic issue at the junction with the Newell Highway due to traffic congestion from the amount of traffic using the Newell Highway. Council has imposed a policy that Wave Hill trucks cannot turn left but have significant difficulty (waiting time) to drive north onto the Newell Highway between about 7.30 am and 5.30 pm, when local Narrabri traffic adds to the flow of vehicles on the Newell Highway. This intersection is generally avoided by Wave Hill quarry trucks if possible.

Barwan Street provides a direct route to the Newell Highway where trucks can continue north or turn south at the intersection with the Newell highway at Killarney Street. This intersection

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was once a roundabout which allowed local traffic to flow from Barwan Street, but the intersection has now been modified to provide a cleaner flow of traffic on the Newell Highway. Killarney Street has no access onto the Highway. A give-way sign has been placed on Barwan Street. The following image provides a recent photograph of the intersection from Barwan Street. Gravel trucks are permitted by Council to turn left onto the Newell Highway or travel straight north.

Figure 5: Newell Highway intersection from Barwan Street

Trucks generally enter Barwan Street via Fitzroy Street to avoid the roundabouts installed by Council at Bowen Street. Trucks do not enter the main street area of Narrabri. Barwan Street has a 40 km/h zone past as school and a pedestrian crossing. Stop signs are present on Doyle Street and crossing of Fitzroy Street. The majority of local trucks from the Narrabri east industrial area and from Old Gunnedah Road utilise this street for access to and from the Newell Highway due to the issues of traffic at the Tibbereena Street intersection.

Once onto the Newell Highway, gravel trucks are subject to the same rules as all other vehicles in relation to load limits, speeds, and truck dimensions.

5.3 Quarry Site Parking Supply

All quarry traffic must pass the weighbridge and office. Trucks are required to weigh in and out to ensure correct weights are recorded. Staff vehicles generally park adjacent to the site workshop in a designated parking area established under the WH&S plan for the site operation. There are more than 10-parking spaces available for staff and visitors, located adjacent to the workshop area which is outside of the main traffic path for haulage trucks. Service vehicles generally travel to the service site. Other larger vehicles such as front-end loaders, excavators and the heavy dump truck are parked adjacent to their working area.

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Haulage trucks do not generally park onsite other than when waiting to be loaded or being repaired (flat tyres). The haulage trucks have designated internal one-way passage through the crushing and stockpile area. This varies according to load types and materials being hauled from the site.

6 Proposed Haulage Routes

Council has advised that Turrawan Road will be the preferred haul route for larger trucks if the quarry wishes to utilise more efficient truck sizes for larger volumes of gravel. This has been agreed to by the applicant in pre-lodgement discussions with Council staff. This approval for larger trucks will extend between Wave Hill Quarry and the Turrawan highway intersection. Once at this point, the truck size will be subject to Transport NSW permissions. Advice provided to date indicates that Transport NSW will allow road trains to utilise the Kamilaroi Highway between Gunnedah and Narrabri subject to permit applications and further consideration of road conditions. This is expected to include permits for Road Trains running at Concessional Mass Limit (CML) with the potential load weights of up to 63-tonnes.

The Applicant's intent is to maintain the existing agreement for travel of semi-trailers and truck & dog combinations through Narrabri for local work and some smaller campaigns. This will include deliveries of gravel to local projects for Council and Transport NSW. For large tonnage contracts obtained for Inland Rail and the Newell Highway works, both south and north of Narrabri, truck combinations will include PBS A-doubles (road trains). The proposal will potentially include trucks with 3-axle prime mover, and 3x3x3 axle combinations for the trailers. These larger trucks will have a capacity to haul approximately 60 tonne of gravel per load, subject to trailer weights.

These larger A-double trucks will be restricted to using Turrawan Road and the Kamilaroi Highway to access the Newell Highway. Preliminary discussions with Council have indicated that this route will be approved for A-doubles once the Tariaro Bridge is completed. This approval will extend between Wave Hill quarry and Turrawan. The intersection of Turrawan Road and the Kamilaroi Highway is being upgraded to cater for this increase in truck size. The agreement to upgrade the Turrawan intersection has resulted from Council preferences to reduce the truck traffic within the central Narrabri area by providing an alternative route to link with the Newell Highway. The Kamilaroi Highway would also be approved for A-double use. This action has been taken to allow quarry operators between Gunnedah and Narrabri the option of delivering to Inland Rail projects with efficient truck sizes.

Figure 6 shows the existing and proposed haul routes from Wave Hill Quarry.

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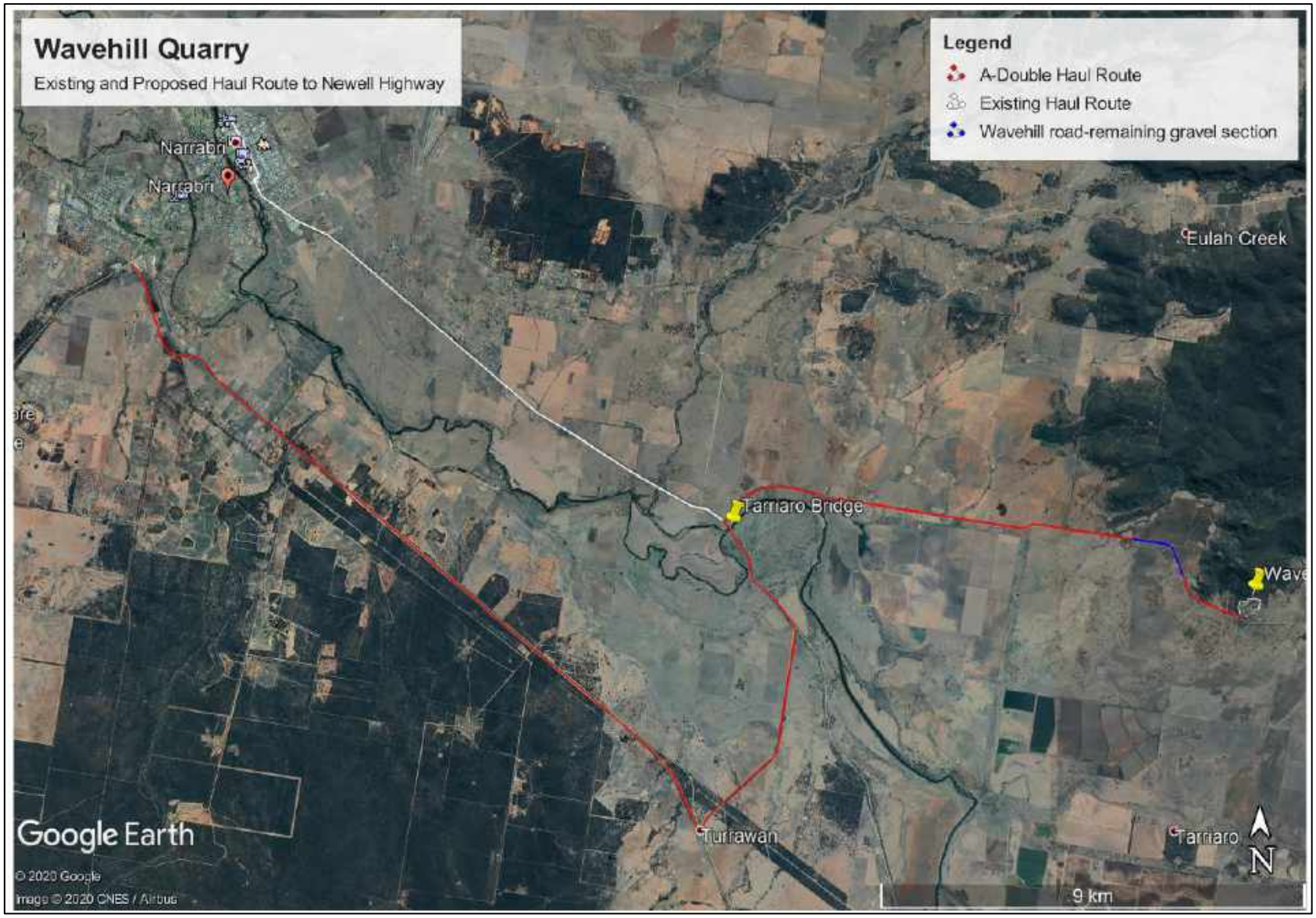

Figure 6 : Proposed and Existing Haul Routes from Wave Hill Quarry

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7 Traffic Volumes Recorded on Current Haul Route

7.1.1 Data Availability

The current haul route consists of Wave Hill Road, Maules Creek Road and Old Gunnedah Road. Traffic data is available for Wave Hill Road and Old Gunnedah Road.

Traffic data is available for Wave Hill Road between the following times:

- Thursday 25 September 2014, 12:23pm; to
- Thursday 2 October 2014, 12:23pm.

Data available for Wave Hill Road includes seven full days (where data from Thursday 25 September and Thursday 2 October are combined to form a full day). It is noted that the dataset incorporates Monday 1 October, which is a public holiday, during which Wave Hill Quarry would not normally operate.

Traffic data is available for Old Gunnedah Road between the following times:

- Tuesday 11 July 2017, 11:28am; to
- Wednesday 23 August 2017, 1:35pm.

Data available for Old Gunnedah Road includes 42 full days and 2 partial days. For calculation purposes, only full day data has been considered below.

The following matters are to be considered when interpreting traffic data:

- The Wave Hill Road dataset is particularly short, and therefore does not reflect temporal variability in road traffic;
- Both datasets only record one-way traffic (northbound on Wave Hill Road, and eastbound on Old Gunnedah Road). It is estimated that the total (two-way) AADT of each road would be approximately double the AADT of the recorded data presented below;
- The traffic generation of Wave Hill Quarry varies significantly over time, and quarry production volumes during the period of data recording along each road is unknown;
- The traffic generated from neighbouring traffic generating developments (including Boral Quarry and agricultural enterprises) during the period of data collection is also unknown; and
- The data uses Austroads Vehicle Classifications from 1 to 12 (Copy attached in Appendix 1). This does not allow for some modern truck combinations available.

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7.1.2 Wave Hill Road Traffic Data

Table 4 shows traffic data recorded for Wave Hill Road. The data is separated into vehicle classes. It is noted that vehicles currently used by Wave Hill Quarry are the equivalent of Class 9 vehicles. Table 5 shows the average AADT for Wave Hill Road. Table 6 outlines vehicle classes as a percentage of total daily AADT throughout the week.

Table 4: Wave Hill Road Recorded North Bound Traffic Data 25/9/2014 - 2/10/2014

	Vehicle Class* - Number Recorded												AADT
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Monday (Public Holiday)	44	0	0	0	0	0	0	0	0	0	0	0	44
Tuesday	67	0	8	14	0	0	3	0	144	18	0	0	254
Wednesday	65	3	9	19	1	0	1	0	123	23	0	0	244
Thursday	67	1	11	18	1	0	1	0	113	16	0	0	228
Friday	46	3	13	11	1	0	0	0	101	12	2	0	189
Saturday	55	0	13	2	0	0	3	0	86	12	0	0	171
Sunday	31	2	4	0	0	0	0	0	48	5	0	0	90

*Vehicle classes are defined as: 1-2: Light Vehicles; 3-5: Light Commercial Vehicles; 6-9: Articulated Vehicles; 10: B-Doubles; 11-12: Road Trains

Table 5: Average AADT Calculated for Wave Hill Road (North Bound)

Averaging Period	Average AADT
Monday* – Sunday (7 Days)	174.3
Monday* – Friday (5 Days)	191.8
Saturday – Sunday (2 Days)	130.5

*Where Monday is a public holiday

Table 6: Wave Hill Road Recorded North Bound Vehicle Class Percentage of AADT

	Vehicle Class* - Percentage of AADT (%)												AADT
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Monday (Public Holiday)	100	0	0	0	0	0	0	0	0	0	0	0	44
Tuesday	26	0	3	6	0	0	1	0	57	7	0	0	254
Wednesday	27	1	4	8	0	0	0	0	50	9	0	0	244
Thursday	29	0	5	8	0	0	0	0	50	7	0	0	228

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	Vehicle Class* - Percentage of AADT (%)												AADT
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Friday	24	2	7	6	1	0	0	0	53	6	1	0	189
Saturday	32	0	8	1	0	0	2	0	50	7	0	0	171
Sunday	34	2	4	0	0	0	0	0	53	6	0	0	90

*Vehicle classes are defined as: 1-2: Light Vehicles; 3-5: Light Commercial Vehicles; 6-9: Articulated Vehicles; 10: B-Doubles; 11-12: Road Trains

Results indicate that heavy vehicles often account for the majority of traffic along Wave Hill Road, with the majority of vehicles being Class 9 vehicles.

Based on the above data, the maximum number of gravel trucks moving north along Wave Hill Road can be as high as 114 at present. Based on current potential peak production from Wave Hill, approximately 53 of these trucks could have been generated from Wave Hill quarry. This accounts for less than half of the total Class 9 vehicle traffic movements recorded from Tuesday to Saturday during the recording period. It is noted that the quarry does not transport materials on Sundays or public holidays, and therefore the heavy vehicle movements recorded on these days would be due to traffic generated by surrounding enterprises.

For the increased annual tonnage, the potential exists to reduce overall truck numbers on peak days from 53 to 36. Annual average truck movements based on moving 200,000 or 500,000 tonnes would involve 17 and 33 trucks respectively (16-more trucks per day). For one-way travel based on the Council AADT numbers, this represents an increase in AADT of 8-percent.

Allowing for the average week-day traffic to utilise the road over a 14-hour day, average hourly movements would be in the order of 13.7 vehicles. Allowing an 8-percent increase would result in 14.8 vehicles per hour on average. This would include the annual averages of 3.1 and 6 truck movements per hour for the existing and proposed operations from the quarry. When road trains are utilised for haulage of the larger volumes of gravel, the peak hourly traffic generated by the quarry would remain at approximately 6.5 trucks per hour along Wave Hill Road. This is similar to the existing traffic volume calculated for Wave Hill production with current vehicle combinations during peak despatch campaigns.

Therefore, whilst Wave Hill Quarry undoubtedly contributes to traffic generation on Wave Hill Road, results indicate that when the Quarry is operating at its maximum capacity, the Quarry accounts for less than 28% of all traffic (AADT) along Wave Hill Road each day from Monday

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to Friday and slightly more on Saturdays due to lower local traffic volumes. The overall average increase in traffic is identified to be 8-percent as a result of the use of larger trucks.

7.1.3 Old Gunnedah Road Traffic Data

Table 7 shows the average daily traffic for each vehicle class recorded between 12/7/2018 and 22/8/2017 (inclusive).

Table 8 shows the calculated AADT for Old Gunnedah Road, based on the data presented in Table 7. Table 9 outlines vehicle classes as a percentage of total daily AADT throughout the week.

Table 7: Old Gunnedah Road Recorded East Bound Traffic Data 12/7/2017 – 22/8/2017

	Vehicle Class* - Average Number Recorded												AADT
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Monday	771	29	346	32	11	8	12	6	25	14	0	0	1254
Tuesday	799	24	363	28	10	8	9	4	24	18	1	0	1287
Wednesday	805	27	330	34	10	8	8	6	40	14	1	0	1283
Thursday	807	28	341	21	11	8	8	5	46	17	0	0	1291
Friday	801	26	311	27	9	10	8	6	44	10	0	0	1252
Saturday	611	31	231	6	2	10	5	1	6	1	0	0	904
Sunday	591	31	230	3	2	11	5	1	2	0	0	0	874

*Vehicle classes are defined as: 1-2: Light Vehicles; 3-5: Light Commercial Vehicles; 6-9: Articulated Vehicles; 10: B-Doubles; 11-12: Road Trains

Table 8: AADT Calculated for Old Gunnedah Road (East Bound)

Averaging Period	AADT
Monday – Sunday (7 Days)	1,163.5
Monday – Friday (5 Days)	1,273.2
Saturday – Sunday (2 Days)	889.2

Table 9: Old Gunnedah Road Recorded East Bound Vehicle Class Percentage of Daily AADT

	Vehicle Class* - Percentage of AADT (%)												AADT
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Monday	61	2	28	3	1	1	1	0	2	1	0	0	1254
Tuesday	62	2	28	2	1	1	1	0	2	1	0	0	1287
Wednesday	63	2	26	3	1	1	1	0	3	1	0	0	1283
Thursday	63	2	26	2	1	1	1	0	4	1	0	0	1291
Friday	64	2	25	2	1	1	1	0	3	1	0	0	1252

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	Vehicle Class* - Percentage of AADT (%)												AADT
	1	2	3	4	5	6	7	8	9	10	11	12	
Saturday	68	3	26	1	0	1	1	0	1	0	0	0	904
Sunday	68	4	26	0	0	1	1	0	0	0	0	0	874

*Vehicle classes are defined as: 1-2: Light Vehicles; 3-5: Light Commercial Vehicles; 6-9: Articulated Vehicles; 10: B-Doubles; 11-12: Road Trains

The majority of traffic along Old Gunnedah Road consists of light vehicles and light commercial vehicles, with heavy vehicles comprising less than 10% of the total number of vehicles on the road. Of heavy vehicles present, the majority are Class 9 vehicles, which account for between 1% to 4% of AADT from Monday to Saturday. Heavy traffic movements along this road are considered as minor. The potential change resulting from change in operations at Wave Hill quarry is considered to potentially make a 1% change in traffic volumes. The use of Turrawan Road by larger trucks from the quarry will potentially reduce the heavy traffic volume during campaign periods. However, it is predicted that the number of heavy vehicles hauling gravel from the quarry into Narrabri will remain at a similar level in order to service Narrabri town area activities, including supply of gravel to the JCLS Ready Mixed Concrete enterprise.

7.2 Traffic Safety Statistics

The NSW Centre for Road Safety provides crash statistics for all reportable accidents within Narrabri Shire Council from 2013-2017. Mapping of reportable accidents in Narrabri Shire Council is presented in Figure 7.

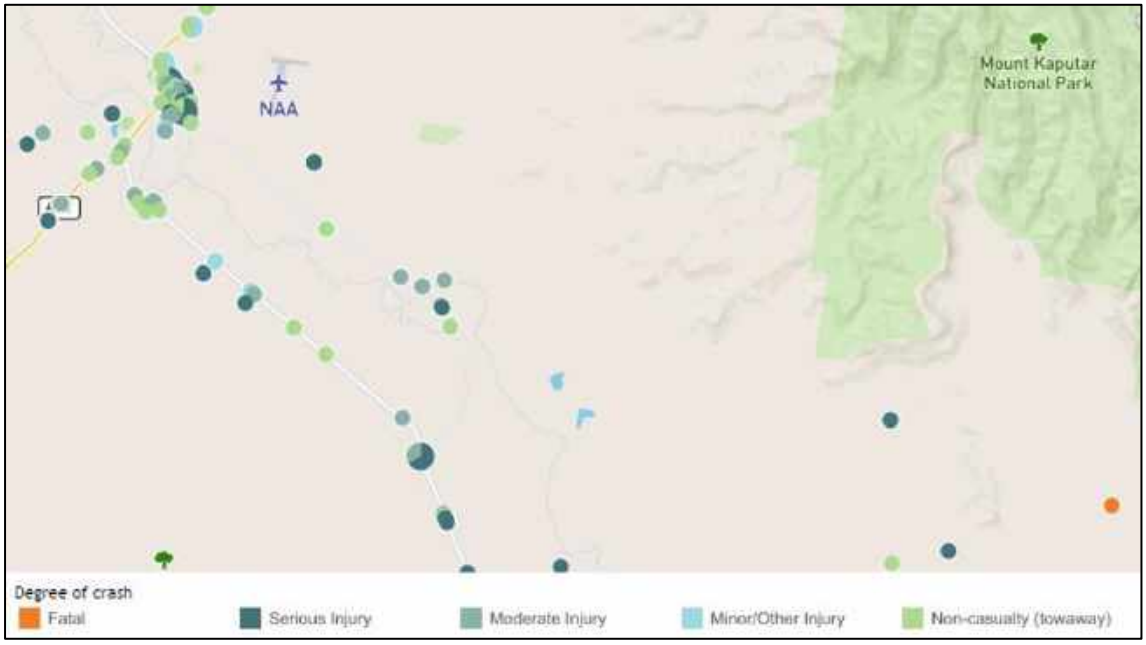

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Figure 7: Reportable Crash Statistics, 2013-2017

Figure 7 indicates that there are a low number of traffic incidents on Wave Hill Road, with one reportable incident occurring to the east of the quarry (outside of the quarry's haul route). The low number of traffic incidents is likely to be a result of the low traffic density on this road. No accidents occurred within the immediate vicinity of the quarry.

From 2013 to 2017, there was one reportable incident on Maules Creek Road (between the intersection with Wave Hill Road and Old Gunnedah Road), and three reportable incidents on Old Gunnedah Road (between the intersection with Maules Creek Road and the boundary of Narrabri). Of the incidents which occurred on Old Gunnedah Road, none of the three incidents occurred in the same location, which suggests that there is no particular location at which the condition of the road is unsafe in such a way as to lead to the occurrence of accidents.

The area with the highest number of reportable accidents is within the township of Narrabri, and along major roads such as the Kamilaroi Highway. The high number of incidents in these localities is likely to be the result of a high traffic density in these locations.

The Turrawan road intersection onto the Kamilaroi Highway has several reported incidents, including serious incidents. The configuration of this intersection has been recognised as an issue by both Transport NSW and Council. The intersection has poor sight distance to the west and to date it has no turning lanes and poor geometry onto the highway (not perpendicular). This intersection is being modified to meet current guidelines, including left and right turning lanes. This should resolve existing traffic safety issues.

7.3 Proposed Developments in the Vicinity

Information provided by the Narrabri Shire Council has indicated that there are no new traffic generating developments within the vicinity of Wave Hill Quarry. Existing traffic in the area is generated from the Boral quarry to the west of Wave Hill quarry and traffic generated from local farms.

Traffic generated from coal mining to the east has limited access to the local road network, including Wave Hill Road. Some local suppliers of gravel that do not have Voluntary Planning Agreements are not restricted along Wave Hill Road, other than self-imposed limits. Truck traffic from farms tends to travel towards the Kamilaroi Highway or more major roads such as Maules Creek road to haul produce from farming operations.

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The Boral Quarry EPL identifies an annual extraction limit of 100,000 tonnes. Table 10 provides an estimate of average annual daily truck movements for the quarry based on the movement of 100,000 tonnes of quarry material over a 12-month period.

Table 10: Boral Quarry – Estimate of average annual truck movements

Description	Parameter
Annual Production Limit	100,000 tonnes
Truck capacity	38 tonnes
Number of truck movements (1-way) required per annum	2,632 trucks
Potential available working days	307
Average trucks per day	8.6
AADT	17.2
Average product moved per day	327 tonnes

The quarry may generate an average of 8.6 truck movements per day or less than 1-truck movement per hour on average. This would be added to the existing and proposed truck movements from Wave Hill Quarry along Wave Hill Road. Table 2 presents the same calculation for existing and proposed truck movements from Wave Hill Quarry, which is 17 and 33 trucks per day, respectively. The addition of the Boral trucks would increase truck movements to approximately 25 and 41 for existing and proposed average annual operations. Both quarries would have peaks for specific gravel delivery campaigns.

Over an 11-hour delivery period, the hourly rate of combined truck movements would be 2.3 and 4.5 for existing and proposed average annual operations. Peak operations for the existing Wave Hill quarry are predicted to generate 9.6 trucks per hour at present and this would reduce to 6.5 trucks per hour once road trains are utilised for haulage via Turrawan Road. The cumulative effect of Boral generated truck traffic may add 1 additional truck movement per hour. This is approximately 10-percent of the predicted peak traffic movements from Wave Hill at present or 12-percent once road trains can be used from Wave Hill. The potential reduction in traffic volume once Wave Hill utilises road trains is a significant offset for truck movements along Wave Hill Road.

The Boral quarry would supply similar contracts to the Wave Hill quarry and therefore truck haul routes through the Shire would be similar.

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8 Impact on Road Network

8.1 Impacts on Road Condition

Heavy vehicle traffic from the proposed increase in annual tonnage of quarry material moved from Wave Hill will include larger trucks in the form of road trains. Road trains will utilise Wave Hill road, Maules Creek road, Old Gunnedah-Turrawan road and the Kamilaroi Highway to reach the Newell Highway. This haul route has been targeted in agreements between the Applicant and local road authorities in improvement works involving bitumen sealing, road widening and intersection improvements.

Wave Hill Road has been subjected to ongoing funding from the applicant through Council planning provisions. The road was constructed with a pavement depth approved by Council under previous development processes for Wave Hill Quarry. The intended pavement width is a minimum of 7.1m which is considered suitable for road trains. This will be consistent throughout the new haul route for heavier vehicles and major project deliveries.

Pavement depth has been designed to support the weight of heavy trucks and therefore minimise the potential degradation of subgrade materials. The bitumen surface will continue to have some decay from small potholes which are patched by Council on an as-required basis under current road maintenance funding.

Maules Creek road is traversed by the trucks for a distance of approximately 2.6 km. This road has been bitumen sealed for an extended period and has had some re-surfacing. This section of road includes a long-curved section. Truck speed is limited as a result of this curve and therefore the impact of loaded trucks is generally reduced when compared to trucks travelling at 100 km/h.

The section of Old Gunnedah Road to Turrawan is presently limited in width for road train access. Council has indicated that the road will be widened to support road trains. This may include upgrade of the pavement in sections showing some degradation of subgrade materials where the road may be subject to further decay under the weight of heavier trucks.

The primary source of road condition decay involves damage to road shoulders due to vehicles having to place their wheels off or directly on the edge of the road. The road shoulder breaks up as a result of the impact of wheels on the edge of the pavement. This can be avoided by having an appropriate pavement width so that vehicles can remain on the road and remain away from the shoulder areas. Council has indicated that roads along the primary haul route for larger projects involving the haulage of gravel from Wave Hill Quarry will be widened to

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meet current Austroads standards. This is generally in excess of the minimum of 7.1m. Modern roads are generally built with a minimum of an 8m wide pavement, where funding is available.

The existing haul route between Maules Creek Road and the eastern edge of Narrabri will continue to be used by Wave Hill trucks under current approvals. As identified above, this can involve up to 38-truck movements per day. It is noted that this represents a relatively minor amount of the existing traffic along this road. Survey of this road indicated an ongoing road shoulder issue in addition to some sections where the subgrade appears to be failing. This can be considered as typical of a bitumen sealed road across a shrinking and swelling black soil base material. This is a major service road between Narrabri and the farming operations to the east. Maintenance of this well-used road is an ongoing cost to Council. At present, Wave Hill quarry contributes to road maintenance on this section of road via gravel levies.

8.2 Impact on Traffic Volumes

For Wave Hill quarry truck traffic, the potential exists for truck numbers to be reduced as a result of the use of larger trucks. Basic calculations suggest a reduction from 53 trucks per day to 36 trucks per day for peak haulage days where 2,000 tonne of gravel product is moved. This is considered as beneficial to local road users in relation to traffic volumes, assuming the work to be done on the identified haul routes is completed. As these additional roads will be subject of permits, the larger trucks will not use the roads without permits being issued by local authorities.

Light traffic generation from Wave Hill Quarry will remain the same as the Proponent has identified that no changes will be made to daily production volumes. The existing staff onsite are considered capable of crushing and loading up to 2,000 tonne of quarry product at present.

8.3 Impact on Traffic Safety

Traffic safety issues have been identified along Wave Hill Road in the existing approval issued by Council. The primary issue related to dust emissions from the gravel sections of road and the intersection into the quarry site. Sealing of Wave Hill road between Maules Creek Road and the quarry will be completed as part of ongoing operations. This will eradicate dust issues in addition to road width issues.

Council requested design plans for Wave Hill Road prior to reconstruction and sealing of this road. The plans had been prepared in accordance with Austroads standards and therefore the

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design of the road is considered to meet current safety standards. No specific issues have been identified along this road in relation to intersections, road geometry or potential sight distances. Sealing of the road has removed dust issues and therefore improved road safety.

The intersection into the quarry has been upgraded to meet Council requirements. These included modification of the geometry of the intersection to ensure that trucks leaving the quarry can approach the intersection at right-angles and therefore have appropriate vision to the east of the intersection. Sufficient sight distance in excess of 150m is now available in both directions from this intersection. No road safety issues have been identified at this intersection since works have been completed.

The geometry of intersections from Wave Hill Road onto Maules Creek and Maules Creek Road onto Old Gunnedah Road are considered to meet current standards. The intersections have been reconstructed by Council as part of the upgrade works undertaken since Wave Hill Quarry obtained approval for extraction of up to 200,000 tonne per annum. At this time, the combined approvals for quarries using this road were in excess of 400,000 tonne per annum. The potential change is traffic if Wave Hill Quarry extends its annual extraction limit to 500,000 tonne would involve a potential reduction in the number of trucks as a result of the use of road trains to replace truck and dog as well as semi-trailer units.

8.4 Impact of Traffic Noise

Traffic noise has been identified as an issue prior to bitumen sealing of Wave Hill Road. The noise most significant noise related to the movement of empty trailers along the gravel road. This noise issue was significantly reduced as a result of bitumen sealing of the road. The most sensitive receivers are residences within 150m of the road. This included two houses, mainly the Glen Aston house located on the Boral Quarry property to the west of Wave Hill and a farm residence adjoining Barra Creek.

Speed limits have been imposed on Wave Hill Quarry trucks within the quarry site. General road conditions limit truck speed along Wave Hill Road to less than 100 km/h which is the designated speed limit. The Operation Environmental Management Plan (OEMP) includes a complaints procedure and management responsibilities. If specific noise complaints have been received along the haul route, management has undertaken a review of the complaint and where necessary, the OEMP allows management to impose restrictions on truck drivers to mitigate impacts such as noise emissions toward sensitive receivers.

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9 Cumulative Impacts with Neighbouring Developments

Only one other traffic generating development has been identified along the major haul route from Wave Hill Quarry to potential delivery points that may be relevant to traffic impacts. This consists of an adjoining quarry referred to by the operator's name, Boral quarry. The potential exists that the adjoining Boral Quarry will recommence regular operations. At present, the quarry operates intermittently.

This assessment has noted that if despatches of product from Wave Hill quarry are increased to meet demand from local major developments such as the Inland Rail Project, truck combinations will alter. Larger trucks will be utilised to haul gravel to destinations other than the Narrabri town area. This will result in less trucks being required to move the same amount of quarry product. Peak daily production will not be altered and therefore less trucks are required to move the peak production of 2,000 tonnes per day. When despatch is averaged over a 12-month period, an additional 16-truck movements are required if all of the 500,000 tonne is hauled from Wave Hill quarry. This additional despatch would be associated with major project development only as the local market for quarry material is relatively limited to an estimated 150,000 tonne.

In relation to cumulative impacts, ongoing local operations have a limit and therefore truck numbers servicing this from either of the two quarries will remain similar over time. The major projects identified will involve despatch of larger quantities of gravel and more trucks. The major contracts are estimated to initially involve the movement of 300,000 tonne of quarry material between Narrabri and Bellata. This quarry material will come from either two or three quarries in the region subject to winning contracts. Project size is the limitation. If Wave Hill quarry wins the contract, this would result in approximately 36-truck movements per day during peak haulage periods. This can be compared to the current peak truck generation of 53-trucks per day. It would be anticipated that the adjoining quarry would utilise the same larger trucks to move quarry product and therefore overall truck number may decline for Wave Hill and other local roads during the peak delivery requirements for larger projects that do not have to be accessed through Narrabri town area.

10 Recommended Works

This traffic impact assessment has identified that the previous development approval for Wave Hill Quarry resulted in an agreement between the Proponent and local Authorities to upgrade the main haul road to the quarry, being Wave Hill Road. This was originally a gravel road. The last remaining section of 1.5 km of road is to be upgraded and bitumen sealed prior

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Wave Hill quarry obtaining approval to increase annual throughput to a 500,000-tonne annual limit.

Council and Transport NSW are at present reconstructing an alternative heavy haulage route to avoid trucks needing to haul gravel and farm produce through a section of residential area and through a school zone within the Narrabri town area. This will result in a long-term benefit to the town to reduce the travel of trucks within the town area. The works in progress include replacement of Tarriaro Bridge over the Namoi River, widening of Turrawan Road and reconstruction of the Turrawan-Kamilaroi Highway intersection to add left and right turning lanes. These works will result in any increase in traffic from Narrabri's major hard-rock quarry precinct, to travel via the Kamilaroi Highway to southern, western and northern destinations, without impacting the town area. The upgrades will also enable use of larger truck units and therefore increase the efficiency of haulage. The same amount of gravel will be hauled by less trucks.

The new proposed haulage route along Kamilaroi Highway has been assessed during this investigation. The only point of constriction or road geometry of concern relates to the round-about intersection of the Newell and Kamilaroi Highways. This round-about has been in place for an extended period. It has a road centreline diameter of approximately 42m. The Newell Highway can be used by 11 Axle Rigid truck and 2-Dog trailer, standard Type 1 road train and AB-triples up to 44m in length under a range of permits. It is therefore assumed that Transport NSW has assessed this round-about and consider that it is suitable for trucks sizes approved for travel on the Newell Highway. The larger vehicles to be used by Wave Hill quarry will not exceed these current users.

No other recommended work has been identified during this investigation.

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11 Conclusions

This traffic impact assessment has considered the potential impacts of the proposed increase in annual production at Wave Hill quarry form the current limit of 200,000 tonnes to a limit of 500,000 tonnes. The proposal change in limit is being applied for on the basis of potential larger projects including Inland Rail that have identified a need for an additional 300,000 of quarry product being required from local Narrabri quarries.

This investigation identified that these larger projects may last for a period of 18-months to several years, before local demand for quarry material returns to an annual limit of an estimated 150,000 tonnes of hard rock. This assessment has therefore considered annual average heavy truck movements as well as peak daily despatch from Wave Hill quarry.

It has been concluded that the proposal to expand the current annual extraction limit would result in a moderate increase in traffic generation from the quarry. In part, this would be offset by an increase in truck size by the potential use of 11 Axle Rigid truck and 2-Dog trailer and standard Type 1 road trains to haul the additional gravel from Wave Hill via Turrawan Road. As a result of this, a major part of the additional gravel haulage will occur via a new route to avoid any increase in truck movements through residential and commercial sectors of Narrabri town, other than along the Newell Highway.

Existing planning agreements are in place as a provision for any increase in traffic and resulting road maintenance costs through Section 94 Contributions and a Voluntary Planning Agreement.

No specific sites have been identified as having a traffic safety issue that would require an upgrade of works that is not already in progress. The remaining gravel section of Wave Hill Road will be sealed under this proposal as a result of bringing forward the requirements to seal the road over an extended period. This is a joint arrangement between Council and JCLS.

Overall, the impact of the proposed development upon the road network is considered to be manageable by rerouting larger trucks in compensation for avoiding local roads and traffic congestion points within Narrabri. The traffic generation potential of the proposed development is therefore not considered to pose a significant risk to the amenity, safety, functionality, or accessibility of the wider region. The main larger project being the Inland Rail Project, it is expected to last for a period of approximately two to three years. Once this is completed, the local hard rock demand is expected to return to current levels.

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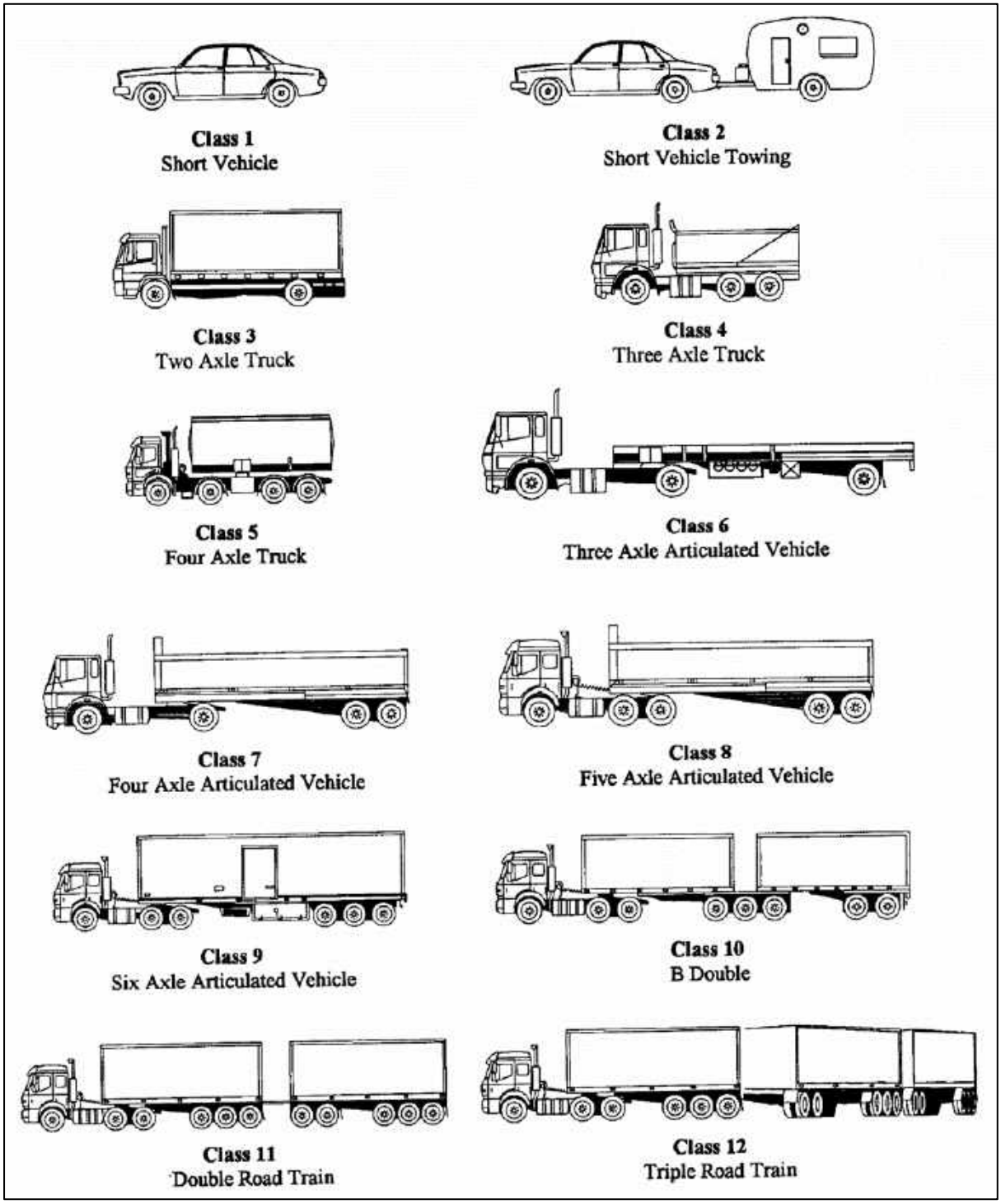
Appendix 1: Austroads Vehicle Classifications



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Appendix 10: Soil and Water Management Plan

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Soil and Water Management Plan

1 Introduction

The following Soil and Water Management Plan (SWMP) has been prepared to satisfy the Secretary's Environmental Assessment Requirements (SEARs) for the proposed increase in output.

A SWMP is the formal plan designed to control erosion and sedimentation on a building site. It details the specific methods of erosion and sediment control that will be used to meet the specific site conditions at the various stages of construction and operation. In accordance with the SEAR's (dated 11 July 2018) this SWMP has been prepared in accordance with the *Landcom document Managing Urban Stormwater: Soils and Construction, Vol. 1, 4th eds.* (Landcom, 2004) (the 'Blue Book').

The primary part of the SWMP is the provision of a sediment basin for the collection of sand, silt and other sediments generated from within the area to be disturbed. In this case, the quarry operation will involve the continued operation of an existing quarry. No land clearing will take place as part of the proposed works, thereby reducing site exposure to erosion and the generation of sediment. The quarry is, however, regarded as a source of sediments because the area has historically been cleared and quarry operations, including the movement and haulage of quarry materials, are regarded as silt generating activities. There are also several soil and gravel stockpiles onsite, which have the potential to generate sediment laden run-off. Sediment generated within the quarry footprint is deemed a pollutant if it reaches watercourses and therefore must be contained within the site.

There is an existing sediment pond at Wave Hill Quarry, in the south-eastern section of the quarry footprint. This SWMP is intended to ensure that the existing sediment pond system has a sufficient capacity to capture sediment from the rainfall runoff within the quarry footprint, based on the intended site operations. The sediment pond on site is below ground level all runoff water stored on site and not released. The site has 2 watershed catchments, identified based on the expected direction and flow of run-off, predicted using available contour information of the site. Run-off from both catchments will drain into the same sediment pond systems via channels and drains.

The area associated with the quarry consists of exposed rock, gravelled haul roads and working areas, and several soil and rock/gravel stockpiles. The quarry area is expected to remain in this condition for longer than 6 months. The entire quarry footprint has been included in the catchment due to the potential to yield sediment. During the year, the water from the sediment pond is used by watercarts in application of water to all roads and quarry areas for dust suppression. Any suspended solids in the runoff water will be recycled onto all road surfaces.

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The Erosion and Sediment Control Operation Plan for Wave Hill Quarry has been included as Appendix 2.

1.1 Soil and Water Management Principles

The principal objective of surface water management at the Wave Hill Quarry is to reduce the potential for transport of sediment offsite into the nearby drainage lines and Deriah Creek, and the flow-on impact of sedimentation on receiving waters. This is a standard objective of erosion and sedimentation designs and controls, and is achieved by implementing the following principles:

- Directing sediment-laden runoff into designated sediment retention basins;
- Diverting 'clean water' runoff unaffected by the operations away from disturbed areas and offsite; and
- Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments.

1.2 Site Description

The site is located on the lower western slopes of the Nandewar Range, 24 kilometres south east of the town of Narrabri. The Wave Hill Quarry is located 500 metres from the Deriah Creek. Deriah Creek converges with Barra Creek, which joins the Namoi River approximately 10km west of the subject site. Deriah Creek is contained within the Namoi catchment area. The subject area drains to the south-east.

The existing quarry includes a sediment pond to capture direct runoff from the site. If runoff from the site were to exceed the sediment pond capacity, the flow would have to travel approximately 500 metres along a slope of less than 2.5 % fall before it could enter the creek. Under these velocity conditions, silt deposition would occur. The area between the sediment pond and the creek consists of pasture land (grasses and forbes) with areas of open woodland. The grass and forbes would provide appropriate filtration of the sediment laden water to minimise potential silt impacts that may degrade water quality in the stream.

The quarry has already been constructed and the proposal involves continued extractive operations within the existing footprint. Extraction of materials will involve excavating raw material from the quarry face and bringing the quarry floor to the level of the existing site office and weighbridge (RL 315). Once quarrying ceases, the surface areas would be remediated.

The following figure presents an aerial image of the existing Wave Hill quarry footprint containing a significant basalt resource. All silt generated as a result of rainfall runoff within the quarry area will be captured and settled within the sediment pond. It is therefore considered that there is minimal risk of sediment and silt entering the Deriah Creek.

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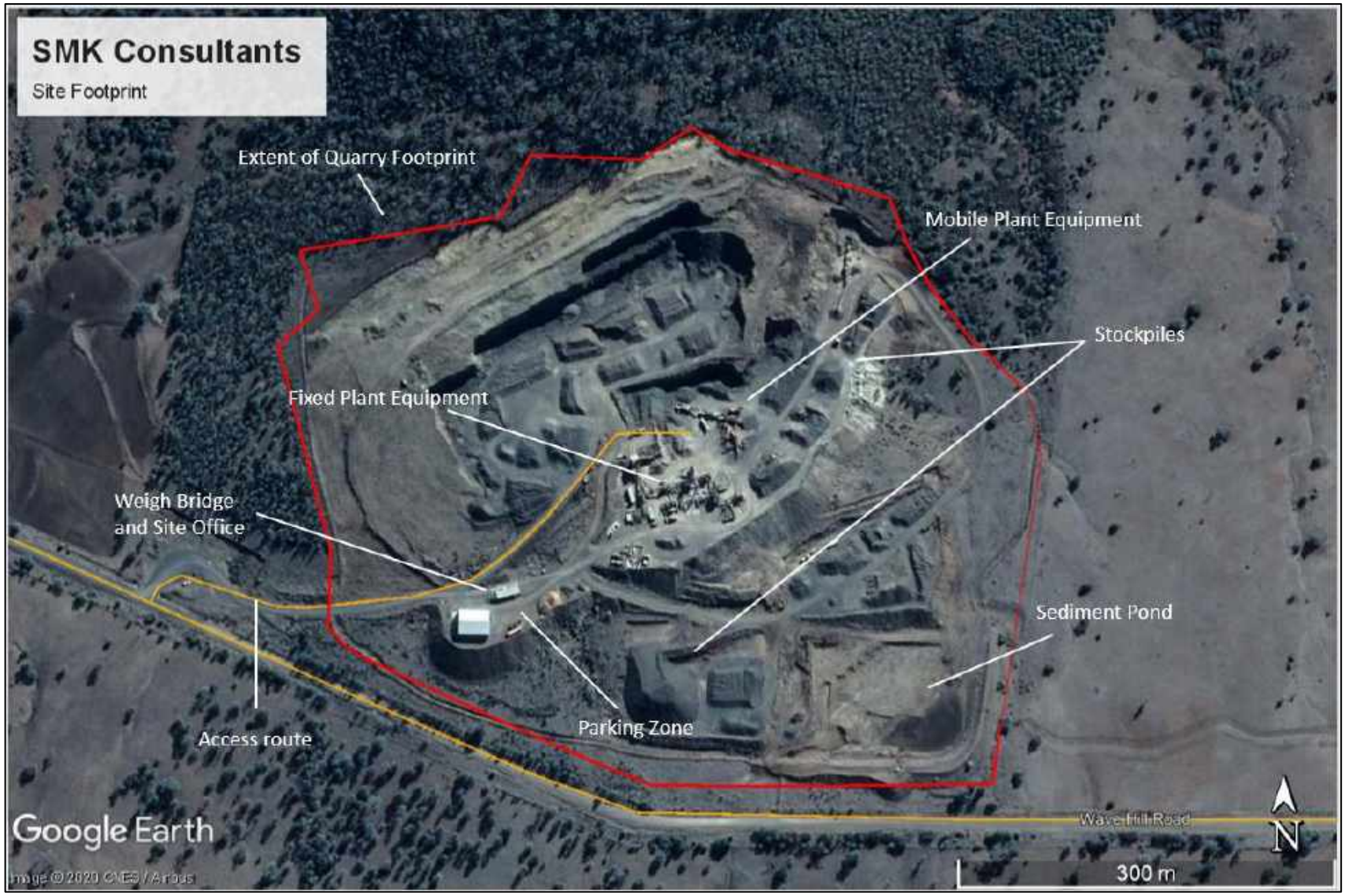

Figure 1: Wave Hill Quarry Footprint and Site Plan

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2 Factors to be Considered

Constraints are classified as either:

- on-site, i.e. relating to soils, landforms, ecology, pollutants and hydrology occurring on the site of the proposed or approved activities; or
- downstream, i.e. relating to aquatic ecosystem sensitivity and the social and aesthetic values of the community.

Based on the identified constraints and opportunities, best management practices (BMPs) have been developed for the site to minimise the potential degradation of soil and water resources and/or other aesthetic/environmental assets while maximising the achievement of outcomes in accordance with principles of Ecologically Sustainable Development (ESD). The recommended constraints to be addressed by the Blue Book are discussed in the sections below. These are in addition to the project-specific constraints discussed elsewhere in the EIS.

2.1 Flooding

This site is in an area undulating with hills, 24 kilometres east of the town of Narrabri. Due to the nature of the site being situated on a hill, the site will not be affected by flood. The sediment pond is located on the downstream of potential runoff from the existing hill and prevents the entrance of flood water and other overland flow water. The sediment pond is located outside of any potential flood areas. In general terms, assessments should identify the 2-year ARI flood event (50% AEP). However, flooding from external areas is not considered an issue and will not be examined.

2.2 Riparian Lands

Waterfront Lands (formally known as Riparian Lands under the Rivers and Foreshores Improvement Act 1948) are those vegetated lands within 40 metres of waterbodies such as rivers, creeks, estuaries, lakes and wetlands. Development on riparian lands is constrained:

- to protect and enhance the social, economic, cultural, spiritual and heritage values of waterfront land for Aboriginal groups and the wider community; and
- to avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, salinity hazards and decline of native vegetation.

The proposed Quarry footprint is not within 40m of a river, creek, estuary, lake or wetland as defined by the Act.

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2.3 Erosion (Rainfall Erosivity & Soil Erodibility)

2.3.1 Rainfall Data & Erosivity

The **rainfall erosivity factor (R),** is a measure of the ability of rainfall to cause erosion. This is a state-wide variable dependent on the total energy within a rainfall event. It is the product of two components, namely:

- total energy; and
- maximum 30-minute intensity for each storm.

The intensity for a 30-min storm event is used in this calculation. Generally, this variable fluctuates across the state per the rainfall intensity that could be expected for the 30-min storm at a particular location. High intensity rain results in high erosion whilst low intensity rain results in low erosion. Erosivity factors for the site can be obtained from Appendix B of the Blue Book.

The Rainfall Erosivity Factor (R) for this site is 1400 with a 2 year 6 hr storm of 7.53 mm/hr.

The proposed quarry site is considered to have a Low Erosion Hazard as shown in the below figure which is an extract from Figure 4.6 of the Blue Book. In comparison, the R-factor varies from up to 7000 along the mid North Coast of the State and approximately 700 in western parts of the state.

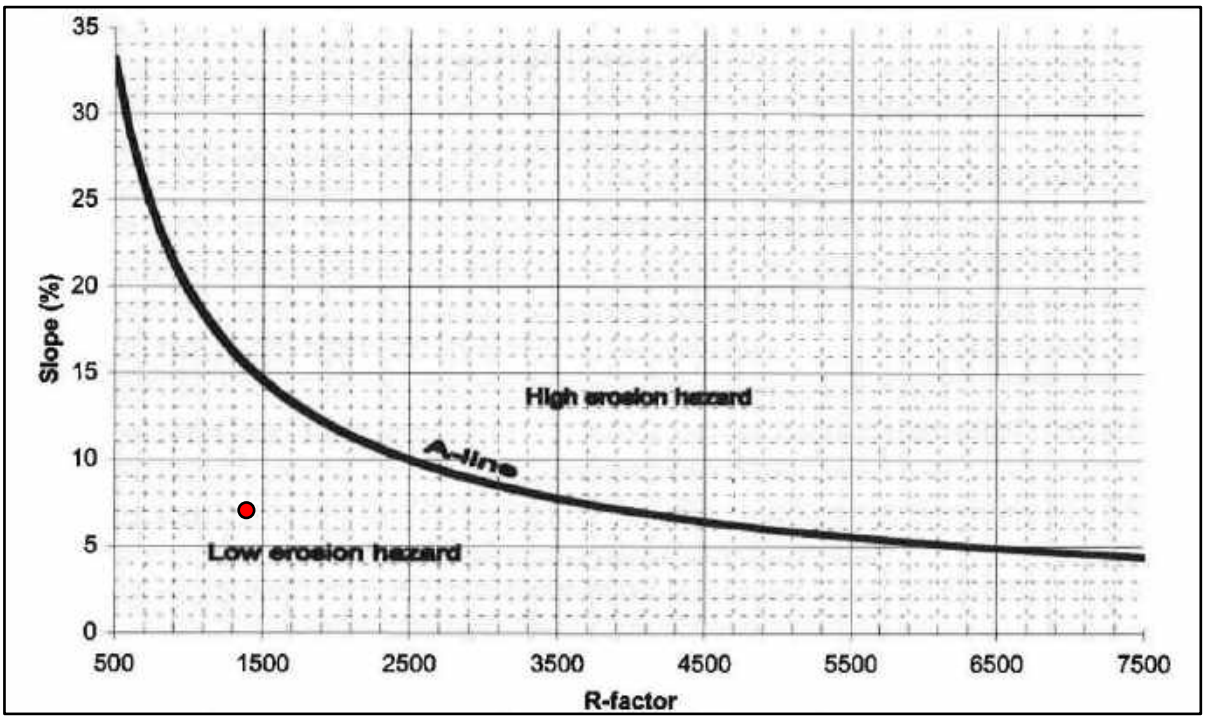

Figure 2: Assessment of Potential Erosion Hazard (Source: Figure 4.6 of the 'Blue Book').

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The total quantity of rainfall over a 5-day period is an important factor in sizing of ponds and allowing the runoff to deposit sediment.

The EPA default is a minimum design of capture for a 90th percentile, 5-day rainfall depth (mm).

The 90th Percentile Rainfall Event for Narrabri, being the nearest data site to the subject site, is 38.4mm. This is the value used in the following calculations.

The following parameters are based on the Bureau of Meteorology's Intensity Frequency Table for the site (see Appendix 1). The **Rainfall Intensity for a 2 year 6-hour storm is 7.53 mm/hr.** Also, the Rainfall Intensities for the 1, 5, 10, 20, 50 and 100 year can be obtained from the IFD Table for use in the calculation of the peak flow.

Volumetric Runoff coefficient for the site is determined from the soil type found and the total rainfall for the 5 day 90th percentile event.

Table F1 in Appendix F of the Blue Book lists the Soil Hydrologic Groups and rates their ability to absorb water. Sands have high infiltration rates and heavy clays have low infiltration rates and therefore high runoff potential. The predominant soil type on the site is largely comprised of Clay soils with Red and Black Vertosols and Dermosols also present. This could be classed as **Soil Hydrologic Group D** and will have a high runoff potential.

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Table F1 Effect of Ksat and profile infiltration rates on Soil Hydrologic Group

Soil Hydrologic Group	Typical infiltration rate (mm/hr)		K_{sat} (mm/hr)	Rate of infiltration	Runoff potential
	Saturated steady state	Dry soil			
A	25	>250	>120	moderate to very rapid	very low
B	13	200	10-120	moderate to rapid [1]	low to moderate
C	6	125	1-10	slow to moderate [2]	moderate to high
D	3	75	<1	very slow [3]	high

1. Includes soils where the subsoil structure grade is moderate or strong or where the texture is coarser than silty clay.
2. Includes moderately permeable surface soils underlaid by silty clays or silty clay loams with weak sub-angular or angular blocky structures; it includes permeable surface soils overlying massive clays or silty clays.
3. Includes soils where depth is limited by a hardpan, rock, high watertable, or other confining layer.

Figure 3: Effect of Ksat and profile infiltration rates on Soil Hydrologic Group (Source: Table F1 of the 'Blue Book').

Table F2 Appendix F of the manual gives the **runoff coefficient for the site as 0.64 for the sites design rainfall depth of 38.4mm**.

Table F2. Runoff coefficients (Cv) for volumetric data in disturbed catchments (adapted from USDA, 1996)

Soil Hydrologic Group	Design Rainfall depth (mm)							Runoff potential
	<20	21-25	26-30	31-40	41-50	51-60	61-80	
A	0.01	0.05	0.08	0.15	0.22	0.28	0.37	very low
B	0.10	0.19	0.25	0.34	0.42	0.48	0.57	low to moderate
C	0.25	0.35	0.42	0.51	0.58	0.63	0.70	moderate to high
D	0.39	0.50	0.56	0.64	0.69	0.74	0.79	high

Figure 4: Runoff Coefficients (Cv) for Volumetric Data in Disturbed Catchments (Source: Table F2 of the 'Blue Book').

2.3.2 Soil Erodibility

The Soil Erodibility Factor (K) is a measure of the susceptibility of individual soil particles to detachment and transport by rainfall and runoff. Soil texture is the principal component affecting soil erodibility, but structure, organic matter and permeability also contribute.

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Three classes of soil are considered:

- Type D - Fine material (<0.005mm). Classed as dispersible material that will not settle unless flocculated.
- Type C – Coarse grained (33% or less < 0.02mm and 66% or More > 0.02mm). Will settle easily in a sediment retention pond.
- Type F – Fine grained (66% or More < 0.02mm and 33% or Less > 0.02mm). Will require a much longer residence time in the pond to settle.

Soil present within the quarry footprint (stockpiles and remaining areas which have not been cleared) consists of clay dominant material. The remainder of the quarry footprint consists of exposed rock and gravel, including stockpiles, and gravelled haul roads and working areas around the plant areas and site office.

For the purpose of the sediment pond design, the site could be regarded as soil Type F. The soils are regarded as non-dispersive.

To accommodate soil Types D and F section 6.3.4 (d) suggests a 5-day rainfall depth can be adopted as standard in the design of the settling zone.

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3 Catchment Areas (A, B)

The total quarry footprint is 24 hectares. This has been separated into the 2 catchment areas (A & B) as shown on the attached plans. Runoff from both catchment areas will be directed to the same sediment pond.

The design event selected is a five (5) day 90th percentile storm where the total runoff for this five-day period is held onsite to allow settlement of sediment to below the maximum discharge threshold of 50 mg/L total suspended solids as required by NSW legislation. Storms in excess of this design event, may discharge from the site. The sediment pond is considered to capture the first flush from the disturbed area which will contain the majority of sediments. Additional runoff from the catchment is deemed to contain an acceptable level of sediment due to the large dilution levels that will occur.

3.1 Design Pond Size for Type D or F Soil

Design Settling Zone Volume required for the catchment is 5,087 m^3 and the Sediment Storage Volume is 2,543 m^3. The Design Total Basin Volume then should then be 7,631 m^3 (see Appendix 1).

Table 1: Total Basin Volume

Site	C_v	R x-day y-%ile	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total volume required (m^3)
A	0.64	38.4	11.6	2695	1347	4042
B	0.64	38.4	9.1	2114	1057	3171
Total				**4809**	**2404**	**7213**

Minimum pond dimensions based on above minimum basin volume with 1.2m water depth and 3:1 batters is shown below. Length to width ratio used was 5:1 L/W ratio.

3.2 Discharge

Johnstone Concrete and Landscape Supplies (JCLS) have indicated that 25ML of water will be used on an annual basis for dust suppression during the operation of the Wave Hill Quarry. Due to the assumed used of water for dust suppression purposes exceeding the volume of water to be captured the site is not expected to have any discharges. However, the water level of the pond should be monitored, particularly during wet periods, to ensure that sufficient capacity is maintained at all time to capture runoff from a significant storm event.

3.3 Water Balance

JCLS have indicated that 25ML/year of water will be used for dust suppression during the operation of the Wave Hill Quarry. The following tables provides a water balance for a 90th percentile wet year, 50th percentile median year and 10th percentile dry year. The water balances indicate the site will have a water deficit based on numerous factors including

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evaporation and the assumed water use for dust suppression. The estimated water deficit required to maintain these dust suppression measures is 10.25ML in a 10th percentile dry year.

The use of water obtained from the sediment ponds for dust suppression on the site would be considered exempt from a separate water use approval under Clause 35 (a) of the *Water Management (General) Regulation 2018*. This exemption applies to any person for the use of water for any purpose as authorised by a development consent under the *environmental Planning and Assessment Act 1979.*

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Table 2: Annual Water Balance (90th Percentile Wet Year) - Sediment Pond Storage (ML)

Month	90th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Seepage	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	59.4	6.7	0.2	0.1	0.59	3.3	2.1	1.0	1.0
Feb	219	24.8	0.6	0.2	0.53	2.7	2.1	20.3	21.3
Mar	53.2	6.0	0.1	0.1	0.59	2.6	2.1	1.0	22.2
Apr	53.5	6.1	0.1	0.1	0.57	1.8	2.1	1.8	24.0
May	119.8	13.6	0.3	0.1	0.59	1.2	2.1	10.1	34.2
Jun	119.9	13.6	0.3	0.1	0.57	0.8	2.1	10.5	44.7
Jul	41.9	4.7	0.1	0.0	0.59	0.9	2.1	1.3	46.0
Aug	1.3	0.1	0.0	0.0	0.59	1.3	2.1	-3.8	42.2
Sep	28.2	3.2	0.1	0.0	0.57	1.7	2.1	-1.1	41.1
Oct	90.1	10.2	0.2	0.1	0.59	2.4	2.1	5.5	46.6
Nov	32.4	3.7	0.1	0.0	0.57	2.8	2.1	-1.6	44.9
Dec	37.8	4.3	0.1	0.0	0.59	3.3	2.1	-1.5	43.4
Total	**856.5**	**97.0**	**2.3**	**0.9**	**6.9**	**24.9**	**25.0**	**43.43**	**46.6**

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Table 3: Annual Water Balance (Median Rainfall) - Sediment Pond Storage (ML)

Month	90th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Seepage	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	218.7	24.8	0.6	0.2	4.15	3.3	2.1	16.1	16.1
Feb	20.4	2.3	0.1	0.0	0.39	2.7	2.1	-2.8	13.3
Mar	12.5	1.4	0.0	0.0	0.24	2.6	2.1	-3.5	9.8
Apr	0.5	0.1	0.0	0.0	0.01	1.8	2.1	-3.8	6.0
May	96.6	10.9	0.3	0.1	1.83	1.2	2.1	6.2	12.1
Jun	35.9	4.1	0.1	0.0	0.68	0.8	2.1	0.6	12.7
Jul	13.5	1.5	0.0	0.0	0.26	0.9	2.1	-1.7	11.0
Aug	0	0.0	0.0	0.0	0.00	1.3	2.1	-3.4	7.7
Sep	46	5.2	0.1	0.0	0.87	1.7	2.1	0.7	8.4
Oct	36.1	4.1	0.1	0.0	0.68	2.4	2.1	-0.9	7.4
Nov	93.4	10.6	0.3	0.1	1.77	2.8	2.1	4.3	11.7
Dec	37.8	4.3	0.1	0.0	0.72	3.3	2.1	-1.7	10.1
Total	**611.4**	**69.3**	**1.7**	**0.6**	**11.6**	**17.4**	**25.0**	**10.08**	**16.1**

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Table 4: Annual Water Balance (10th Percentile Rainfall) - Sediment Pond Storage (ML)

Month	90th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Seepage	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	71.8	8.1	0.2	0.1	1.36	3.3	2.1	1.7	1.7
Feb	71.8	8.1	0.2	0.1	1.36	2.7	2.1	2.2	3.9
Mar	12.7	1.4	0.0	0.0	0.24	2.6	2.1	-3.4	0.5
Apr	15.8	1.8	0.0	0.0	0.30	1.8	2.1	-2.3	0.0
May	56.1	6.4	0.2	0.1	1.06	1.2	2.1	2.2	2.2
Jun	30.2	3.4	0.1	0.0	0.57	0.8	2.1	0.0	2.3
Jul	10.7	1.2	0.0	0.0	0.20	0.9	2.1	-2.0	0.3
Aug	6.2	0.7	0.0	0.0	0.12	1.3	2.1	-2.8	0.0
Sep	0.6	0.1	0.0	0.0	0.01	1.7	2.1	-3.8	0.0
Oct	35.4	4.0	0.1	0.0	0.67	2.4	2.1	-1.0	0.0
Nov	4.3	0.5	0.0	0.0	0.08	2.8	2.1	-4.4	0.0
Dec	88.4	10.0	0.2	0.1	1.68	3.3	2.1	3.3	3.3
Total	**404.0**	**45.8**	**1.1**	**0.4**	**7.7**	**17.4**	**25.0**	**-10.25**	**3.9**

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4 Surface Water Monitoring

The following parameters consider all facets of water control and monitoring associated with the proposed operation of the Wave Hill Quarry.

4.1 Water quality

The proposed sediment pond will collect runoff from within the above ground working area of the quarry. No chemicals associated with vehicles or crushing and sieving machinery material will be disposed of within the sediment pond. Fuel used on the site would be stored in sealed tanks and only used in designated refuelling areas that are isolated from the drainage network through bunding. The pond will primarily capture silty water. Any water used for dust suppression should be assessed in terms of water quality to ensure it is suitable for the proposed use (eg. salinity levels should be considered).

4.2 Surface and groundwater impacts

Potential impacts on surface water as a result of the construction and operational phases of the project include:

- Pollution of surface water through:
  - Increased turbidity of surface waters due to sediment loss and erosion from stockpiles, haul roads or other disturbed areas.
  - Impurities, incidental minerals or other leachates from the disturbed rocks and soil.
  - Elevated salinity levels, as quarrying can disrupt saline aquifers or allow salt to be leached from freshly shattered overburden.
  - Stormwater runoff from plant and equipment areas, fuel storage areas, chemical spills and uncontrolled surface runoff.
- Increased risk of erosion on slopes through increased flow rates.

The site will need to operate as a bare earth area to avoid vegetative contamination of the quarried material. No ground cover will be present and therefore artificial erosion control or silt capture devices will need to be deployed on an as required basis. Such systems will include the sediment pond and a system of diversion drains to capture and manage the flow of runoff into the pond system at suitable velocities that avoid additional erosion within the quarrying site.

The following mitigation measures should be adopted onsite to ensure protection of surface water quality:

- Maintenance of vegetated buffer zones between the quarry site and watercourses within the region, to enable natural filtration of surface water in the event of a sediment pond overflow;

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- Minimising the disturbed area by working in sections to reduce the exposure area and stabilising disturbed land as soon as possible to minimise erosion;
- A silt fence is to be placed around any top soil stockpiles present onsite;
- Stockpiles are to have a single point of access and are to be rehabilitated upon project completion;
- Silt traps, fences and shakedowns are to be checked weekly and after rain events. Sediment is to be removed once it builds up to a height of 300mm above the upslope height;
- Sediment basins and drains should be inspected on a monthly basis, or following a significant rainfall event;
- Table drains should be inspected on a monthly basis at a minimum, or following a significant rainfall event with particular emphasis on the condition of the land immediately downslope of the discharge point.
- Ensure that the storage and use of hazardous and dangerous materials occurs in accordance with relevant legislation, and ensuring spillages are contained;
- Placing hay bales, silt fences or other suitable control devices in drainage lines within the site to reduce onsite erosion where possible.

The implementation of the appropriate mitigation measures in accordance with the above recommendations and best practice management techniques are considered sufficient to avoid potential contamination of offsite surface waters.

Based on the available information it is considered that hauling water purchased from Council to the site in water trucks would be the most appropriate backup option for the dust mitigation measures throughout the operation of the quarry. There would be therefore be no increase to the existing licensed entitlements. No additional extraction will ensure that the Quarry does not adversely impact on the drawdown of sourced and/or adjacent aquifer(s).

The available setback from surface water and potential GDE's is substantial providing a sufficient barrier between the Quarry. The provision of suitable drainage and sediment controls will prevent erosion and ensure runoff does not contaminate offsite areas, including waterways and GDE's.

The storage and/or use of hazardous materials which may be used on site will occur in accordance with *National Code of Practice for the Storage and Handling of Workplace Dangerous Goods (2001).* The appropriate storage and handling will ensure such materials do not pose an unacceptable risk in respect to the pollution of groundwater.

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5 Conclusions and Recommendations

All dirty water collected on site will be directed to the sediment pond. The existing sediment pond onsite has a capacity of approximately 50.1ML, and the cumulative required capacity (i.e. the sediment settling pond and the sediment holding pond) is 46.6 ML, based on a 90th percentile year rainfall event. It is therefore concluded that the existing sediment retention system at Wave Hill Quarry is appropriate and has a sufficient capacity to accommodate run-off generated by the proposed continued quarry operations.

The water collected will be utilised for dust suppression throughout operations. As seen in the water balance, there will be limited water collected in the sediment pond and as such it is expected additional water will be required to maintain dust mitigation measures.

JCLS should implement all erosion and sediment controls measures as outlined within this report and included within the attached erosion and sediment control plans to ensure the development does not cause the pollution of water in accordance with Section 120 of the *Protection of the Environment Operation Act 1997*. The proposed mitigation measures, if implemented, are considered sufficient to avoid the potential for impacts to offsite surface and groundwater from the proposed development.

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Appendix 1: Calculations

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IFD Design Rainfall Intensity – mm/hr

Wave Hill Quarry

Location Label:	Narrabri			
Requested coordinate:	Latitude	30.3375	Longitude	149.5625
Nearest grid cell:	Latitude	30.3375	Longitude	149.5625

Table 5: Bureau of Meteorology IFD Table – Holding Pond

	Annual Exceedance Probability (AEP)						
Duration	**63.20%**	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**
1 min	118	134	184	220	255	304	342
2 min	101	115	161	193	225	266	299
3 min	93.5	106	148	177	206	244	274
4 min	87.5	99.3	137	164	191	226	254
5 min	82.4	93.4	129	154	179	212	238
7 min	73.8	83.7	115	137	159	189	213
10 min	64.1	72.6	99.8	119	138	164	185
15 min	52.9	59.9	82.5	98.3	114	136	153
16 min	51.2	58	79.8	95.1	111	132	148
20 min	45.3	51.4	70.8	84.5	98.3	117	132
25 min	39.8	45.2	62.4	74.5	86.7	103	117
30 min	35.7	40.5	56	66.9	77.9	93	105
45 min	27.5	31.3	43.3	51.9	60.5	72.2	81.5
1 hour	22.7	25.8	35.8	42.9	50	59.7	67.4
1.47 hour	17.5	19.9	27.5	33	38.5	45.9	51.8
1.5 hour	17.2	19.6	27.1	32.5	37.9	45.2	51
2 hour	14.1	16	22.2	26.6	30.9	36.9	41.7
3 hour	10.7	12.1	16.7	19.9	23.2	27.7	31.2
4.5 hour	8.1	9.16	12.6	15	17.4	20.7	23.4
6 hour	6.67	7.53	10.3	12.2	14.2	16.9	19.1
9 hour	5.08	5.73	7.81	9.26	10.7	12.8	14.4
12 hour	4.19	4.72	6.43	7.63	8.85	10.6	11.9
18 hour	3.18	3.59	4.9	5.82	6.76	8.07	9.1
24 hour	2.61	2.95	4.04	4.81	5.6	6.69	7.55
30 hour	2.23	2.52	3.47	4.15	4.83	5.78	6.53
36 hour	1.96	2.21	3.06	3.67	4.28	5.13	5.8
48 hour	1.58	1.79	2.49	3.01	3.53	4.23	4.79
72 hour	1.15	1.31	1.84	2.24	2.64	3.17	3.59
96 hour	0.91	1.04	1.46	1.78	2.11	2.54	2.88
120 hour	0.752	0.858	1.21	1.47	1.74	2.1	2.38
144 hour	0.641	0.731	1.03	1.24	1.47	1.78	2.01
168 hour	0.559	0.636	0.886	1.06	1.27	1.53	1.73

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IFD Design Rainfall Intensity – mm/hr

Wave Hill Quarry

Location Label:	Narrabri			
Requested coordinate:	Latitude	30.3375	Longitude	149.5625
Nearest grid cell:	Latitude	30.3375	Longitude	149.5625

Table 6: Bureau of Meteorology IFD Table – Sediment Pond

	Annual Exceedance Probability (AEP)						
Duration	63.20%	50%	20%	10%	5%	2%	1%
1 min	118	134	184	220	255	304	342
2 min	101	115	161	193	225	266	299
3 min	93.5	106	148	177	206	244	274
4 min	87.5	99.3	137	164	191	226	254
5 min	82.4	93.4	129	154	179	212	238
10 min	64.1	72.6	99.8	119	138	164	185
15 min	52.9	59.9	82.5	98.3	114	136	153
18 min	48	54.4	75	89.4	104	124	140
20 min	45.3	51.4	70.8	84.5	98.3	117	132
25 min	39.8	45.2	62.4	74.5	86.7	103	117
30 min	35.7	40.5	56	66.9	77.9	93	105
45 min	27.5	31.3	43.3	51.9	60.5	72.2	81.5
1 hour	22.7	25.8	35.8	42.9	50	59.7	67.4
1.5 hour	17.2	19.6	27.1	32.5	37.9	45.2	51
2 hour	14.1	16	22.2	26.6	30.9	36.9	41.7
3 hour	10.7	12.1	16.7	19.9	23.2	27.7	31.2
4.5 hour	8.1	9.16	12.6	15	17.4	20.7	23.4
6 hour	6.67	7.53	10.3	12.2	14.2	16.9	19.1
9 hour	5.08	5.73	7.81	9.26	10.7	12.8	14.4
12 hour	4.19	4.72	6.43	7.63	8.85	10.6	11.9
18 hour	3.18	3.59	4.9	5.82	6.76	8.07	9.1
24 hour	2.61	2.95	4.04	4.81	5.6	6.69	7.55
30 hour	2.23	2.52	3.47	4.15	4.83	5.78	6.53
36 hour	1.96	2.21	3.06	3.67	4.28	5.13	5.8
48 hour	1.58	1.79	2.49	3.01	3.53	4.23	4.79
72 hour	1.15	1.31	1.84	2.24	2.64	3.17	3.59
96 hour	0.91	1.04	1.46	1.78	2.11	2.54	2.88
120 hour	0.752	0.858	1.21	1.47	1.74	2.1	2.38
144 hour	0.641	0.731	1.03	1.24	1.47	1.78	2.01
168 hour	0.559	0.636	0.886	1.06	1.27	1.53	1.73

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Table 7: Frequency Factor Determination

TABLE 5.1 - Frequency Factors FF_Y for Rational Method in Eastern New South Wales

Frequency Factors FF_Y	Zone in Figure 5.2 A Below 500m	A Above 500m	B Below 500m	B Above 500m	C Below 500m	C Above 500m	D Below 500m	D Above 500m	E Below 500m	E Above 500m	F Below 500m	F Above 500m
FF_1	0.67	0.50	0.62	0.57	0.62	0.89	0.43	0.37	0.38	0.52	0.66	0.59
FF_2	0.81	0.66	0.74	0.70	0.78	0.92	0.58	0.53	0.54	0.64	0.74	0.77
FF_5	0.92	0.85	0.88	0.86	0.90	0.95	0.80	0.77	0.78	0.82	0.87	0.89
FF_{10}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FF_{20}	1.07	1.14	1.12	1.14	1.10	1.05	1.20	1.25	1.26	1.21	1.15	1.10
FF_{50}	*	1.32	*	1.33	*	1.17	1.54	1.74	1.71	1.52	1.39	1.26
FF_{100}	*	1.46	*	1.50	*	1.24	1.80	2.20	2.14	1.78	1.60	1.34

Zones Below 500m	FF_{50}	FF_{100}
A	$FF_{50} = 1.90 - \frac{0.366\, I_{12.50}}{I_{12.2}}$	$FF_{100} = 2.45 - \frac{0.588\, I_{12.50}}{I_{12.2}}$
B	$FF_{50} = 1.99 - \frac{0.368\, I_{12.50}}{I_{12.2}}$	$FF_{100} = 2.57 - \frac{0.588\, I_{12.50}}{I_{12.2}}$
C	$FF_{50} = 1.97 - \frac{0.368\, I_{12.50}}{I_{12.2}}$	$FF_{100} = 2.54 - \frac{0.588\, I_{12.50}}{I_{12.2}}$

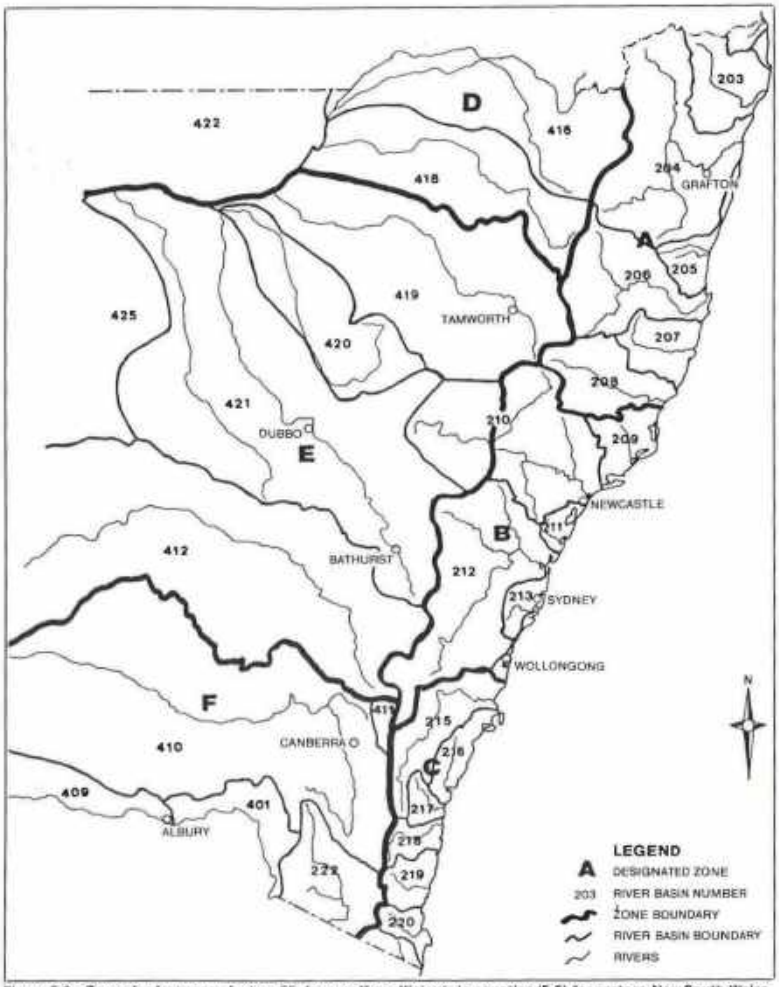

Figure 5.2 - Zones for frequency factors FF_Y for runoff coefficients in equation (5.5) for eastern New South Wales.

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Site Data Sheet

Site name: Wave Hill Quarry
Site location: 24 km South East of Township of Narrabri, NSW
Co-ordinates: MGA Zone 56 E 212543 N 6631524
Precinct: Narrabri
Description of site: An existing quarry on the southern side of a hill 24km south east of Narrabri with a paddock on its eastern boundary and a road along its southern boundary. No vegetation clearance will take place.

Table 8: Site Area

Site area	Site		Remarks
	A	B	
Total catchment area (ha)	11.6	9.1	Includes roads and sheds
Disturbed catchment area (ha)	11.6	9.1	

Table 9: Soil Analysis

Soil Landscape	The quarry hill is largely comprised of Sandy Gravel with Red and Black Vertosols and Dermosols also present. Sandy gravel road base as covering.		DIPNR mapping (if relevant) Sections 6.3.3(c), (d) & (e)
Soil Texture Group	F	F	

Table 10: Rainfall Data

Design rainfall depth (days)	5	5	See Sections 6.3.4 (d) and (e)
Design rainfall depth (percentile)	90	90	See Sections 6.3.4 (f) and (g)
x-day, y-percentile rainfall event	38.4	38.4	See Section 6.3.4 (h)
Rainfall intensity: 2-year, 6-hour storm	7.53	7.53	See IFD chart for the site
Rainfall erosivity (R-factor)	1400	1400	Automatic calculation from above data

Comments: The two catchments have been separated based on how the run-off is expected to flow over the quarry, as theorised using available contour information of the landscape.

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Storm Flow Calculations

Peak flow is given by the Rational Formula:

$$Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$$

where:

Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years

C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years. Rural runoff coefficients are given in Volume 2, figure 5 of Pilgrim (1998), while urban runoff coefficients are given in Volume 1, Book VIII, figure 1.13 of Pilgrim (1998) and construction runoff coefficients are given in Appendix F

F_y is a frequency factor for "Y" years. Rural values are given in Volume 1, Book IV, Table 1.1 of Pilgrim (1998) while urban coefficients are given in Volume 1, Book VIII, Table 1.6 of Pilgrim (1998)

A is the catchment area in hectares (ha)

$I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs (Volume 1, Book IV of Pilgrim, 1998)

= 0.34 Hours (Rural)

= **20.11 Minutes (Rural)**

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent.

Table 2: Peak Flow Calculations 1

Site	A (ha)	tc (mins)	Rainfall Intensity, I, mm/hr						C_{10}
			$1_{yr,tc}$	$5_{yr,tc}$	$10_{yr,tc}$	$20_{yr,tc}$	$50_{yr,tc}$	$100_{yr,tc}$	
A	11.6	20	45.3	70.8	84.5	111	117	132	0.9
B	9.1	18	48	75	89.4	104	124	140	0.9

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Table 3: Peak Flow Calculations 2

ARI years	Frequency Factor (F_Y)	Peak Flows		Comment
		A	B	
		(m^3/s)	(m^3/s)	
1 yr, tc	0.38	0.500	0.415	
5 yr, tc	0.78	1.603	1.332	
10 yr, tc	1	2.452	2.035	
20 yr, tc	1.23	3.963	2.923	
50 yr, tc	1.71	5.807	4.828	
100 yr, tc	2.14	8.198	6.821	

Volume of Sediment Basins: *Type C* Soils (Not Used)

Basin volume = settling zone volume + sediment storage volume

Settling Zone Volume

The settling zone volume for Type C soils is calculated to provide capacity to allow the design particle (e.g. 0.02 mm in diameter) to settle in the peak flow expected from the design storm (e.g. 0.25-year ARI). The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle. Peak flow/discharge for the 0.25-year, ARI storm is given by the Rational Formula:

Q tc, 0.25 = 0.5 x [0.00278 x C10 x Fy x I 1yr, tc x A] (m3/sec)

where:

Q tc,0.25 = flow rate (m3/sec) for the 0.25 ARI storm event
C10 = runoff coefficient (dimensionless for ARI of 10 years)
Fy = frequency factor for 1 year ARI storm
I 1 yr,tc = average rainfall intensity (mm/hr) for the 1-year ARI storm
A = area of catchment in hectares (ha)

Basin surface area (A) = area factor x Qtc, 0.25 m2

Particle settling velocities under ideal conditions (Section 6.3.5(e))

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Particle Size	Area Factor
0.100	170
0.050	635
0.020	4100

Volume of settling zone = basin surface area x depth (Section 6.3.5(e)(ii))

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 100 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.5(e)(iv)), in which case the "Detailed Calculation" spreadsheets should be used.

Table 4: Total Basin Volume

Site	$Q_{tc, 0.25}$ (m^3/s)	Area factor	Basin surface area (m^2)	Depth of settling zone (m)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)	Minimum Basin shape		
								L:W Ratio	Length (m)	Width (m)
A	0.250	4100	1024	0.6	615	615	1229	5	71.6	14.3
B	0.208	4100	851	0.6	511	511	1022	5	65.2	13

Volume of Sediment Basins: Type D and Type F Soils

Basin volume = settling zone volume + sediment storage zone volume

Settling Zone Volume

The settling zone volume for Type F and Type D soils is calculated to provide capacity to contain all runoff expected from up to the y-percentile rainfall event. The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle and can be determined by the following equation:

V = 10 x Cv x A x Ry-%ile, x-day (m3)

where:

10 = a unit conversion factor

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Cv = the volumetric runoff coefficient defined as that portion of rainfall that runs off as stormwater over the x-day period

R = is the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. (See Sections 6.3.4(d), (e), (f), (g) and (h)).

A = total catchment area (ha)

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 50 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(ii)), in which case the "Detailed Calculation" spreadsheets should be used.

Site	C_v	R x-day y-%ile	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)
A	0.64	36.3	11.6	2695	1347	4042
B	0.64	36.3	9.1	2114	1057	3171

Note: These "Standard Calculation" spreadsheets relate only to low erosion hazard lands as identified in figure 4.6 where the designer chooses to not use the RUSLE to size sediment basins. The more "Detailed Calculation" spreadsheets should be used on high erosion hazard lands as identified by figure 4.6 or where the designer chooses to run the RUSLE in calculations.

Conclusion

Given the calculations for required volume for the Sediment Holding Pond at Wave Hill Quarry, it is evident that the existing sediment pond exceeds what is required to handle a 90th percentile year rain event, if the holding pond functions with a by-wash level at least 1.6m below top bank (this is the estimated current freeboard). It is noted that 1m is an allowable freeboard level. This in tandem with, the rate of water usage for dust suppression, means that the existing sedimentation system does not require the addition of a settling basin or any extensions on the ponds capacity. Any further efforts to increase the pond's capacity are solely up to the discretion of the quarry management.

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Appendix 2: Erosion and Sediment Control Plan

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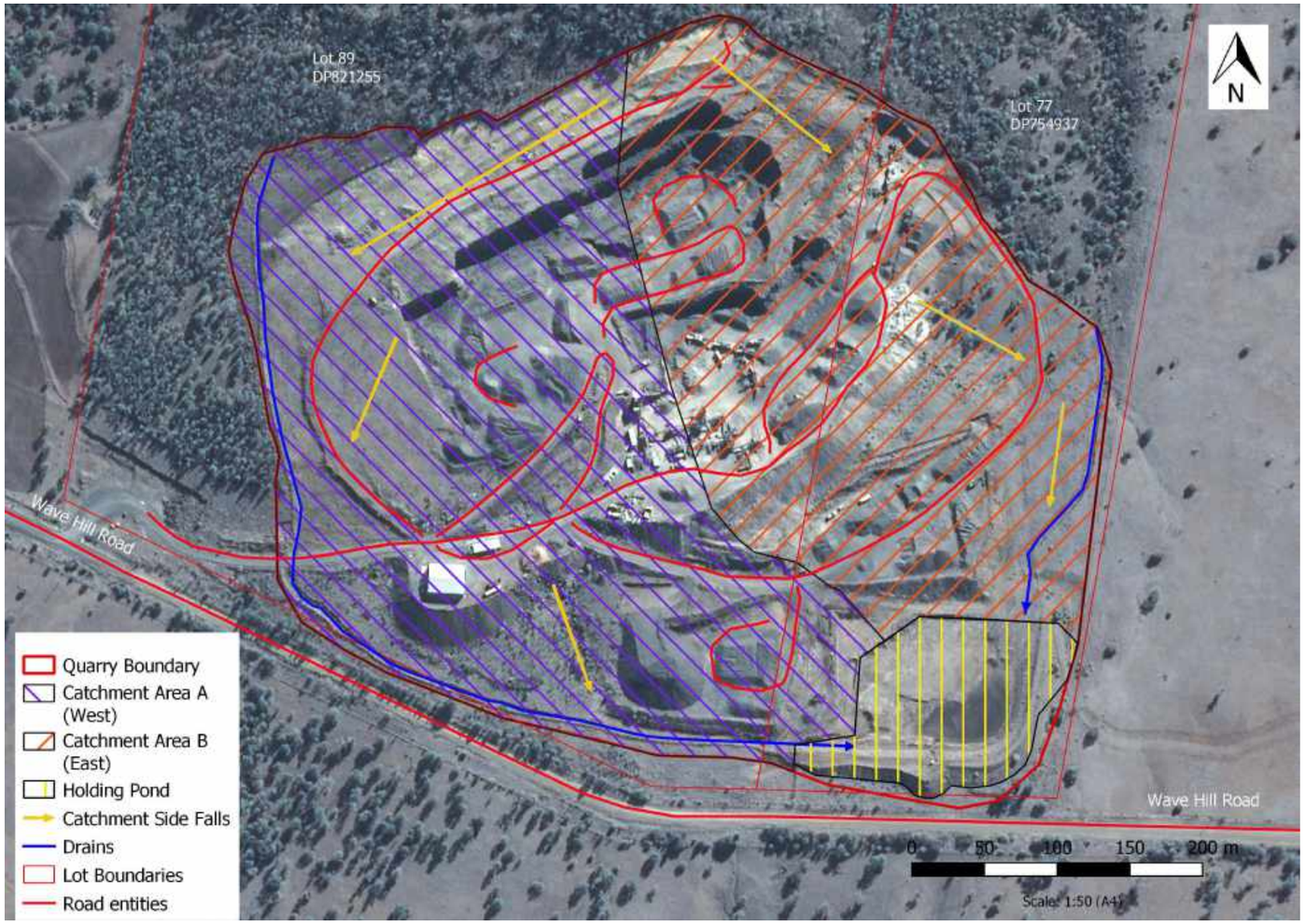
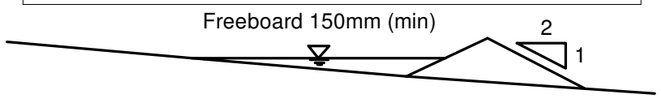


RUN-OFF CONTROL AND MITIGATION PARAMETERS

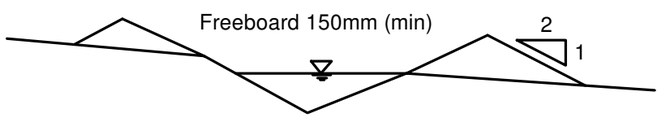
. Water from the holding pond can continue to be used for dust suppression provided it is uncontaminated
. The contractor is to ensure all operation areas are to remain in a bare state for the minimum amount of time possible.
. During the time that these areas are left exposed, all efforts must be taken to ensure the subject area is not eroded
. Any topsoil that is to be stripped is to be placed in a designated top soil stockpile
. Any top soil stockpiles are to be placed on suitably higher ground and a silt fence is to be built surrounding the stockpile
. Stockpiles are to have one access only and are to be rehabilitated on operation completion
. Silt traps/fences/shakedowns are to be checked weekly and after rain events and sediment is to be removed once it builds up to a height of 300mm from top of upslope side.
. Dust is to be minimised during operation with watering of the site when required
. The sediment basins and drains should be inspected monthly, or following a significant rainfall event
. It is up to the contractor to manage sediment and erosion control to suit the varying stages of opration and make sure all placement of devices and management of devices is up to best practice guidelines.
. Each table drain should be inspected at least monthly, or following heavy rainfall with particular emphasis on the condition of land immediately down-slope of the discharge point. Any maintenance work should be completed within 7 days of the initial inspection
. It is up to the contractor to manage sediment and erosion control to suit the varying stages of operation and make sure all placement of devices and management of devices is up to best practice guidelines.
. The bund surrounding the crushing and seiving plant should be inspected monthly or following a significant rainfall event and necessary repairs be conducted as soon as possible
. In the case of an overflow occuring, there are two sets of appropriate sample bottles supplied by a NATA registered laboratory held on the site for sampling of any overflows from the primary storage.

Catch drains and V-Drains are designed to be open channels that collect runoff and desposit sediment to designed sediment controls.



CATCH DRAIN TYPICAL SECTION

Holding Pond Parameters and Subsequent Details Table:
Catchment Area = 24ha
Allowable Free-Board Depth = 1m
Batter Ratio = 2:1
Required Capacity = 46.6ML*
Approximate Current Capacity = 50.1ML
*Capacity is calculated from a 90th Percentile Year Rainfall Event



V-DRAIN TYPICAL SECTION

SEDIMENT POND USAGE DURING OPERATION

A monthly inspection shoud be undertaken for: the sediment holding pond, diversion structures, and the quarry sump.
The following information should be recorded during the inspection:
- General condition.
- Evidence of overflow and condition of downstream catchment.
- Water colour, eg. highly turbid, brown, clear etc.
- Evidence of eroding surfaces.
- Evidence of sediment discharge.
- Approximate retained capacity.

SCALES: HORIZ 1:1000 VERT - DATUM: LOCAL AHD MGA ZONE 56	A3	**SMK CONSULTANTS** surveying - irrigation - environmental PO BOX 774 MOREE 2400 PHONE (02) 67 521021	CLIENT: Johnstone Concrete	DESCRIPTION: Wave Hill Quarry Site Plan During Operation Report	PLAN REVISION:	DATE	SHEET No. 1 of 1
SURVEYED J.BARR DESIGNED T.MOSS CHECKED M.CARRIGAN	Contours Design Existing Major: 1.0 m Minor: 0.2 m		PROJECT: Wave Hill Quarry		A FIRST ISSUE	20-04-2020	JOB No.
					B		COMPUTER FILE (MJO): Quarry Report Draft 2 - Draft Plan 2
					C		

Appendix 11: Rehabilitation Plan

SMK
CONSULTANTS

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Rehabilitation Plan

1 Introduction

SMK Consultants have been engaged by Johnstone Concrete and Landscape Supplies Pty Ltd (the Proponent) to prepare a development application to the Narrabri Shire Council to expand the existing 'Wave Hill Quarry', which is located on Wave Hill Road, approximately 24km west of Narrabri. This Rehabilitation Plan has been prepared to accompany the Environmental Impact Statement (EIS) in support of the development application. The Plan outlines the rehabilitation strategy to be adopted on site, both during site operations and following the closure of the quarry.

The development is 'Designated Development' as described in Part 1 of Schedule 3 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) for 'Extractive Industries'. In accordance with environmental assessment procedures for Designated Developments under the Act, the Secretary of the Department of Planning issued environmental assessment requirements (SEAR's) on 11 July 2018 for the proposed development. The SEAR's include a requirement that the Proponent prepare a Rehabilitation Plan.

In particular, the SEAR's specifies that the Rehabilitation Plan must include:

- A detailed description of the proposed rehabilitation measures that would be undertaken throughout the development and during quarry closure;
- 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, recognising that a rehabilitation bond will likely be required as a condition of any future development consent.

This Plan is considered to satisfy these requirements.

1.1 Relevant Plans and Policies

The following reference documents have been used in the preparation of the design and supporting documents for the proposed rehabilitation of Wave Hill Quarry. The documents provide best practice methods for operation and management:

- Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry 2016 (Commonwealth)

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- Mine Closure – Leading Practice Sustainable Development Program for the Mining Industry 2016 (Commonwealth)
- Extractive Industries – Quarries – EIS Guideline 1996 (NSW Department of Urban Affairs and Planning)
- Exploration Code of Practice: Rehabilitation 2015 (NSW Department of Planning and Environment, Division of Resources and Geoscience)
- Improving Mine Rehabilitation in NSW: Discussion Paper 2017 (NSW Government Department of Planning and Environment)

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2 Development Background

2.1 Locality

The subject site is located at 975 Wave Hill Road, Tarriaro, approximately 24 kilometres east of Narrabri. The real property description of the land includes Lot 77 in Deposited Plan 754937 and Lot 89 in Deposited Plan 821255. The property is located within the Local Government Area of the Narrabri Shire Council and consists of an area of approximately 123 hectares. A locality plan is presented in Figure 1.

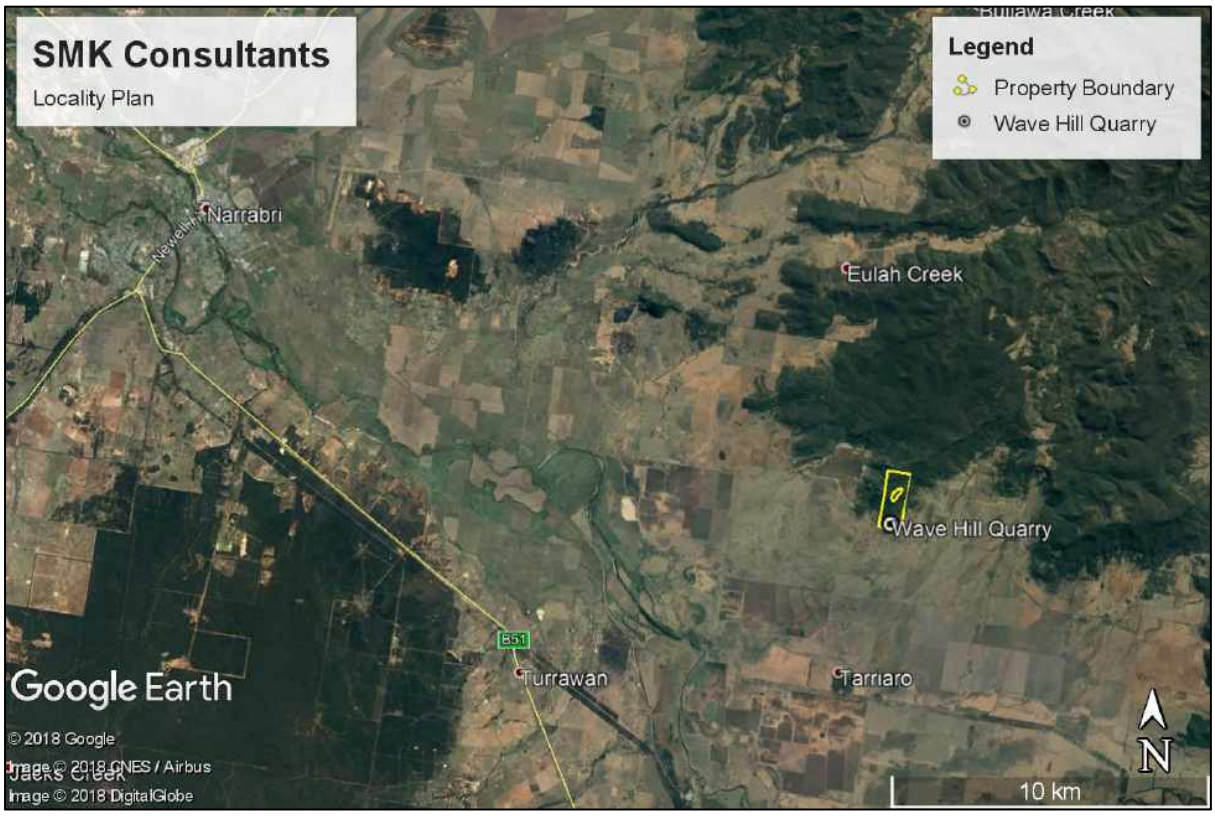

Figure 1: Locality Plan

2.2 Current Land Use

The subject site, located on the southern portion of the property, currently consists of an active quarry site. The proposal does not involve a change of land use. The land is currently zoned RU1 'Primary Production' under the *Narrabri Local Environmental Plan 2012*.

Surrounding land uses generally comprise rural agricultural land to the south (including grazing and crop production), and remnant vegetation to the north. Approximately 1 kilometre to the west and on the adjoining property is another quarry, operated by Boral. The Boral Quarry has a current EPL for 100,000 tonnes/year.

Figure 2 presents the layout of the existing quarry site. The site layout will not be altered in the event of the approval of the proposal.

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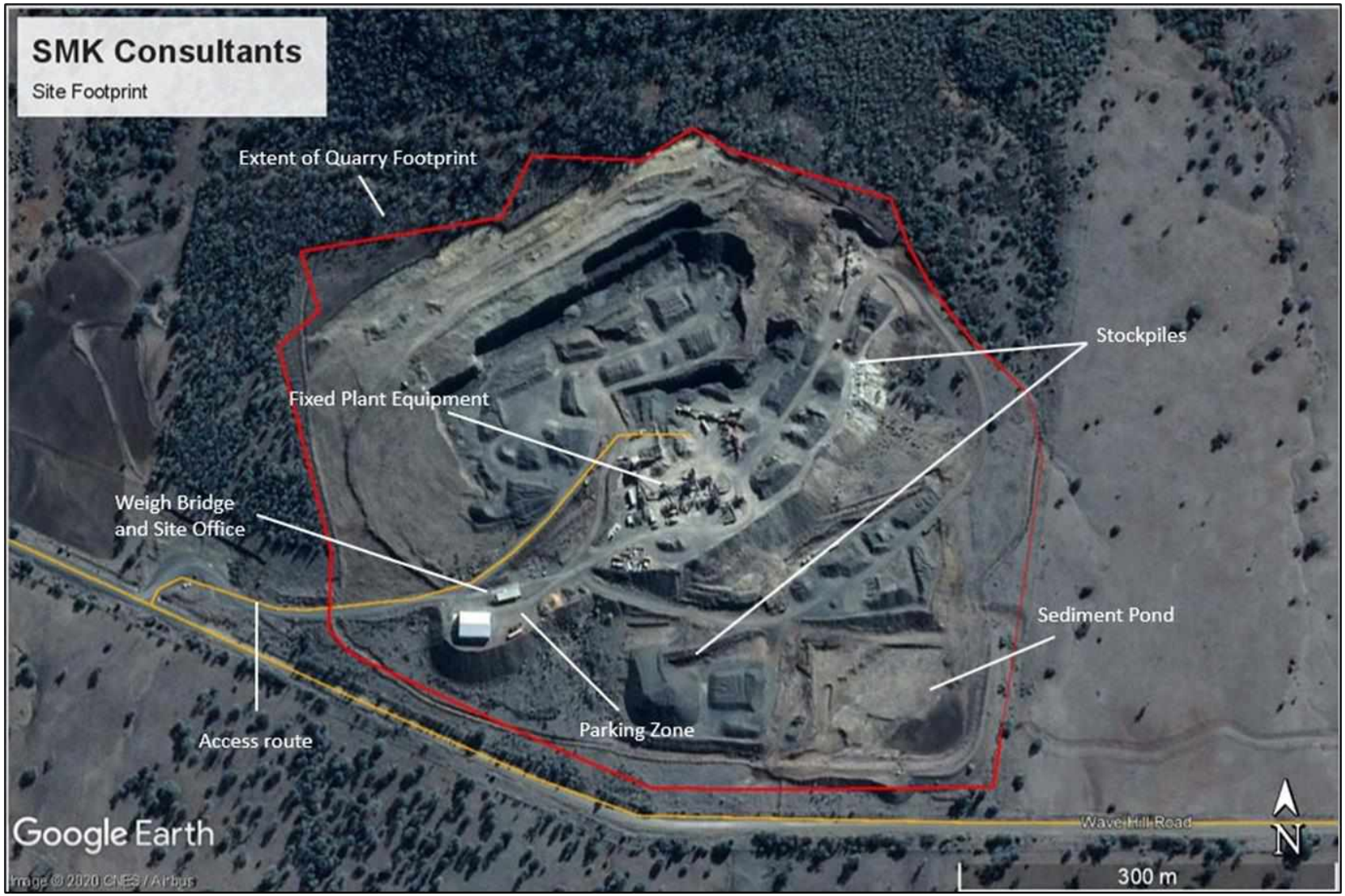

Figure 2: Wave Hill Quarry – Site Layout

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2.3 Activities

The activities currently associated with the quarry include:

- Extraction of material (via methods such as drilling and blasting or mechanical methods such as hammers, rippers, bulldozers, excavators, front end loaders or hydraulic methods) and temporary storage of extracted material at the quarry;
- Processing using on-site equipment (which may involve: crushing to reduce particle size, screening/sieving to separate materials into size fractions, blending of materials with other extractive materials to achieve required characteristics); and
- Loading and transport (involving front end loaders, excavators and trucks).

These activities will continue into the future in the event of approval.

2.4 Development Timeline

Based on the quantity of resource available (as outlined in the Resource Assessment in Appendix 3, at current production rates of 100,000 tonnes per year, the existing approved quarry probably has a future lifespan in the order of ten (25) years beyond the current date. It is intended to increase production rates to up to 500,000 tonnes per year such that the lifespan of the development would be considerably reduced. However, the increased extraction rate is expected to only occur for 5 years in support of the Inland Rail Project. Following the completion of this significant infrastructure project, extractive rates would return to current production rates, which are approximately 100,000 tonnes per year. Following the conclusion of quarrying activities, the site will be rehabilitated in accordance with this document.

2.5 Current Site Condition

The existing quarry site has been mostly cleared of vegetation and consists of active working faces, internal roads, stockpile areas, crushing and processing facilities and a sediment control system including diversion bunds and sediment pond. The site also includes a weighbridge, staff facilities, workshop and fuel tanks for on-site machinery and vehicles. The existing footprint of the quarry is therefore significantly altered from its original state as it is an actively managed and productive quarry site. The layout of the current quarry site is indicated in Figure 2.

The remainder of the property (to the north of the quarry site) is vegetated, and this vegetation is contiguous with a large area of remnant vegetation that covers the Nandewar Ranges.

Vegetation to the north of the quarry site resembles dry rainforest comprising vines, shrubs and trees. Vegetation structure resembles a regrowth forest in the vicinity of the subject site, although remnant vegetation occurs further north and on higher slopes, with large trees

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present. The area is currently impacted by introduced herbivores including Pigs and Goats through trampling and grazing.

Tall canopy species include *Eucalyptus albens* (White Box) and *Casuarina cristata* (Belah), dominate certain vegetation zones in the study area, where these are present due to less impact by historic clearing. Low canopy species include *Geijera parviflora* (Wilga), *Ehretia membranifolia* (Peach Bush) and *Notelaea macrocarpa* (Native Olive). The shrub stratum includes and *Carissa ovata* (Currant Bush) and *Capparis mitchellii* (Wild Orange) while the ground layer consists of various chenopods and grasses including *Einadia nutans* (Climbing Saltbush) and *Paspalidium gracile* (Slender Panic). This vegetation is consistent with PCT 117 – Mock Olive – Wilga – Peach Bush – Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion.

2.6 Original Site Condition

The footprint of Wave Hill Quarry has previously been extensively cleared and was utilised as grazing land for cattle and sheep production. Figure 2 and Figure 3 provide aerial imagery indicating the historic extent of land clearing on the subject site.

The original site had a land use capability classification of Class 4 to Class 5, with the primary constraints being associated with shallow soils and steep slope.

Figure 2: Aerial Imagery - 1979

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Figure 3: Aerial Imagery - 1985

2.7 DA 60-2013 Rehabilitation Plan

The Environmental Impact Statement (EIS) associated with DA 60-2013 provides an outline of the approved rehabilitation processes in place for the current footprint of Wave Hill Quarry. The purpose of rehabilitation of the existing quarry footprint as stated in the EIS is to return the site to pastures which are suitable for grazing of livestock. The EIS outlines rehabilitation methodologies including overburden and topsoil management, handling and stockpiling, soil respreading and revegetation practices.

This plan updates and replaces the rehabilitation plan outlined in the EIS associated with DA 60-2013, to bring rehabilitation methodologies in line with current best management practice, and to ensure consistency in rehabilitation methodology across the entire quarry footprint.

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3 Rehabilitation Objectives

3.1 Rehabilitation Goals

The following objectives have been adopted to guide rehabilitation procedures for the site:

- To produce a stable final landform able to support the rehabilitation of the land for grazing and native vegetation purposes;
- To minimise the environmental impact of all site earthworks associated with the rehabilitation works;
- To optimise the use of available overburden and top soil as a substrate for vegetation; and
- To achieve a stable and functional drainage system at the site under extreme rainfall events.

3.2 Intended Final Landform and Land Use

The subject site will be rehabilitated as agricultural land for use as pasture. The final landform would be free draining with a gently sloping floor to the south. Drainage would be designed to provide runoff to existing sediment dams. Stockpiled topsoil and overburden would be spread on the pit floor, fertilised and vegetated with pasture grasses.

3.3 Land Capability Overview

Land and soil capability assessment is based on the biophysical features of the land, including slope, wind hazard, soil pH, surface structural stability, salinity, rocky outcrop, water logging potential and existing erosion of a landform. The following table summarises the appropriate land use for each capability class.

Table 1: Land and Soil Capability Classes

Class	Most Intensive Use	Land Definition
Class 1	Regular cultivation including intensive crops	Suitable for a wide range of agriculture. It may be regularly cultivated. Very slight to negligible limitations.
Class 2	Regular cultivation	Suited to a wide range of horticulture in rotation with pastures. Several minor constraints may limit suitability for continuous cultivation. These include stony and shallow phases of soil and moderate erosion hazard.
Class 3	Regular cultivation, but must be consciously managed to prevent degradation	Suited to grazing, including the use of improved pastures. Cultivation is limited to cash or forage crops in rotation with pastures.
Class 4	Grazing, intermittent cultivation with specialised practices	Suitable for grazing, but not for cultivation. Pasture improvement relies on minimum tillage techniques. Productivity may be seasonally high but overall is low as a result of major environmental constraints.
Class 5	Grazing, very occasional cultivation for pasture establishment	Non-arable land suitable for grazing but not cultivation. Maintain or improve perennial pastures and preserve ground cover.
Class 6	Grazing only	Non-arable and often non-trafficable. Land suitable for grazing but not cultivation. Maintain or improve perennial pastures and preserve ground cover.

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Class	Most Intensive Use	Land Definition
Class 7	Unsuitable for rural production	Includes steep (slope 33 to 50%) or extremely erodible, or saline or shallow soils. Generally unsuited to agriculture or at best suited only to light grazing.
Class 8	Unusable for any agricultural purpose	Extremely severe limitation, includes precipitous slopes (>50%), areas with large proportion of rock outcrop and frequently inundated. Agricultural production is very low or zero as a result of severe constraints and as a results retirement form agriculture for conservation purposes may be the best option.

The NSW Soil and Land Information Database eSPADE, managed by OEH, identifies the quarry site as having a land and soil capability ranking of Class 4. The mapped land capability classes for the subject site and surrounding land are shown in Figure 4.

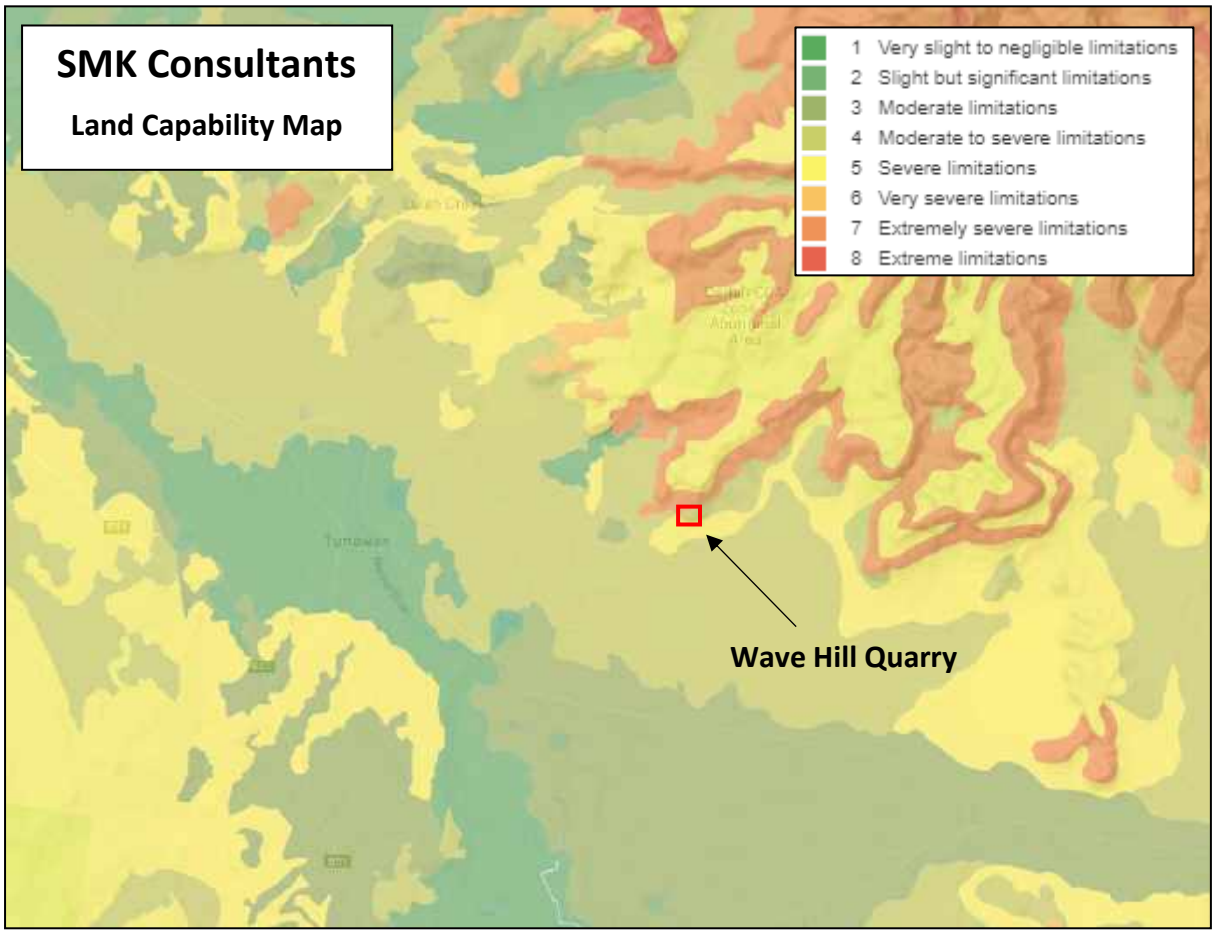

Figure 4: Land and Soil Capability Classes (Source: eSPADE (OEH))

Field inspection of the subject site and surrounding locality indicates that the land upon which the existing quarry is located would be better classified as having an original land capability of 5, as a result of the steep slope and shallow soils upon which the site is located.

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3.4 Intended Final Land Capability

The objective of the proposal with respect to land capability is to return the existing quarry site to a land capability of 5 or greater for grazing purposes.

It is noted that the proposed expansion area is classified as having a land capability of 8, the lowest possible land capability class. Therefore, this land will not be rehabilitated for agricultural purposes, and is not intended for agricultural use following conclusion of quarrying activities on site. The site will instead be revegetated with native vegetation. Land capability objectives are therefore not relevant with regards to the management of this area.

The proposed management controls to be implemented would ensure that the final landform and potential for future agricultural activities is not compromised by excessive erosion, pollution or restricted availability of water.

3.5 Financing and Provisions

It is recognised that provision of adequate financial resources is critical to the success of this Rehabilitation Plan. To this end, the Proponent has committed to a minimum of $150,000 to be set aside over the course of the development process, to be contributed to supporting rehabilitation efforts. It is considered that this fund will be adequate to ensure that the quarry site will be successfully rehabilitated at the conclusion of quarry activities. This fund can be modified on an as-required basis to achieve the desired rehabilitation of this site.

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4 Pre-Closure Rehabilitation Procedures

4.1 Soil Stripping

Topsoil refers to the top surface layer of soil which is biologically active and of value in revegetation. Subsoil is less biologically active than topsoil yet is still of use in rehabilitation. Together, the topsoil and subsoil form the soil profile.

The proposed works do not involve vegetation removal and/or soil stripping as the quarry footprint has already been cleared and stripped as part of the existing quarry operations.

4.2 Soil Stockpiling

Soil which contains high quantities of weeds and/or weed seed banks should be separated from soil stockpiles to be utilised for rehabilitation. This soil should not be utilised for rehabilitation, but instead should be disposed of either at an appropriate waste management facility, or in an area separated from remnant vegetation communities.

Topsoils are to be stockpiled separately to subsoils. Saline soils (if present) are to be stockpiled separately to non-saline soils, over an aggregate substance to allow leaching of salt concentrations over time.

Where possible, the length of time that soils are stockpiled for should be minimised as far as practicable. Where stockpiles are retained for periods in excess 6 months, stockpiles will be fertilised and seeded with a cover crop of non-persistent pasture species to maintain soil structure, organic matter and microbial activity and to prevent erosion.

A maximum stockpile depth of approximately 3 metres should be maintained to preserve viability and reduce soil deterioration. Longer term soil stockpiles should be sown with the species recommended in the following table as soon as possible after stockpiling. Soil stockpiles should be constructed with a slope of <2:1(H:V) and the stockpile surface left roughened. Placement within natural or constructed drainage lines should be avoided.

Table 2: Stockpile Species Specification and Sowing Rate

Species	**Sowing rate kg/ha (as mixture)**	
	Spring	**Autumn**
Queensland Bluegrass (*Dichanthium sericeum*)	0.5 - 2	0.5 - 2
Kikuyu (*Pennisetum clandestinum*)	1 - 2	1 - 2
Perennial Ryegrass (*Lolium perenne*)	3 - 10	3 - 10
Lucerne (*Medicago sativa*)	2 - 4	2 - 4
Narrow leaf plantain *(Plantago lanceolata*)	1 - 4	1 - 4

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4.3 Progressive Rehabilitation

During the course of quarry operations, the site will be progressively rehabilitated as far as is practicable to minimise the extent of the disturbed quarry footprint at any given time. Progressive rehabilitation may either include immediate, temporary stabilisation of worked sections, or initiation of permanent rehabilitation procedures of completed quarry sections.

All noxious weed species, environmental weeds and Weeds of National Significance are to be managed across the site during the course of quarry operations. Proactive weed management strategies during the course of quarry operations will minimise the need for a reactive weed management strategy following the closure and final rehabilitation of the quarry.

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5 Post-Closure Rehabilitation Procedures

5.1 Landscape Stabilisation and Final Landform

Overall, the final landform of the quarry will include a gently sloping landscape to the south (within the footprint of the existing quarry, upon which current stockpiles, processing and office areas are located), with the potential for steeper terrain to be present in the northern portion of the site (within active extraction areas).

Active faces of the quarry are excavated by drilling horizontally into the hill. The maximum height of any working face is limited to 20m as a result of safety and practical considerations. Once the working face reaches a maximum height of 20m, a new ledge is formed at the top of the excavation site from which future drilling occurs into the hillside. While active, extraction area therefore appears as a series of steps pushing into the side of the hill.

High walls of the quarry faces within the active extraction area would be stabilised following conclusion of quarrying activities. This may involve scaling down of the walls to remove weathered rock, and to remove unstable features such as overhangs or steep, erodible surfaces. Subsoil and topsoil would also be spread on site to help to smooth the landscape and provide a medium for plants to become established in. Some bare rock faces will remain in the form of small cliffs on site. The steep active extraction areas will be rehabilitated with native vegetation.

The smoother, more level areas towards the base of the quarry will be rehabilitated for grazing purposes. The sediment pond to the south of the site will be retained, and will be utilised as a farm dam to supply surface water to cattle within the pasture area on site.

5.2 Post-Closure Site Assessment

A site inspection by suitable qualified persons is to be undertaken as soon as practicable following the closure of quarry operations on site, to identify any potentially contaminated sites.

If the site assessment identifies potentially contaminated sites, the following steps will be undertaken:

- Detailed site assessment and testing to characterise the nature and extent of contamination; and
- Implementation of contamination remediation measures to isolate the impacts of and treat the contaminated site, such that the site is stable and does not pose a risk to human health or welfare, or to surrounding environmental values.

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5.3 Fencing/Access Control

It is noted that Wave Hill Quarry is located entirely on private property. No public accesses (such as roads, tracks or stock routes) are present to enable visitation to the site by members of the public. During the period of site rehabilitation, all visitors, contractors and employees of Wave Hill will be informed as to the location of relevant controlled areas and exclusion areas associated with rehabilitation processes.

The property on which the quarry is located does not currently have livestock or other animals on site. Fences are present along the boundaries of the property to ensure exclusion of livestock from neighbouring properties onto the quarry site during rehabilitation. Therefore, no internal fencing will be required during the early phases rehabilitation process to ensure stock exclusion whilst vegetation is being established on site.

Once the current footprint of the quarry has been rehabilitated to form stable and adequate pasture, internal rural fences will be constructed on site to control the movement of livestock and to prevent livestock access to remnant vegetation to the north of the pasture areas.

Where required, rural fences will also be constructed along the top of any steep faces which remain in the landscape, to prevent any occurrences in which either people or cattle may inadvertently fall or slip down the slope.

The sediment pond will remain unfenced within the pasture area and will function as a farm dam for cattle on site.

5.4 Soil Replacement and Preparation

Only endemic soil is to be utilised for site rehabilitation. Endemic soil is taken to mean soil that was stripped from the site at the commencement of quarry operations, or soil sourced adjacent to the quarry site as required following the closure of quarry operations (which may be required to smooth the final landform). The use of endemic soil improves the likelihood of rehabilitation success, as it consistent with natural soil characteristics on site, and enables utilisation and propagation of endemic seed banks within the soil.

Soil replacement should occur in reverse order to stripping, i.e. subsoil should be replaced prior to topsoil. To minimise waste generation on site and to enhance drainage, remaining stockpiles of raw or crushed gravel should be mixed with subsoil (where appropriate) and spread evenly over the site.

Before soil respreading, the ground surface should be scarified or ripped along the line of the contour to break any compacted and smooth surfaces and assist in keying the respread soil. An alkaline (non-acidifying) fertiliser should be added to respread soil to assist in any nutrient deficiencies as required.

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Soil is to be applied across the quarry site in such a way that it provides:

- Suitable soil depth to enable vegetative growth (where appropriate); and
- Suitable topography such that the site is stable, with an absence of steep/unstable areas which are susceptible to erosion.

To this end, topsoil respread over areas of rehabilitation should be approximately 100mm on flat or shallow slopes (<4(H):1(V)) and no greater than 50mm on steeper slopes (>4(H):1(V)).

Erosion during the soil replacement and preparation phase will be minimised by the following measures:

- Ensuring respread soils are left with a roughened surface and are revegetated as soon as is practicable following soil replacement;
- Where appropriate, undertaking progressive soil replacement and revegetation across the site, to minimise the creation of large areas of bare earth; and
- Ensuring that erosion control measures installed during the course of quarry operations (such as sediment fences) remain in place until the site is revegetated with a low risk of erosion.

5.5 Revegetation

5.5.1 Pasture

Smoother, more level areas within the existing quarry footprint will be rehabilitated for grazing purposes following the conclusion of quarry operations. Replaced soil is to be seeded with a cover species during the course of revegetation works, to ensure stabilisation of the soil surface and protect the landscape from erosion, and to maintain the biota of the topsoil to preserve soil fertility. Replacement subsoil may be mixed (as appropriate) with gravels left over from quarry operations.

Watering and fertilisation of rehabilitation sites will be undertaken as required to ensure the success of revegetation activities on site.

Upon the completion of the landform sculpting, stabilising and revegetating process, the landscape will have the potential to be utilised for grazing purposes. This may involve the sale of the land to adjacent landholders to be incorporated into existing grazing enterprises within the locality.

5.5.2 Native Vegetation

Steeper extraction areas will be revegetated to support native vegetation upon conclusion of quarry activities. To this end, soil will be replaced on site and will be fertilised and watered as required to encourage propagation of the natural seed bank stored within the topsoil that is replaced on site.

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Additional planting of seeds/saplings (as appropriate) will be undertaken to complement natural germination of seeds within the soil. Species to be planted as part of the revegetation process are to be consistent with local species present in the vicinity.

5.6 Rehabilitation Monitoring and Maintenance

Once rehabilitation activities (landscaping, soil replacement and revegetation) have completed, rehabilitation sites will be regularly monitored to measure the success of rehabilitation strategies.

Monitoring will primarily rely upon visual inspections of the sites to examine:

- Whether revegetation activities have been successful in re-establishing vegetation cover;
- Whether there are any actively eroding locations, or whether the landform is stable.

In the event that initial revegetation practices have been unsuccessful (i.e. the plants die), the site will be re-seeded and regularly monitored, and managed as required (through measures such as regular watering and application of fertiliser) to encourage the success of rehabilitation strategies.

If actively eroding locations are identified during site inspections, control measures may be implemented on site to stabilise the landscape. Examples of such measures include additional earthworks (such as contouring or flattening of slopes) and increased emphasis on fast revegetation of the eroding surface (e.g. by planting fast-growing groundcover species such as grasses over problem areas, to complement existing revegetation efforts).

The rehabilitation process will be considered to have succeeded when:

- A self-sustaining vegetation community has been established;
- The landform of the site is stable; and
- The site may be utilised safely for its intended post-rehabilitation purpose.

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Appendix 12: Onsite Environmental Management Plan

SMK
CONSULTANTS

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ABN: 43 151 205 882

PO Box 878 Narrabri NSW 2390 Ph: 026792 3036
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Environmental Management Plan

Wave Hill Quarries Pty Ltd-Wave Hill Road, Wave Hill, 2390

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The contents of this EMP have been aligned with key elements from State and Federal Environmental Legislation and revised by an independent environmental consultancy firm.

1. INTRODUCTION

This Environmental Management Plan has been prepared for Johnstone Concrete and Landscape Supplies Pty Ltd (ABN: 43 151 205 882) for the operation and ancillary activities associated with the Wave Hill Quarry. Johnstone Concrete and Landscape Supplies is a family owned company that operates a concrete batching facility and quarry in the Narrabri area. The company is ISO 9001 endorsed and supplies road building materials to the RMS, Local Government and Mines as well as concrete to the construction industry and landscape supplies to the wider community.

The Wave Hill Quarry is located approximately 25 km east of the township of Narrabri at 975 Wave Hill Road, Tarriaro. The Quarry is located in the Parish of Eulah, County of Nandewar on Lot 89 DP 821255 and Lot 77 DP 754937.

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JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD

ABN: 43 151 205 882

PO Box 878 Narrabri NSW 2390 Ph: 026792 3036 Fax: 0267924778

POLICY STATEMENT

Johnstone Concrete & Landscape Supplies Pty Ltd (JCLS) is committed to achieving the principles of responsible environmental management, sustainability and protection of the natural environment in our workplace, JCLS recognises our moral and legal responsibility to ensure that our activities, products, and services are designed to protect and enhance the environment in the communities in which JCLS operate, and our obligations to ensuring that our operations do not place the natural environment or the local community at risk of harm.

AIMS AND OBJECTIVES

JCLS are committed to environmental improvement and prevention of pollution. W will achieve this by working with our customers, suppliers and the community to adopt procedures that: -

- Reduce waste through innovative work practices and recycling practices
- Minimise environmental impacts by reduction of polluting substances produced by our operations, activities, products of services
- Minimise the impact of our operations on the neighbouring community
- Increase the use of environmentally acceptable materials, equipment and technology in place of those which are considered harmful
- Ensure that our suppliers follow acceptable environmental policies, and
- Actively promote environmental awareness among workers, clients, customers and the general public

RESPONSIBILITIES

JCLS recognises that the overall responsibility environmental sustainability rests with management, who will be accountable for the implementation of this policy. These responsibilities include:

- Ensuring that all environmental policies and procedures are implemented
- Establishing measurable objectives and targets to ensure continued improvement aimed at the elimination of waste, pollution and environmental harm;
- Encouraging consultation and co-operation between management, workers and stakeholders in matters which may affect or impact on the environment; and
- Providing adequate resources to meet these environmental commitments

Workers also have responsibilities, which include: -

- Following all environmental policies and procedures; and
- Recognising and reporting hazards which may affect the health and well-being of the environment

AUTHORISED BY

Brock Johnstone DIRECTOR **16.8.19**

Clint Johnstone DIRECTOR 16.8.19

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2. STATEMENT OF COMMITMENT

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD recognises its moral and legal responsibility to minimise damage to the environment caused by work activities. This commitment extends to ensuring that operations do not unnecessarily endanger flora, fauna, sensitive areas, sites of heritage importance or present concerns to members of the public and community.

The objective of this EMP is to actively work towards elimination and reduction of negative effects to the environment by ensuring environmental impacts are incorporated into all levels of the organisation, from planning to project delivery, and utilising best practice techniques wherever possible.

Responsibilities

Management are committed to:

- Integrating EMP into all aspects of JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD operations
- Compliance with all relevant legislative requirements and co-operation with Regulatory bodies.
- Consultation with relevant workers and other parties to improve decision-making on environmental matters.
- Identification of environmental issues, assessment of risks and implementation of best practice controls to limit negative impacts to the environment
- Development, implementation and review of written work procedures
- Distribution and communication of information and work procedures
- Training and supervision to relevant workers, contractors, clients and visitors to ensure EMP and written procedures to minimise environmental impacts are followed.
- Review and assessment of the EMP, including persons who are responsible for the management, update and review of EMP

Relevant workers are expected to:

- Take reasonable care, and consideration, of environmental impacts while at work;
- Co-operate with JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD to enable compliance with legal obligations
- Participate in consultative arrangements in relation to environmental matters
- Assist management to meet environmental targets/key performance indicators
- Notify of Environmental Risk and opportunities

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3. RISK ASSESSMENT

This risk assessment forms the basis of selecting risk controls. The risk matrix helps to characterise the nature and magnitude of risk to human receptors (residents, workers, visitors) and environmental receptors (flora, fauna, land/water, ecological communities etc).

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will use the risk matrix below to assess the likely impact proposed work activities will have on both human and environmental receptors. Information will be used to guide the assessment process, such as:

- Health and Safety
- Environmental – ecological, land/water usage
- Financial Impact
- Community feedback/ reputation
- Legislation requirements

Risk and Likelihood Criteria Matrix (adapted from AS/NZS 4360)

Basis of Rating	**E – Rare**	**D – Unlikely**	**C – Possible**	**B – Likely**	**A – Almost Certain**
Lifetime or Project fixed time period or new process – plant	Unlikely to occur	Could occur at some time or once during lifetime	Could occur more than once dur a lifetime	May occur about once per year	May occur several times per year or expected to occur
4. Catastrophic					
4. Major					
3. Moderate					
2. Minor					
1. Negligible					

5. PROPOSED ACTIVITIES SUMMARY

A brief summary of the proposed activities:

- **Drilling and blasting.**
- **Crushing, screening and separation of hard rock into quarry materials and aggregates.**
- **Stockpiling and handling of produced materials by on-site plant.**
- **Repairs and maintenance of internal road-works and material storage areas.**
- **Transport of produced materials from site by trucks.**
- **Repairs and maintenance of on-site plant and equipment by staff and contractors.**

WORK ELEMENTS	DESCRIPTION
Name of Site	Wave Hill Quarry
Duration of works	Ongoing
Total work site area	Refer Site Plan
Area of disturbance (including access/egress)	Previously disturbed
Operating hours at site (indicate am, pm)	As per EPA Licence 20139 / L6 Monday to Friday 7am-6.00pm, Saturday 7am – 5.30pm *(dispatch and arrival trucks. light vehicle maintenance plant (Monday to Friday 6am – 10pm, crushing, screening, stockpiling)* Monday – Friday 9am-3pm *(Drilling)**only*** Monday – Friday 9am-3pm (Blasting) ***only***
Chemicals, fuels, volume and storages	Diesel fuel machinery oils and grease
Miscellaneous	Air borne dusts and emissions. Low level noise Ground Water

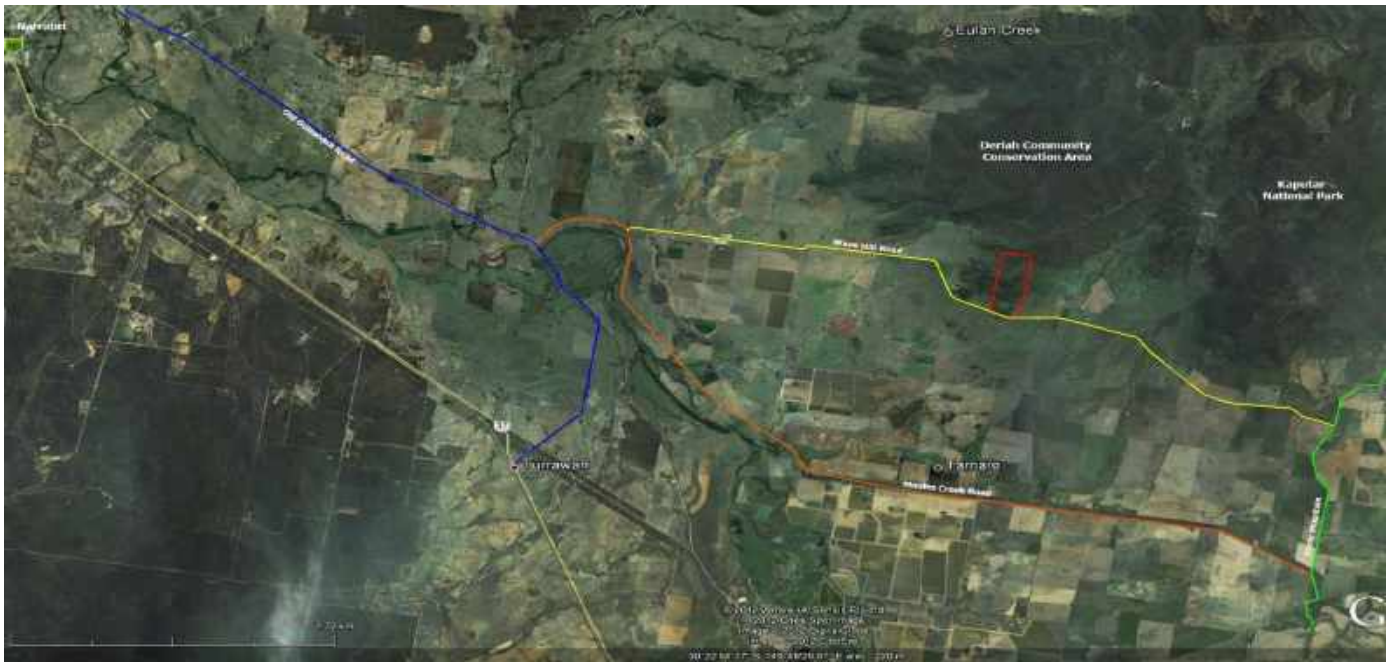
JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD

ABN: 43 151 205 882

PO Box 878 Narrabri NSW 2390 Ph: 026792 3036 Fax: 0267924778

SUMMARY OF SITE AND SURROUNDING AREA

The Wave Hill Quarry is located approximately 25km east of the township of Narrabri on the Wave Hill Road.



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SITE PLAN

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6.ENVIRONMENTAL FACTORS ASSESSMENT AND CONTROL SUMMARY

PRIORITY	ASSESSMENT OUTCOME RATINGS				CONTROL MEASURES SUMMARY
	Extreme	High	Moderate	Low	
Communication	✓				Site toolbox meetings Pre-scheduled environmental meetings with management and staff Open liaison with general public when changes are implemented or required Contact person/s and details displayed at site entrance
Inductions & Training	✓				Internal and third party training Detail and maintain records
Cultural Heritage	✓				Reporting procedure Employee induction and training
Notification	✓				Annual returns and incident reporting
Water Management	✓				Site specific monitoring Annual and periodic reporting
Noise	✓				Site specific monitoring Annual and periodic reporting
Air Quality	✓				Site specific monitoring Annual and periodic reporting
Hazardous Chemicals	✓				Correct storage and handling facilities Bunding of storage areas Compliance with chemical SSD conditions Staff induction and training
Public Safety	✓				Site Induction for visitors Incident Reporting Procedure Advertised complaints phone-line Warning and instructional signage
Waste	✓				Supply of appropriate waste storage containers Designated waste storage areas Regular regime for correct disposal of waste.
Traffic Management	✓				Documented and displayed Traffic Management Control Plan Site Induction for both staff and visitors Record keeping
EMP Compliance	✓				Internal auditing, monitoring and reporting

6.1 AIR QUALITY MANAGEMENT

The purpose of this control measure is to address the environmental impacts associated with potential air contamination, including fumes, vapours, aerosols, dusts, mists, particulates, smoke and odour.

Objectives:

1. Identify possible sources of air contamination and likely exposed receptors, conduct risk assessments and apply best practice techniques to eliminate or reduce their environmental impact
2. Ensure JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD is not responsible for community complaints regarding dusts, odors or other likely air contaminants.
3. Ensure legislated air emission standards are not exceeded.

The objectives will be met by implementing the following as required for task:

- Liaise with sensitive work communities/affected receptors and monitor worksite feedback
- Use non-toxic or the least toxic (human and ecological) chemicals where possible
- Comply with permits/licenses and their conditions.
- Conduct regular monitoring as instructed by EMP conditions.
- Provide adequate resources for required equipment.

RESPONSIBILITIES		
Name	**Job Title**	**Reporting to:**
Clint Johnstone	Quarry Manager	Director
Brock Johnstone	Operations Manager	Director
Margaret Koutoumanos	Compliance Manager	Brock Johnstone , Clint Johnstone - Directors

References:

Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)
NSW Office of Environment and Heritage: (1997) Protection of Environmental Operations Act (PEOA)
NSW Office of Environmental and Heritage: (2010) PEOA (Clean Air) Regulations
Clean Air Society of Australia and New Zealand (2009): Air Quality Regulation and Odour Management in Australia and New Zealand

Table : Risk Assessment and Controls in relation to Air Quality Management

Task	Potential Impact	Risk Assessment				Controls
		Extreme	High	Mod	Low	
Task only:						
Air Quality	Nuisance dust to others both on and off site.				✓	Dust suppression by watering
Gravel delivery trucks				✓		Covered loads when transporting
Loading and handling materials				✓		Keep FEL bucket low when handling and transporting materials
Road-ways and gravel hard stand storage areas				✓		Dust suppression by water truck

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6.2 CHEMICALS MANAGEMENT

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD is aware of the damage that can be caused by mismanagement and poor chemical controls to sensitive ecological communities and surrounds and remain committed to reducing the environmental impact of such chemicals or substances that are required for any work related tasks.

Objectives:

- To ensure negative environmental impacts arising from the use, transport and disposal of chemicals, including fuel and oil are eliminated or reduced as far as possible.
- To ensure that exposure standards (where relevant) are not exceeded

The objectives will be achieved by the following:

- Develop a chemical management program including:
    - Purchasing procedure that requires the sourcing of the most commercially and environmentally friendly products and chemicals available that will have the least toxic impact on the environment and to others as possible, while still performing its intended purpose.
    - Ensuring only minimal volumes are ordered as required
    - Allocate responsible persons to monitor, review and update the program as required
    - Development of comprehensive emergency response procedures where flammable or toxic materials are stored or handled. This will include a 24/7 emergency contact person, responsible person, and detailed instructions for emergency response and notification as relevant for type of materials stored
- Obtain Safety Data Sheets (SDS) and other relevant ecological data for any chemicals used- Retain and maintain SDS's and register
- Conduct risk assessment for human and environmental impacts
- Use non-toxic or the least toxic (human and ecological) chemicals where possible
- Ensure correct disposal, including collection of run-off, waste water from clean-up as required
- Provide adequate resources.
    - Low volume spray nozzles
    - Spill containment and suitable bunded equipment
    - Suitable storage areas and containers
    - Suitable transport vehicles, containers and loading/unloading procedures and equipment
    - Licenses, permits and training as required
    - Personal Protective Equipment (PPE)

• RESPONSIBILITIES		
Name	***Job Title***	***Reporting to:***
Clint Johnstone	Quarry Manager	Director
Brock Johnstone	Operations Manager	Director
Margaret Koutoumanos	Compliance Manager	Brock Johnstone , Clint Johnstone - Directors

References:
Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)
NSW Office of Environment and Heritage: (1997) Protection of Environmental Operations Act (PEOA)
NSW Office of Environmental and Heritage: (2010) PEOA (Clean Air) Regulations
NSW Chemical Control Orders (CCO)
NSW Office of Environment and Heritage (1985): Environmentally Hazardous Chemicals Act
NSW Office of Environment and Heritage (1997) Contaminated Land Management Act
NSW Office of Environment and Heritage (2014) PEOA (Waste) Regulations
NSW Dangerous Goods (Road and Rail Transport) Act 2008
AS 3833 – 2007: The Storage and Handling of mixed classes of dangerous goods, in packages and intermediate bulk containers
AS 3780 – 2008: The storage and handling of corrosive substances
AS 1940 – 2017: The storage and handling of flammable and combustible liquids

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Table: Risk Assessment and Controls in relation to Chemicals Management

Chem Name	Volume (kg/L)	Health and environment impacts	Risk Assessment				Controls
			Extreme	High	Mod	Low	
Task only:							
Diesel		Highly Flammable Toxic to aquatic organisms Can cause long-term adverse effects to aquatic environment Harmful if inhaled, ingested. Irritating to eyes and skin Carcinogenic		✓			Appropriate PPE Containers or tanks provided by manufacturer, are suitable for transport of flammables Bunded bulk storages No ignition sources within 6m of storage or refueling Provide suitable fire- fighting equipment Ensure containers closed No storage or refueling close to waterways Do not allow to enter drains, storm water drains, rivers, waterways etc Provide spill kits Documented Emergency Procedures Provide training on spill containment Dispose of according to Local Authority instructions Ensure adequate ventilation when refueling Provide SSD's and maintain register
Motor, hydraulic and transmission oils					✓	✓	PPE Provide SSD's and maintain register Bunded storage area Suitable storage containers Provide spill training and kits

6.3 FLORA AND FAUNA MANAGEMENT

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will endeavour to ensure minimal adverse impacts on local and adjoining ecosystems, in relation to terrestrial and aquatic flora and fauna resulting from work tasks.

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD is committed to limiting environmental impact from the following:

- Loss of habitat and biodiversity
- Spills and leaks

Objectives:

- Reduce/ prevent degradation of water and land habitats for native species

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will meet these objectives by:

- Development of flora and fauna management program specific to job. Including:
  - Ensure no activities are undertaken that place threatened species at risk
  - Allocate responsible persons to monitor, determine non-compliance, review and update the program as required
- Provide training for staff, including contractors on work practices to minimise potential damage to native flora/fauna, minimise soil disruption.

RESPONSIBILITIES		
Name	**Job Title**	**Reporting to:**
Clint Johnstone	Quarry Manager	Director
Brock Johnstone	Operations Manager	Director
Margaret Koutoumanos	Compliance Manager	Brock Johnstone , Clint Johnstone - Directors

References:
NSW Office of Environment and Heritage: (2016) Biodiversity Conservation Act
NSW Office of Environment and Heritage: (1979) Environmental Planning and Assessment Act
NSW Office of Environment and Heritage: (1974) National Parks and Wildlife Acts
NSW Office of Environment and Heritage (2015) Biosecurity Act
NSW Office of Environment and Heritage: (2013) Local Land Services Act
AS 1940 – 2004: The storage and handling of flammable and combustible liquids
Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)
NSW Office of Environment and Heritage: (1997) Protection of Environmental Operations Act (PEOA)

Table: Risk Assessment and Controls in relation to Flora and Fauna Management

All species are located within the Atlas Map of *Figure 3*

Common Name	NSW status *P – Protected* *E – Endangered* *V - Vulnerable*	Risk Assessment for Likely Impact			Controls
		HIGH	MED	LOW	
Common Eastern Froglet	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Salmon Striped Frog	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Sudell's Frog	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Eastern Banjo Frog	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Green Tree Frog	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Broad-palmed Frog	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Bynoe's Gecko	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Southern Spotted Velvet Gecko	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Thick-tailed Gecko	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Two-clawed Worm-skink	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Brown-blazed Wedgesnout Ctenotus	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Robust Ctenotus	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Black Rock Skink	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any

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					unnecessary clearing
Tree Skink	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Wood Mulch-slider	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Tree-base Litter-skink	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Nobbi	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Burns' Dragon	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Lace Monitor	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Yellow-faced Whip Snake	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Eastern Brown Snake	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Australian Brush-turkey	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Australian Brush-turkey	E2,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Stubble Quail	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Brown Quail	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Pacific Black Duck	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Australian Wood Duck	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Bar-shouldered Dove	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Peaceful Dove	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Crested Pigeon	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Common Bronzewing	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
White-throated Nightjar	P			✓	Check trees prior to any clearing, minimise

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					unnecessary tree clearing
Australian Owlet-nightjar	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Australian Pelican	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
White-necked Heron	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Wedge-tailed Eagle	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Spotted Harrier	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Black-shouldered Kite	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Little Eagle	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Nankeen Kestrel	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Sulphur-crested Cockatoo	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Galah	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Australian King-Parrot	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Red-winged Parrot	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Little Lorikeet	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Turquoise Parrot	V,P,3		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Blue Bonnet	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Eastern Rosella	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Red-rumped Parrot	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Fan-tailed Cuckoo	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Eastern Koel	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Channel-billed Cuckoo	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Southern Boobook	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Eastern Barn Owl	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Laughing Kookaburra	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Sacred Kingfisher	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Rainbow Bee-eater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Brown Treecreeper (eastern subspecies)	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing

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White-throated Treecreeper	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Spotted Bowerbird	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Superb Fairy-wren	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Variegated Fairy-wren	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Inland Thornbill	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Striated Thornbill	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Yellow Thornbill	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Brown Thornbill	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Southern Whiteface	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Speckled Warbler	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Western Gerygone	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
White-throated Gerygone	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
White-browed Scrubwren	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Weebill	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Spotted Pardalote	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Striated Pardalote	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Spiny-cheeked Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Eastern Spinebill	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Yellow-faced Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Singing Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Yellow-tufted Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Noisy Miner	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Lewin's Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Brown-headed Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Black-chinned Honeyeater (eastern subspecies)	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
White-eared Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Noisy Friarbird	P			✓	Check trees prior to any clearing, minimise

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					unnecessary tree clearing
White-cheeked Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Striped Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Fuscous Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
White-plumed Honeyeater	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
White-browed Babbler	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Black-faced Cuckoo-shrike	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Cicadabird	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Grey Shrike-thrush	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Eastern Shrike-tit	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Golden Whistler	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Rufous Whistler	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Olive-backed Oriole	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Black-faced Woodswallow	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Dusky Woodswallow	V,P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Pied Butcherbird	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Australian Magpie	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Grey Butcherbird	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Pied Currawong	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Grey Fantail	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Willie Wagtail	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Australian Raven	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Magpie-lark	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Restless Flycatcher	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Leaden Flycatcher	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
White-winged Chough	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Eastern Yellow Robin	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing

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Hooded Robin (south-eastern form)	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Jacky Winter	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Rufous Songlark	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Silvereye	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Welcome Swallow	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Mistletoebird	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Plum-headed Finch	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Red-browed Finch	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Diamond Firetail	V,P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Double-barred Finch	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Zebra Finch	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Short-beaked Echidna	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Yellow-footed Antechinus	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Sugar Glider	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Common Brushtail Possum	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Eastern Grey Kangaroo	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Common Wallaroo	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Swamp Wallaby	P			✓	Check surrounding bushland for nests or evidence of habitat prior to clearing, minimise any unnecessary clearing
Yellow-bellied Sheathtail-bat	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Large-eared Pied Bat	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing
Gould's Wattled Bat	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Chocolate Wattled Bat	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Corben's Long-eared Bat	V,P		✓		Check trees prior to any clearing, minimise unnecessary tree clearing

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Lesser Long-eared Bat	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Gould's Long-eared Bat	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Inland Broad-nosed Bat	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Little Broad-nosed Bat	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Central-eastern Broad-nosed Bat	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Little Forest Bat	P			✓	Check trees prior to any clearing, minimise unnecessary tree clearing
Flannel Flower	P			✓	Check regrowth vegetation onsite to ensure flora is not cleared
Tiger Orchid	P,2		✓		Check regrowth vegetation onsite to ensure flora is not cleared
Greenhood	P			✓	Check regrowth vegetation onsite to ensure flora is not cleared
Ooline	V,P		✓		Check regrowth vegetation onsite to ensure flora is not cleared
Johnson's Grass Tree	P			✓	Check regrowth vegetation onsite to ensure flora is not cleared

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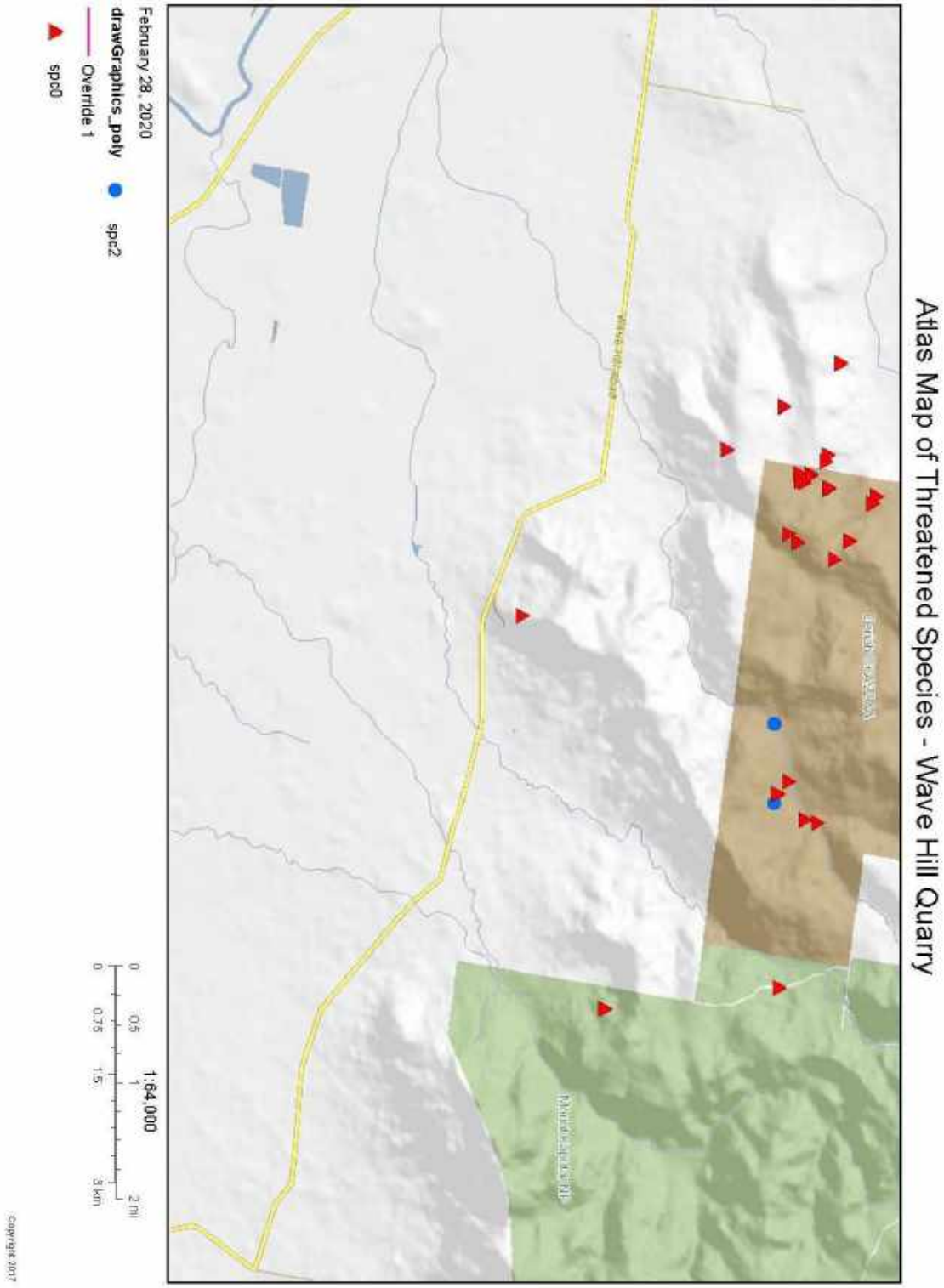

Figure 3: Threatened Species Map (Source: Bionet Atlas of NSW Wildlife - OEH)

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6.4 NOISE / VIBRATION MANAGEMENT

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD is committed to ensuring noise/vibration from work activities does not adversely affect the working community, buildings and structures

Objectives:

- Minimise the impact of noise / vibration to protect the amenity of sensitive receptors, such as other contractors or workers and prevent damage to buildings and structures.
- Identify possible sources of noise / vibration and likely exposed receptors, conduct risk assessments and apply best practice techniques to eliminate or reduce the environmental impact of noise / vibration
- Ensure JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD is not responsible for worksite complaints regarding noise or vibration
- Ensure noise/ vibration legislation standards are not exceeded.

The objectives will be met by implementing the following as required for task:

- Provide adequate resources as required.
    - Suitable timing of works in line with permits and approvals
    - Engineering controls fitted to equipment (silencers etc)
    - Regular maintenance of all equipment
    - Machinery operated within manufacturer's recommendations
    - Annual assessment and auditing of the adequacy and efficiency of resources and controls ISO9001 QMS
    - Maintain due diligence, controls of noise monitoring and recording

RESPONSIBILITIES		
Name	**Job Title**	**Reporting to:**
Clint Johnstone	Quarry Manager	Director
Brock Johnstone	Operations Manager	Director
Margaret Koutoumanos	Compliance Manager	Brock Johnstone , Clint Johnstone - Directors

References:
Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)
NSW Office of Environment and Heritage: (1997) Protection of Environmental Operations Act (PEOA)
NSW Office of Environmental and Heritage: (2010) PEOA (Clean Air) Regulations

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Table : Risk Assessment and Controls in relation to Noise/ Vibration Management

Task	Type of noise or vibration	Potential Impact	Risk Assessment				Controls
			Extreme	High	Mod	Low	
Drilling and blasting	Airborne noise & Vibration	Nuisance Environment Health & Safety Structural			✓ ✓ ✓	✓	• Liaise with sensitive receptors in relation to noise generation activities • Ensure production works undertaken only during specified times • Provide contact details for concerns and liaison • Ensure regular preventative maintenance of machinery • Ensure machinery is not defective and operated within manufacturer's specifications • Provide PPE (Hearing protectors) to staff • Initiate shutdown procedure if noise levels exceed those detailed in EPA Environmental Protection Licence 20139 or upon receipt of a complaint. Complaint to be recorded on complaints form (Appendix 4) and dealt with at the earliest convenience.
Quarry Equipment Operation	Airborne Noise	Nuisance Environment Health & Safety Structural			✓ ✓ ✓	✓	
Machinery Operations		Nuisance Environment Health & Safety Structural			✓ ✓ ✓	✓	
Gravel transport	Airborne Noise	Nuisance Environment Health & Safety Structural			✓ ✓ ✓	✓	

L3 Noise limits

L3.1 Noise generated at the premises must not exceed the noise limits in the table below.

Locality and Location	Day LAeq (15 minute)	Evening LAeq (15 minute)	Night LAeq (15 minute)	Night LA1 (1 minute)
Any affected residence	35	35	35	45

L3.2 For the purpose of the table above:

a) Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
b) Evening is defined as the period from 6pm to 10pm;
c) Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

Figure 1: Noise Limit Criteria from EPA Environmental Protection Licence 20139

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6.5 GROUNDWATER MANAGEMENT

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD understands the importance of groundwater management and the role groundwater plays in supporting ecosystems. Disturbance to groundwater can affect buildings, soil condition, tree and vegetation growth and public/private roadways.

Objectives:

- Minimise the impact to groundwater from work activities
- Identify possible sources of groundwater disturbance, conduct risk assessments and apply best practice techniques to eliminate or reduce the environmental impact.
- Conduct testing and monitor groundwater as required.

The objectives will be met by implementing the following as required for task:

- Determine extent of groundwater disturbance as a result of work activities and apply best practice techniques to reduce impact to groundwater and the surrounding environment. Include:
    - Impacts on nearby structures from potential settlement
    - Impacts on existing authorised groundwater users
    - Groundwater inflow control
    - Protocol to handle, treat and dispose of contaminated groundwater
- Exposed groundwater will be diverted, collected, tested and re-used in an environmentally sustainable way, such as for dust suppression as required.
-

RESPONSIBILITIES		
Name	**Job Title**	**Reporting to:**
Clint Johnstone	Quarry Manager	Director
Brock Johnstone	Operations Manager	Director
Margaret Koutoumanos	Compliance Manager	Brock Johnstone , Clint Johnstone - Directors

References:
Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)
NSW Office of Environment and Heritage: (1997) Protection of Environmental Operations Act (PEOA)
NSW Office of Environmental and Heritage: (2010) PEOA (Clean Air) Regulations
NSW Office of Environment and Heritage: (1994) Fisheries Management Act
NSW Office of Environment and Heritage: Water Management Act 2000
ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Table : Risk Assessment and Controls in relation to Groundwater Management

Task	Potential Impact	Risk Assessment				Controls
		Extreme	High	Mod	Low	
Aggregate production operations	• Groundwater inflow		✓			• Groundwater inflow to be contained in holding pond/s, tested for contamination and disposed of as required. • Periodic inspections will be undertaken to assess groundwater levels and effect on surrounding environment
	• Possible contamination from machinery fuel, oils etc		✓			• Ensure all machinery maintained and serviced. • Inspect all machinery before operation for fuel, oil or hydraulic fluid leaks. • Refueling area and tank to be bunded

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6.6 SURFACE WATER AND SOIL MANAGEMENT

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will endeavour to reduce the occurrence of salinity, reduction in water and soil quality and erosion as a result of work activities.

Objectives:

- To ensure efficient controls are implemented to control erosion, sedimentation and impacts on water quality.

The objectives will be met by implementing the following:

- Identify work practices that may negatively impact soil or water quality, assess the risk and implement controls using best practice technologies.
- Identify likely receptors (nearby waterways, wetlands, sensitive ecosystem)
- Divert undisturbed (uncontaminated) surface run-off in a manner to prevent erosion
- Prevent surface water from disturbed areas from entering waterways by use of sediment fences, straw bales sediment traps or other controls as required.
- Ensure all controls are in place before work commences
- Reclaim or recycle water wherever possible
- Create temporary or permanent sediment basins/traps if required and implement a program for regular inspection and cleaning
- Ensure on-site detention systems are sufficient capacity
- Ensure all spills and leaks are cleaned up immediately and waste disposed of correctly

RESPONSIBILITIES		
Name	**Job Title**	**Reporting to:**
Clint Johnstone	Quarry Manager	Director
Brock Johnstone	Operations Manager	Director
Margaret Koutoumanos	Compliance Manager	Brock Johnstone , Clint Johnstone - Directors

References:
Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)
NSW Office of Environment and Heritage: (1997) Protection of Environmental Operations Act (PEOA)
NSW Office of Environment and Heritage: (1994) Fisheries Management Act
NSW Office of Environment and Heritage: Water Management Act 2000
ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality
NSW Office of Environment and Heritage: (2015) Fisheries Management Amendment Act
NSW Office of Environment and Heritage: (1979) Environmental Planning and Assessment Act
NSW Office of Environment and Heritage (2015) Biosecurity Act
NSW Office of Environment and Heritage: (2016) Biodiversity Conservation Act
NSW Office of Environment and Heritage: (2013) Local Land Services Act
AS 1940 – 2004: The storage and handling of flammable and combustible liquids

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Table : Risk Assessment and Controls in relation to Surface Water and Soil Management

Task	Potential Impact	Risk Assessment				Controls
		Extreme	High	Mod	Low	
Task						
Aggregate production operations	Possible contamination of surface water from machinery fuel, oils etc		✓			• Ensure all machinery maintained and serviced. • Inspect all machinery before operation for fuel, oil or hydraulic fluid leaks. • No refueling within 25m of a waterway • Refueling area and tank bunded • Spills/leaks to be cleaned up and contaminated water/soil to be disposed of by licensed contractor. • Periodic tests to determine grease/oil levels adjacent waterway.
Runoff Monitoring during storm events	Possible contamination of surface water from machinery fuel, oils etc		✓			• Test kit to be available onsite and all staff trained in sample techniques. • Sampling to be undertaken of overflow from the Catch dam located in south east corner of the site as per EPA requirements (Oil and Grease and Total Suspended Solids) Sample COC attached in Appendix 5.

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6.7 WASTE MANAGEMENT

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD is committed to successfully conserving natural resources and is aware of the importance of waste management and reducing waste to landfill.

Objectives:

- To ensure the overall amount of waste is kept to a minimum.
- To ensure the handling, stockpiling and disposal of waste does not adversely impact the environment or community
- To ensure waste is disposed of meeting local, State and Federal requirements

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will meet these objectives by the following:

- Implementing the waste hierarchy:
    - Avoid
    - Reuse
    - Recycle/Re-process
    - Dispose
- Use of biodegradable and recycled/reprocessed substances and materials wherever possible
- Reuse materials wherever possible
- Development of purchasing procedures to ensure:
    - Number of items with expiry dates are kept to a minimum
    - Items have minimal packaging
    - Less hazardous products selected wherever possible
- Provide appropriate receptacles for each waste stream. Ensure these are labelled
- Conduct regular inspections/audits to ensure waste is separated as required
- Waste receptacles will not be stored in close proximity to sensitive areas such as waterways.
- Follow manufacturer's instructions for disposal of chemicals (Safety Data Sheet) along with local waste disposal facility direct
- Site toilets will be serviced regularly
- No Littering policy will be implemented. All litter will be picked up immediately and disposed of in appropriate receptacle
- Materials contaminated by leaks (such as fuel or oils) will be stored in a sealed container and transported to a suitable waste facility
- Incompatible wastes are kept separate
- Waste water collection and treatment system will be implanted as required. Contaminated water will be disposed of following State Authority requirements.
- Waste collection will be arranged at regular intervals to ensure no adverse impacts on the environment and community (such as overfilling of receptacles and subsequent littering, odour, pests or other disturbances)

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RESPONSIBILITIES		
Name	**Job Title**	**Reporting to:**
Clint Johnstone	Quarry Manager	Director
Brock Johnstone	Operations Manager	Director
Margaret Koutoumanos	Compliance Manager	Brock Johnstone , Clint Johnstone - Directors

References:
Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)
NSW Office of Environment and Heritage: (1997) Protection of Environmental Operations Act (PEOA)
NSW Dangerous Goods (Road and Rail Transport) Act 2008
AS 3833 – 2007: The Storage and Handling of mixed classes of dangerous goods, in packages and intermediate bulk containers
AS 3780 – 2008: The storage and handling of corrosive substances
AS 1940 – 2017: The storage and handling of flammable and combustible liquids

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Table : Waste Stream Management Register

Waste Management Register	
Waste stream	**Disposal Method**
General Rubbish	To be taken to the Narrabri Shire Council Waste Management Facility
Recyclables	To be taken to the Narrabri Waste Management facility for recycling
Oil and fuels	To be taken to an authorised disposal centre
Wastewater	Effluent to be treated and disposed of onsite using a septic tank and disposal area. Contaminated wastewater to be disposed of as required by the State Authority

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6.8 Environmental Triggers and Actions

All management, staff and contractors are to be aware of emission criteria during site operations or work being conducted on the site. Management, staff and contractors are to continuously be aware of operations and conditions of operation on the site. Where concerns are noted that a potential exceedance of operating criteria may occur or is occurring, the person identified as the site supervisor is to be verbally notified.

The Quarry Manager is responsible for compliance with site emission criteria. If it is noted that operation maybe or are exceeding these criteria or under the circumstances where a complaint is received that has identified a potential compliance issue with emissions, appropriate actions is to be undertaken immediately in order to mitigate these emissions.

Appropriate action would include but not be limited to the following activities:

Emission Type	Source	Mitigation Activity	Management & Monitoring
Dust	Crushing and screening plant	➢ Ensure water application systems are working – Increase the water flow ➢ Ensure dust housing remains in place. ➢ Slow the processing capacity ➢ ***If dust emissions cannot be reduced, cease operations until repairs are completed or wind conditions alter to reduce emissions***	➢ Refer Dust Management Plan for specific details of monitoring actions to verify the mitigation action has been successful.
	Road dust	➢ Utilise the water truck to suppress road dust ➢ Reduce truck speeds	
	Stockpile dust, wind borne dust	➢ Dampen down exposed stockpile areas that are generating dust	
Noise	Crushing and processing noise	➢ In the event that noise is excessive from the crushing process, alter the rate of crushing until noise levels reduce ➢ Alter the source of raw rock input to increase content of finer rock materials ➢ ***If noise emissions toward receptors cannot be reduced, cease operations until weather conditions***	➢ Refer Noise Monitoring Management Plan for specific details of monitoring actions to verify the mitigation action has been successful

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Emission Type	Source	Mitigation Activity	Management & Monitoring
		alter to reduce noise emissions toward receptors	
Water	Surface runoff after storm or rainfall event	➢ During normal site operations, ensure that any fuel or oil spills are cleaned up to prevent runoff of fuel related contaminants ➢ Check sedimentation pond silt levels after each severe rainfall event to ensure that sedimentation pond capacity is maintained ➢ Utilise water from silt ponds for dust suppression purposes ➢ Obtain water samples when pond overflow occurs	➢ Verify results from laboratory testing to determine compliance

The criteria for emissions are presented below:

Noise Emission Criteria

Locality and Location	Day LAeq (15min)	Evening LAeq (15 min)	Night LAeq (15 min)	Night LA1 (1 min)
Any affected residence	35	35	35	45

Dust Emission Criteria

As stated in EPL 20139, “All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.”

General Impact Assessment Criteria used in NSW is presented in the following table.

Pollutant	Averaging period	Concentration	Units
Particles as PM10	1 day	50	µg/m^3
Particles as PM 10	Annual	30	µg/m^3
Deposited dust	Annual	4	g/m^2/month
Deposited dust – maximum increase	Annual	2	g/m^2/month

Blasting

The following present limitations presented in the EPL under section L4 for Blasting emission criteria.

L4 Blasting

L4.1 The overpressure level from blasting operations at the premises must not exceed 120dB (Lin Peak) at any time and at any point within 30 metres of any non project related residential building or other noise sensitive location. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L4.2 The overpressure level from blasting operations at the premesis must not exceed 115dB (Lin Peak) for more than five per cent of the total number of blasts over each reporting period at any time and at any point within 30 metres of nay non project related residential biulding or other noise sensitive location. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L4.3 Ground vibration peak particle velocity from the blasting operations at the premises must not exceed 10mm/sec at any time and at any point within 3.5 metres of any non project related residential building or other noise sensitive location. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L4.4 Ground vibration peak particle velocity from the blasting operations at the premises must not exceed 5mm/sec for more than five per cent of the total number of blasts over each reporting period at any time and at any point within 3.5 metres of any non project related residential building or other noise sensitive location. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L4.5 Blasting operations on the premises must only be carried out between the hours 9am to 3pm, Monday to Friday, inclusive. Blasting is not permitted on Saturdays, Sundays or Public Holidays.

L4.6 The hours of operation for blasting operations specified in this licence may be varied by the EPA, having regard to the effect that the proposed variation would have on the amenity of the residents in the locality, gives written consent to the variation.

Water Discharge

The quality of water overflowing from the sediment and holding pond system must not exceed the following concentrations of potential pollutants identified under the EPL:

Pollutant	Unit of Measurement	Limit
Oil and Grease	mg/L	10
Total suspended solids	µg/L	50

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7. CONTRACTOR MANAGEMENT

All contractors and sub-contractors engaged to perform work on JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD premises or other nominated locations, are required to comply with relevant Legislation, Standards, Codes of Practice and JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD's Environmental management plans and programs.

Objective:

To incorporate JCLS P/L EMP requirements into every stage of contractor selection, approval, work processes and completion.

Policy:
JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will allocate responsibilities as follows:

- JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD Contract Managers:
  - Review environmental impacts for job
  - Review contract to ensure environmental impacts are controlled

- JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD Site Management:
  - Induction for contractors
  - Permits to work
  - Licenses, competencies
  - Risk assessment and EMP implementation
  - Supervision

- Contractor:
  - Evidence of licenses, training and competency to perform work
  - Development and implementation of risk assessments, risk controls
  - Compliance with above
  - Compliance with Environmental legislation,
  - Participate in site meetings and site consultative arrangements

References:
NSW Environmental Legislation

8. LEGISLATIVE CHANGE MANAGEMENT

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD embraces opportunities to improve knowledge about new legislation and best practice solutions and technologies to reduce environmental impacts from work activities.

Objective

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will pro-actively seek out advice, education and industrial knowledge to foster continual improvement in environmental management systems and updates of relevant legislation.

Policy

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will endeavour to manage legislative change by:

- Assigning responsibilities for researching legislative changes with State and Federal Authorities
- Seek advice from suitably qualified persons where required
- Attending conferences, trade shows etc where possible.
- Ensuring refresher training is undertaken where required
- Liaising with local Authorities as required

References:
NSW Environmental Legislation

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9. ROLES, RESPONSIBILITIES & ACCOUNTABILITIES

Successfully managing environmental impacts relies on commitment, consultation and co-operation. Everyone needs to understand the need for mitigation controls, what their role is in reducing environmental impacts, and how they can fulfill their responsibilities and duties

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD allocates the following responsibilities:

Directors:

- Approval of EMP's and environmental protection policies
- Communication of EMP and policies
- Leadership
- Allocating sufficient resources
- Providing direction for increasing performance

Management:

- Integration of environmental considerations into all decision making
- Consult with relevant workers and contractors
- Planning, developing, implementing, monitoring and reviewing EMP and environmental policies and programs
- Control risks
- Communication in relation to environmental plans, policies, programs
- Identify training needs and enable training as required
- Reporting and recording
- Liaise with relevant State Authorities
- Meet legislative requirements

All relevant workers (including sub-contractors and relevant workers of sub-contractors):

- Comply with EMP, environmental policies, procedures and programs
- Work in a manner that does not create unnecessary risks to the environment
- Report and assist to rectify hazards/non-conformances
- Participate in consultative arrangements

Relevant persons:

- Develop, monitor and review EMP, environmental policies and procedures
- Monitor and report on environmental performance
- Monitor changes in legislation
- Review Corrective Actions/Non-conformances
- Provide environmental information to relevant workers

References:
Environmental Legislation in all States

10. TRAINING, COMPETENCY AND AWARENESS

Training is vital to assist relevant workers to perform their work. JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will arrange training which covers environmental impacts related to tasks being performed, as well as training in the overall approach to environmental protection taken by our organisation.

Objective

To provide training to all relevant workers and contractors to ensure they have the skills and competencies for work in a manner that does not create unnecessary risks to the environment.

Policy

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD will:

- Conduct training needs across the organization where it neccitates
- Develop formal training needs and competencies for position requirements at all levels, including management.
- Provide formal induction programs for new and transferred relevant workers and contractors
- Use Registered Training Organisations (RTO) and appropriately accredited and approved courses/trainers
- Ensure training is competency based
- Record all training
- Review effectiveness of training
- Provide training for languages other than English and other relevant learning barriers

Training will include:

- All environmental policies, EMP and procedures for the organisation
- Licenses and competencies to perform tasks
- Specific hazards risk controls
- Consultation and communication arrangements
- Corrective actions and non-conformances
- Emergency Response (spill containment etc)

All managers and supervisors will be provided with additional training to ensure that they are aware of their responsibilities under the EMP and environmental management systems. This training includes legislative responsibilities for managers and supervisors.

References:
NSW Environmental Legislation

11. RELEVANT WORKER AGREEMENT

I have read and agree to abide by JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD EMP. I have raised any questions or issues that required clarification with my Person Conducting a Business or Undertaking (PCBU). I am aware that breaches of the EMP will be subject to disciplinary action.

Relevant worker Sign-off Register	
Name	**Date & Signature**

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12. CONTRACTOR AGREEMENT

I have read and agree to abide by JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD EMP. I have raised any questions or issues that required clarification with my JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD. I am aware that breaches of the EMP will be subject to disciplinary action.

Contractor Sign-off Register		
Name	**Company**	**Date**

13. AUDITS

Johnstone Concrete & Landscape Supplies Pty Ltd will ensure auditing of the environmental management plan requirements and measures are carried out on a yearly basis which will be integrated into the QM plan. These audits will determine the ongoing implementation of the EMP along with objectively providing evidence of conformity and maintenance of the plan. The results of these audits will be reported back to JCLS Management Meeting.

Objective

To provide an audit programme(s) that is planned, established, implemented and maintained taking into consideration the environmental requirements of the site, operations and the results of previous audits.

Audit procedure(s) shall be established, implemented and maintained that will address:

- The responsibilities and requirements for planning and conducting audits, reporting results and retaining associated records.
- The determination of audit criteria, scope, frequency and methods.

Responsibility

Senior company management will designate specific management representative/s with defined responsibility and authority to monitor, audit and report back the ongoing implementation and compliance of JCLS P/L environmental requirements.

Reporting

Auditing will be documented with non-compliance or deficient areas recorded and reported on a NCR form with corrective action follow ups and further recorded details maintained on CAR report. These records will be used as both a continual improvement mechanism and objective evidence of continuing compliance of the environmental conditions required as contained in the EMP.

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14. GLOSSARY

Act
A law (legislation) passed and enacted by a state or territory parliament, also commonly known as an Act of Parliament. Acts are the principal pieces of law covering, in this case, environmental protection.

Bunding
A retaining system designed to contain the contents of a tank or chemical storage in the event of a rupture/spill or leak

Contractor
A contractor is any person (other than an JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD relevant worker) or a company performing work for, or on behalf of JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD

Decibel
A unit used to measure the intensity of a sound or the power level of an electrical signal by comparing it with a given level on a logarithmic scale.

Ecological
The science of the relationships between organisms and their environments

Hazard
A hazard is a source or a situation with a potential for harm in terms of human injury or illness, damage to property, damage to the environment, or a combination of these

HEPA Filter:
A High Efficiency Particulate Absorbing filter is a type of high-efficiency air filter that can effectively trap pollutants.

Internal Audit:
A systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the set audit criteria are fulfilled.

Safety Data Sheet (SDS)
Information containing data regarding the properties and effects of a particular substance that must be provided, by the manufacturer, supplier or importer of the hazardous substance/dangerous goods. SDS must be current – within 5 years of the issue date and meet specific legislated format requirements

Particulates:
Fine liquid or solid particles, such as dust, smoke, mist, fumes or smog, found in air or emissions.

Regulations
Regulations are law that is created under the authority of an Act. Regulations are subordinate to an Act and are the secondary level of law covering, in this case, environmental protection.

Risk
Risk is a combination of the likelihood and consequences of any incident or impact occurring.

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Water table:
Underground - the upper limit of the portion of the ground wholly saturated with water. The water table may be within a few inches of the surface or many feet below it

Weather Inversion

A temperature inversion is a thin layer of the atmosphere where the normal decrease in temperature with height switches to the temperature increasing with height. An inversion acts like a lid, trapping the atmosphere, including pollutants, below the inversion, allowing them to build up.

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APPENDIX 1: MONITORING SCHEDULE

Use the following to record who is responsible for monitoring compliance with each aspect of the EMP and to ensure non-compliances, where detected, are rectified in a timely manner.

Task	Responsible person	Corrective Actions	Timeframe for corrective action	Completed (Y/N)
Water Quality Monitoring	Management	• Collect water samples from overflow events at the Catchment dam	Within 24hours of overflow event	
Noise	Management	• If noise complaint received, check levels if levels exceed INP levels stop operation check machinery, re-check levels	Upon Complaint	
Air Quality	Management	• During periods of excessive dust generation use dust suppression sprays on machinery and water roads. • If complaint received initiate shutdown procedures until investigation complete and initiate corrective measures.	Immediate action Refer to TARP	
Weather	Management	• Monitor weather data onsite • Download weather data regularly	Continuous	

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APPENDIX 2: CHECKLIST

Complete a Non-compliance Report/Corrective Action Report for any "NO" answers.

Project Name: Wave Hill Quarry			
Project Location: Wave Hill Road			
Environmental Controls: Site Specific	Yes	No	Comments
Air Quality			
Are vehicles being restricted to sealed or dedicated areas?			
Is machinery complying with emission standards (i.e. emissions not visible for more than 10 seconds)?			
Are truck and vehicle speeds below 20km/hr on unsealed access tracks?			
Soils and Hydrogeology			
Are geotextile fences installed in appropriate locations and secure?			
Are geotextile fences clean and well-maintained?			
Is overburden being placed upslope as a protective bund?			
Noise Control			
Is all site work being conducted inside prescribed hours (ibetween 7am-5pm Mon to Sat)?			
Hazardous Goods			
Are MSDS available?			
Are spill kits on-site and complete?			
Are all chemicals, fuel and wastes being kept in appropriately sealed containers or storages and not leaking onto ground or into water-ways?			
Waste Management			
Are rubbish containers and other waste being removed from site regularly?			
Is the site left in a tidy and safe condition every day?			
Subcontractors			
Have all subcontractors completed a site induction?			
Are all subcontractors complying with the EMP?			

Name of person inspecting site:
Signature:
Date and time of inspection:

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APPENDIX 3: SITE INDUCTION PROCEDURES

Truck Operations Induction Procedure	
Control Noise and Dust Emissions	
Truck operators Regulations	It is the responsibility of the truck operator to conform to JCLS site policies for truck standards and operation within the boundary of the JCLS site
	Operate equipment in accordance with the equipment operator's manual.
	Trucks entering the site must be maintained in accordance with the manufacturer's specification to comply with relevant noise and emission regulations
	All operators are to comply with regulation speed limits and road rules when travelling to and from the site
	Ensure that all guards and silencers are in place when equipment is being used.
	Truck operator to provide details of registration and truck road worthy certification upon request by Management
	Avoid unnecessary engine revving during operations.
	Do not exceed the speed limit of 10kph on the site for all heavy vehicles.
	Avoid the use of exhaust brakes on trucks while traversing the site.
	Trucks to reverse a minimum 10m before approaching the weigh bridge to remove dust from the wheel rims
	Trucks may only enter and exit the site from the main entrance road.
Management of Regulations	JCLS has the right to request an Operator to remove his truck from the site if it is suspected that the truck or operator does not conform to manufacturers specifications or the operator does not abide by these regulations established for vehicle operation on this site.

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General Site Induction/ Operating Procedure	
All Personnel	All personnel are required to undertake a site induction and sign to verify they understand the policies, procedures and their responsibilities white working on the site. Any person not willing to undertake site induction will not be allowed to enter the site and will be asked to leave.
	Personal Protective Equipment it to be worn at all times while operating on the site. Any person not complying with JCLS policies will be asked to leave the site.
	All personnel to be aware of dust and noise requirements and understand the shutdown procedures required should either be exceeded.
	All personnel are to be aware to the complaints register and understand how to complete the require forms should a complaint be made.
	All complaints are to be reported to Management and dealt with in a timely manner.
	Staff should selectively and carefully place materials into an empty truck or trailer to avoid larger rocks hitting the floor and creating unnecessary noise.
	Staff should selectively and carefully place materials into the primary hopper when it is empty, and once it is charged with rock, maintain a constant flow of rock into the hopper, so that new rock is always introduced onto other rock from the previous load, and does not strike the walls/floor of the hopper.
	Staff should plan machinery operations (particularly excavator/front end loader) so that they occur in locations where they are screened by stockpiles or the quarry walls to reduce line of sight noise emissions towards sensitive receptors.
	Staff should arrange travel paths for trucks entering and leaving the site to utilise the trucks as a noise barrier during loading operations (i.e. position the truck between the loader/excavator and sensitive receptors) and to minimise the requirement for the manoeuvring of fully laden trucks within the quarry area.
	All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.
	Trucks entering and leaving the premises that are carrying loads must be covered at all times, except during loading and unloading.
	Participate and comply with Pollution Incident Response Management Plan (PIRMP)
	Participate in annual testing of PIRMP
Responsibility	It is the responsibility of all staff to ensure that the site operating procedures, as detailed above, are complied with at all times during operations.

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APPENDIX 4: COMPLAINTS FORM

Complaint Form		
Date:	Time:	Name of person receiving the complaint:
Name of Complainant:		
Address of Complainant:		
Contact Details of Complainant:		
Date and Time of Incident:		
Complaint detail:		

Wind direction and estimate wind speed at time of incident:
Possible cause of pollution/Pollution source:
Action to resolve complaint
Complaint acknowledged: Date: ..... Time: .....
Complainant Advised of any action : Date: ..... Time: .....
Person the complaint was referred to:

APPENDIX 5: OVER FLOW SAMPLE PROCEDURES & COC FORM

Sample bottles are stored in the weighbridge office. The overflow is required to be sampled from the catchment dam in the south east corner of the site. This sample needs to be taken within 24 hours of an overflow event.

The samples are to be taken from the over flow point using the two bottles provided (one Plastic Bottle and one amber glass wide mouth jar when the overflow is occurring.

The sample bottles are to be clearly labelled with the date, time of the sample and the name of the person taking the sample.

Once the samples have been obtained, they will need to be refrigerated/chilled prior to being transported to ALS Laboratory in Sydney for analysis. The samples will need to be packaged in an esky with an Ice brick and sent via freight to the address below. A chain of custody form must accompany the samples. A sample copy of the Chain of Custody Form is included in this appendix.

Shipping Address:

ALS Environmental

277-289 Woodpark Road

SMITHFIELD NSW 2164

Phone: 02 8784 8555

Email: samples.sydney@alsglobal.com

JOHNSTONE CONCRETE & LANDSCAPE SUPPLIES PTY LTD

ABN: 43 151 205 882

PO Box 878 Narrabri NSW 2390 Ph: 026792 3036 Fax: 0267924778

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

- ❑ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
- ❑BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
- ❑GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
- ❑MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
- ❑MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
- ❑MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
- ❑NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
- ❑NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
- ❑PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
- ❑SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
- ❑TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townesville.environmental@alsglobal.com
- ❑WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: SMK Consultants
OFFICE: Moree
PROJECT: JCLS - Wave Hill Overflow Event
ORDER NUMBER:
PROJECT MANAGER: Peter Talyor — **CONTACT PH:** 02 6752 1021
SAMPLER: — **SAMPLER MOBILE:**
COC emailed to ALS? (YES / NO) — **EDD FORMAT (or default):**
Email Reports to (will default to PM if no other addresses are listed): peter.taylor@smk.com.au
Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☐ Standard TAT **(List due date):**
☐ Non Standard or urgent TAT **(List due date):**
ALS QUOTE NO.:

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt:		°C	
Other comment:			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
DATE/TIME:	DATE/TIME:	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Oil & Grease	Total Dissolved Solids							Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	Wavehill (Overflow)		W	SG, P	2	1	1							
				TOTAL		1	1							

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Prese
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

APPENDIX 6: NOISE MONITORING MANAGEMENT PLAN

WAVE HILL QUARRY

NOISE MONITORING MANAGEMENT PLAN

MARCH 2020

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Document Verification

Johnstone Concrete and Landscape Supplies – Wave Hill Quarry NMMP				
Document title:	Noise Monitoring Management Plan – Wave Hill Quarry			
Revision	Date	Prepared by	Reviewed by	Authorised by
0	4th August 2014	Sarah Grady B.Env.Sc	Peter Taylor B.Sc. MEIANZ	Ian Johnstone
1	10th June 2016	Hayley Greenham B. Bus, B.Sc. Env	Peter Taylor B.Sc. MEIANZ	
2	9th March 2017	*Update – Margaret Koutoumanos Compliance Manager*	Clint Johnstone	Clint Johnstone (Director – under direction Ian Johnstone)
3	15th March 2018	*Revised – Margaret Koutoumanos*	Clint Johnstone	Clint Johnstone (Director)
4	30th April 2019	*Revised Margaret Koutoumanos*	Clint Johnstone & staff onsite	Clint Johnstone (Director)
5	7th March 2020	*Revised SMK* **Marie Duffy** B.Sc. Hons, M.Sc.	**Marie Duffy** B.Sc. Hons, M.Sc.	Clint Johnstone (Director)

Introduction

The following presents a Noise Monitoring Management Plan (NMMP) for the operation of Wave Hill Quarry by Johnstone Concrete and Landscape Supplies. The Plan has been prepared in accordance with the requirements of the Development Consent Conditions, the Environment Protection Licence (EPL) and company Objectives under the OEMP.

Noise Monitoring Management Plan	
Issue	**Safeguards**
Scope and Objectives	The scope of this management plan is to provide details of noise monitoring to be undertaken upon receipt of noise emission complaints and the initial scheduled noise monitoring to be undertaken for compliance assessment by JCLS.
	The objective of this plan is to provide management and staff with sufficient detail to ensure measurements are undertaken using appropriate location and procedures to examine compliance with site approval conditions.
	This Noise Monitoring Management Plan shall consider all operational consent conditions issued by the Narrabri Council as part of development consent conditions and under the EPL.
Roles and Responsibilities	Persons responsible for noise management and decision making shall be delegated suitable authority to take action to achieve the objectives of this plan.
	The Primary role is delegated to the Directors
	The secondary role is delegated to the site supervisor/s on a daily or shift basis in addition to the Quarry Manager.
	All staff employed on the site shall be aware of the plan and their responsibilities to manage the impact of their specific role on the site.
	Where required, the site operator shall refer noise assessment, interpretation of noise data, monitoring methods to a competent person.
	Operational noise shall conform to the NSW INP as determined in consent conditions and conditions imposed under the EPL.
Site Operating Procedures	Staff should selectively and carefully place materials into an empty truck or trailer to avoid larger rocks hitting the floor and creating unnecessary noise.
	Staff should selectively and carefully place materials into the primary hopper when it is empty, and once it is charged with rock, maintain a constant flow of rock into the hopper, so that new rock is always introduced onto other rock from the previous load, and does not strike the walls/floor of the hopper.
	Staff should plan machinery operations (particularly excavator/front end loader) so that they occur in locations where they are screened by

Noise Monitoring Management Plan	
Issue	**Safeguards**
	stockpiles or the quarry walls to reduce line of sight noise emissions towards sensitive receptors.
	Staff should comply with travel paths for trucks entering and leaving the site to utilise the trucks as a noise barrier during loading operations (i.e. position the truck between the loader/excavator and sensitive receptors) and to minimise the requirement for the manoeuvring of fully laden trucks within the quarry area – Follow the Traffic Management Plan of the Quarry.
Noise Logging	A calibrated and operational portable noise meter, capable of logging data, is to be used onsite as necessary.
	When required for periods of extended monitoring, appropriately calibrated noise loggers shall be established on the selected site/s and operated in accordance with relevant standards.
Monitoring	Establish noise logging equipment to record noise emissions from the site in accordance with the objectives stated in this NMMP.
	Noise monitoring is to be undertaken to determine noise levels and noise sources at relevant receptors or complainants until sufficient information is available to obtain appropriate noise data to assess either the complaint, compliance levels, source of noise emission.
	Noise monitoring is to be conducted on an as required basis at pre-established locations as outlined below for the purpose of quantifying noise emissions from the site and determining compliance with emission criteria as outlined above.
	If a complaint is received relating to noise emissions, verify the level and source of noise that caused the complaint in order to rectify or modify the source of noise.
Monitoring Point 1	Homestead 1 (Western side) – Monitor to be located at Logger point 1 or under agreement adjacent to residence as per Figure 1
Monitoring Point 2	Monitor to be located at Logger 2 location – southeast corner of quarry land
Monitoring Point 3	Homestead 2 (East) – Monitor to be located adjacent to house 2 on **figure 1** under agreement with resident
Rover monitoring	Attended monitoring to be undertaken at complainant's receptor point on an as required basis (e.g. When complaint is received)
Noise Analysis	All monitoring readings are to be retained as a record of noise emissions from the site and be made available for inspection by Managing Director, staff and other authorised by the Quarry Manager to inspect the data.
	Conduct an analysis of recorded data to determine whether noise criteria adopted to quantify noise spikes and source of noise spike emissions.
	Ensure noise criteria as established for the site under approval conditions and EPL conditions are being met,

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Noise Monitoring Management Plan	
Issue	**Safeguards**
	The noise calculations and definitions provided in the NSW INP and the Interim NSW Construction Noise Guideline to be adopted for this site.
Noise Criteria	Noise emission criteria are presented in the EPL (No. 20139) section L3 (L3.1) Noise Limits. These noise criteria are to be adopted as the noise limitations from the site unless modified in the EPL or any other overriding document.

Locality and Location	Day LAeq (15min)	Evening LAeq (15 min)	Night LAeq (15 min)	Night LA1 (1 min)
Any affected residence	35	35	35	45

	For the purpose of the above table: Day is defined as the period from 7 am to 6 pm Monday to Saturday Evening is defined as the period from 6 pm to 10 pm Night is defined as the period from 10 pm to 7 am Monday to Saturday and 10 pm to 8 am Sundays and Public holidays.
Noise Monitoring Equipment	Noise monitored to be undertaken with NATA calibrated noise monitoring equipment by a competent person.
Weather	Record weather data from site records to provide basis for assessment of monitoring data.
	Weather logger located at weighbridge to record wind direction, wind speed, and temperature. Records to be maintained by management.
Noise Monitoring Frequency	Noise monitoring is to be undertaken on an as needed basis to determine general noise emissions and provide an education/quantification process to staff involved in the construction and operation process.
	Noise monitoring to be undertaken on an as required basis or in response to a noise complaint until sufficient data is collected to determine that site operations are meeting compliance levels
	Noise monitoring to be undertaken when directed under the EPL.
	Roving noise monitoring shall be undertaken during Operations for testing of new equipment or operational procedures to ensure noise emission criteria are met and shall continue "as necessary". **"As necessary"** is defined as during maintenance inspections and upon receival of a complaint.
	If noise emissions are not quantified by the frequency as established above, noise levels shall be quantified when site operations are varied from previous recording periods for variations of machinery type and

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Noise Monitoring Management Plan	
Issue	**Safeguards**
	weather conditions.
Amendments	The plan shall be amended by JCLS as required to ensure that any changes to site operations, conditions and/or approvals are represented in this plan.

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ROVING Noise Monitoring Form

Sound level Meter results

Date				
Time				
Duration				
Purpose				
Recorded file name				
Source description				
Measurement Location				
Operator				
Noise Pattern C = continuous In = Intermittent IM = Impulse/Impact	C In IM	C In IM	C In IM	C In IM
Result				
L Aeq,15 min				
Lmax				
Lmin				
L A90.15 minute				

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Distance from noise source				
Field Calibration OK: Yes / No				
Field Calibrated By:				

TRIGGER ACTION RESPONSE PLAN – TARP - NOISE

	TRIGGER	ACTION	RESPONSE
MEDIUM RISK EVENT	▪ Noise Complaint received	**1. INVESTIGATE COMPLAINT** **2. DETERMINE IF ADDITIONAL NOISE MONITORING IS REQUIRED TO ADEQUATELY INVESTIGATE COMPLAINT – LOOK AT CCTV FOOTAGE IF NECESSARY** **3. DOCUMENT THE COMPLAINT AND INVESTIGATION**	➢ If the noise is attributed to Wave Hill Quarry, review whether an exceedance has occurred or is likely to occur (including a review of weather conditions – wind). If an exceedance has occurred or is likely to occur, review and modify quarry operations until compliance is achieved and/or the complaint has been resolved. If noise is to be determined by another source, record the investigation. ➢ Arrange noise monitoring if required ➢ Respond to the complaint with outcomes of the investigation
	TRIGGER	**ACTION**	**RESPONSE**
L3 HIGH RISK EVENT	▪ Exceedance of noise as per the EPA licence	**INVESTIGATE NOISE SOURCE USING ATTENDED NOISE MONITORING AND DEVELOP ACTIONS TO REDUCE WAVE HILL QUARRY NOISE.** **IF THE RESULTS OF ATTENDED MONITORING ARE GREATER THAN THE ALLOWABLE NOISE LEVELS JCLS SHALL NOTIFY THE AFFECTED LANDHOLDERS AND PROVIDE REASONS WHY THE NOISE SHALL BE EXCEEDING THE LIMITS. JCLS SHALL PROVIDE QUARTERLY MONITORING RESULTS TO EACH OF THE LANDHOLDERS UNTIL THE NOISE COMPLIES WITH NOISE LEVELS AS SET OUT IN THE EMP.**	➢ Review NMP including frequency of attended noise monitoring. ➢ Document the incident, investigation and outcomes.

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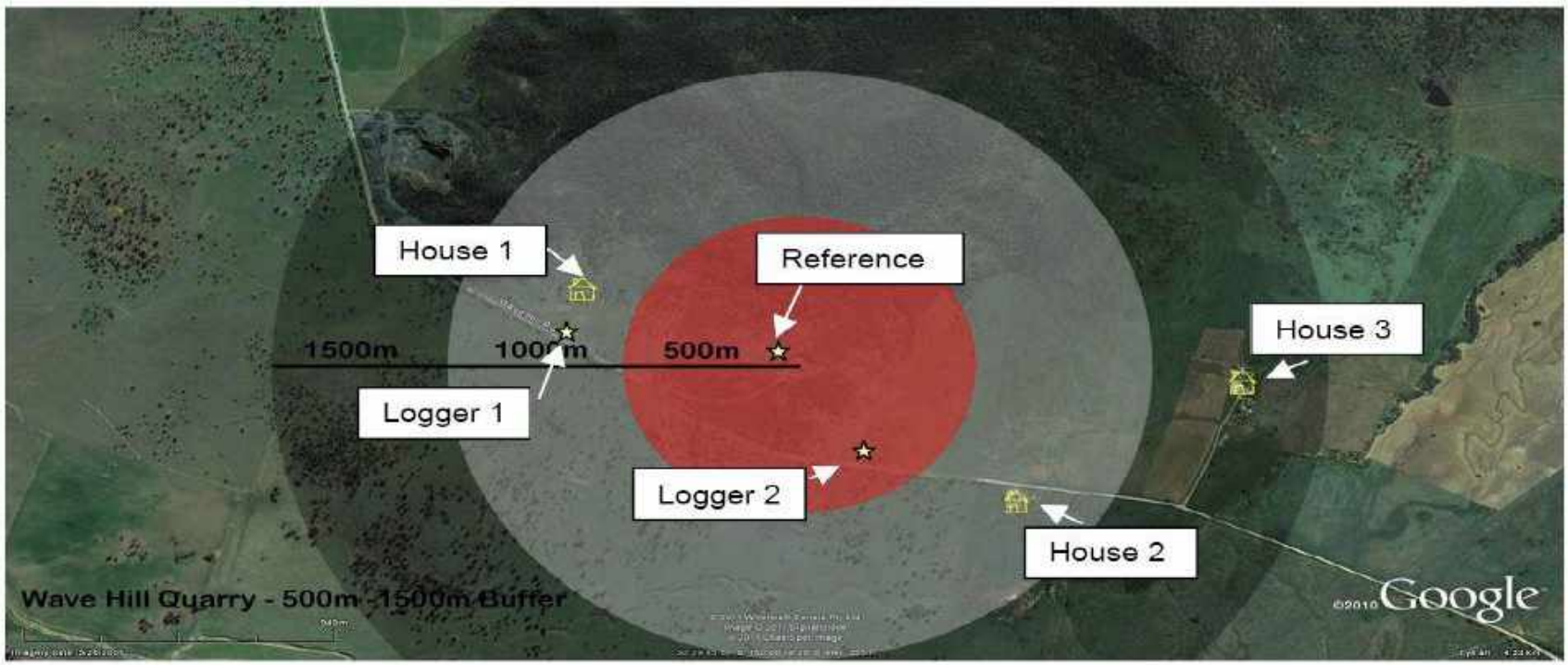

Figure 1: Wave Hill quarry - Receivers and Logging locations.

APPENDIX 7: DUST MONITOING MANAGEMENT PLAN

WAVE HILL QUARRY

DUST MONITORING MANAGEMENT PLAN

MARCH 2020

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Document Verification

Johnstone Concrete and Landscape Supplies – Wave Hill Quarry DMMP				
Document title:	Dust Monitoring Management Plan – Wave Hill Quarry			
Revision	Date	Prepared by	Reviewed by	Authorised by
0	5th August 2014	Sarah Grady B.Env.Sc	Peter Taylor B.Sc. MEIANZ	Ian Johnstone
1	9th March 2017	*Updated Margaret Koutoumanos Compliance Manager*	Clint Johnstone Quarry Manager	Ian Johnstone
2	15th March 2018	*Revised – Margaret Koutoumanos*	Clint Johnstone	Clint Johnstone (Director)
3	30th April 2019	*Revised – Margaret Koutoumanos*	Clint Johnstone & staff on site	Clint Johnstone (Director)
4	7th March 2020	**Marie Duffy** B.Sc. Hons, M.Sc.	**Marie Duffy** B.Sc. Hons, M.Sc.	Clint Johnstone (Director)

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Introduction

The following presents a Dust Monitoring Management Plan (DMMP) for the operation of Wave Hill Quarry by Johnstone Concrete and Landscape Supplies. The Plan has been prepared in accordance with the requirements of the Development Consent Conditions, the Environment Protection Licence (EPL) and company Objectives under the OEMP.

Dust Monitoring Management Plan	
Issue	**Safeguards**
Scope and Objectives	The scope of this management plan is to provide details of dust monitoring to be undertaken upon receipt of dust emission complaints and the initial scheduled dust monitoring to be undertaken for compliance assessment by JCLS.
	The objective of this plan is to provide management and staff with sufficient detail to ensure measurements are undertaken using appropriate location and procedures to examine compliance with site approval conditions.
	This Dust Monitoring Management Plan shall consider all operational consent conditions issued by the Narrabri Council as part of development consent conditions and under the EPL.
Roles and Responsibilities	Persons responsible for dust management and decision making shall be delegated suitable authority to take action to achieve the objectives of this plan.
	The Primary role is delegated to the Managing Director
	The secondary role is delegated to the site supervisor/s on a daily or shift basis in addition to the Quarry Manager.
	All staff employed on the site shall be aware of the plan and their responsibilities to manage the impact of their specific role on the site.
	Where required, the site operator shall refer dust assessment, interpretation of dust data, monitoring methods to a competent person.
Dust Monitoring	A calibrated and operational portable dust monitor, capable of logging data, is to be used onsite as necessary.
	When required for periods of extended monitoring, dust deposition gauges shall be established on the selected site/s and analysed in accordance with relevant standards by a NATA accredited lab.
	Establish dust monitor/s and dust gauge equipment to monitor dust emissions from the site in accordance with the objectives stated in this DMMP.
	Dust monitoring is to be undertaken to determine dust levels and dust sources at relevant receptors or complainants until sufficient information is available to obtain appropriate dust data to assess either the complaint, compliance levels and source of dust emission.
Dust Emission Response to Complaint	If a complaint is received relating to dust emissions, verify the level and source of dust that caused the complaint in order to rectify or modify the source of dust.
Monitoring Point 1	Homestead 1 (Western side) – Monitor to be located at Logger point 1 or under agreement adjacent to residence as per Figure 1
Monitoring Point 2	Monitor to be located at Logger 2 location – southeast corner of quarry land
Monitoring Point 3	Homestead 2 (East) – Monitor to be located adjacent to house 2 on **Figure 1** under agreement with resident
Rover monitoring	Attended monitoring to be undertaken at complainant's receptor point on an as required basis (e.g. When complaint is received)

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Dust Monitoring Management Plan	
Issue	**Safeguards**
Dust Analysis	All monitoring readings are to be retained as a record of dust emissions from the site and be made available for inspection by Managing Director, staff and other authorised by the Quarry Manager to inspect the data.
	Conduct an analysis of recorded data to determine whether dust emissions meet the criteria adopted.
	Ensure dust criteria as established for the site under approval conditions and EPL conditions are being met
Dust Emission Criteria	As stated in EPL 20139, "All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises." General Impact Assessment Criteria used in NSW is presented in the following table.

Pollutant	Averaging period	Concentration	Units
Particles as PM10	1 day	50	µg/m^3
Particles as PM 10	Annual	30	µg/m^3
Deposited dust	Annual	4	g/m^2/month
Deposited dust – maximum increase	Annual	2	g/m^2/month

Dust Monitoring Equipment	Dust monitored to be undertaken with NATA calibrated dust monitoring equipment by a competent person.
	Dust Deposition gauges to set up and collected by a suitably qualified person and the bottles are to be analysed by a NATA accredited lab.
Weather	Record weather data from site records to provide basis for assessment of monitoring data.
	Weather logger located at weighbridge to record wind direction, wind speed, and temperature. Records to be maintained by management.
Dust Monitoring Frequency	Dust monitoring to be undertaken when directed under the EPL.
	Roving dust monitoring shall be undertaken during Operations for testing of new equipment or operational procedures to ensure dust emission criteria are met and shall continue "as necessary". **"As necessary"** is defined as during maintenance inspections and upon receival of a complaint.
	If dust emissions are not quantified by the frequency as established above, dust levels shall be quantified when site operations are varied from previous recording periods for variations of machinery type and weather conditions.
Amendments	The plan shall be amended by JCLS as required to ensure that any changes to site operations, conditions and/or approvals are represented in this plan.

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ROVING Dust Monitoring Form				
Dust level Meter results				
Date				
Time				
Duration				
Purpose				
Recorded file name				
Source description				
Measurement Location				
Operator				
Result				
Particles as PM 10				
Field Calibration OK: Yes / No				
Field Calibrated By:				

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TRIGGER ACTION RESPONSE PLAN (TARP) – DUST

	TRIGGER	ACTION	RESPONSE
L1 NORMAL EVENT	▪ Normal temperature ▪ Wind speed less than 20kph	**1. TRUCKS MUST USE TARPS AT ALL TIMES EXCEPT LOADING AND UNLOADING** **2. MONTHLY DUST MONITORING** **3. 2 YEARLY PERSONNEL DUST MONITORING** **4. WHEN OPERATING PLANT ENSURE CABINS ARE CLOSED TO ENSURE NO DUST INFILTRATION** **5. ADHERE TO 10KM SPEED LIMITS TO MINIMISE DUST DISTURBANCE**	➢ Video monitoring with the weather station wind speed must be less than 20kph ➢ Visual monitoring ➢ Watering of roads
	TRIGGER	**ACTION**	**RESPONSE**
L2 MEDIUM RISK EVENT	▪ Elevated temperatures slightly above normal ▪ Wind speed increases between 20 and 40 kph	**4. HOURLY INSPECTION BY QUARRY MANAGER** **5. ENSURE ALL TRAFFIC IS KEEPING TO 10KM SPEED** **6. ENSURE ALL TRUCK ARE UTILISING TARPS** **7. EXTRA WATERING OF ROADS TO INCREASE TO KEEP UP WITH THE DUST**	➢ Continual monitoring of the weather station, any elevation to be notified to the QM ➢ If Quarry Manager offsite staff to immediately notify the QM of current conditions
	TRIGGER	**ACTION**	**RESPONSE**
L3 HIGH RISK EVENT	▪ Excessive temperatures ▪ Wind speed over 40kph	**1. MANNED BY QM** **2. IMMEDIATE SHUT DOWN OF ALL PLANT AND EQUIPMENT**	➢ All Operations are to be ceased and all plant and equipment are to be shut down until further notification by the QM and when the wind speed decreases to workable conditions ➢ Continual monitoring of the weather station

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Appendix 13: Correspondence with Siding Springs Observatory

SMK
CONSULTANTS

Document Set ID: 1783446
Version: 1, Version Date: 04/06/2020

Marie

From: Christopher Lidman <Christopher.Lidman@anu.edu.au>
Sent: Friday, March 20, 2020 8:41 AM
To: marie <marie@smk.com.au>
Cc: Christopher Lidman <Christopher.Lidman@anu.edu.au>
Subject: Re: Proposed Amendment to Existing Quarry - Consultation

Dear Marie,

The Observatory has reviewed the documentation that you have provided on the proposal to increase the amount of material extracted from Wave Hill Quarry. In that documentation, it is noted that, under exceptional circumstance, night time operations would occur, which would necessitate lighting. The documentation notes the measures that need to be taken to mitigate the impact of the lighting on the night sky above Siding Spring Observatory.

The Observatory is entirely satisfied with the measures listed in the documentation. In particular, the Observatory is pleased to see that lights with a colour temperature of less than 3,000K will be used.

When the lighting plan is available, the Observatory would like to see a copy. Included in that plan should be the total amount of light (measured in lumnes) that will be used for night time operations,

Kind Regards

Chris Lidman

A/Professor Chris Lidman
Director, Siding Spring Observatory, Research School of Astronomy and Astrophysics,
The Australian National University, Canberra, ACT, Australia
Work: +61-2-6125-0238
Christopher.Lidman@anu.edu.au

From: marie <marie@smk.com.au>
Date: Monday, 10 February 2020 at 2:08 pm
To: Christopher Lidman <Christopher.Lidman@anu.edu.au>
Subject: Proposed Amendment to Existing Quarry - Consultation

Dear Chris,

My name is Marie, I work for an environmental consulting firm and our client is proposing to increase the annual extraction limit of their quarry (Wave Hill Quarry), from 200,000 tonnes to 500,000 tonne per annum. The site is located 24km east of Narrabri. The development application will include an Environmental Impact Assessment which I am preparing at the moment. The proposal is required to consider the *Dark Sky Planning Guideline 2016* in relation to the Siding Springs Observatory as it is a designated development located within 200km of the observatory.

Having reviewed the Guidelines, it is clear we need to consult with the Observatory Director in relation to the proposal. To allow you to familiarise yourself with the proposal I have attached a site/contour plan and kmz files. I have also attached a draft assessment including measures to

ensure all lighting conforms with the guidelines and that suitable dust mitigation measures are undertaken.

The Siding Springs Observatory is located at approximately 130 kilometres to the south west of the project site. The observatory has a direct line of sight to the quarry. The proposed standard operational hours are 6am – 6pm. However, it is also requested that the operation be allowed to operate 24 hours per day in exceptional circumstances.

Please could you let me know if there are any additional points that you feel need to be addressed within the assessment other than the factors outlined in the guidelines, or whether you suggest any amendments to the draft assessment.

Please don't hesitate to contact me should you wish to clarify or discuss anything further.

Kind Regards,

Marie

Marie Duffy B.Sc. Hons, M.Sc.
Environmental and Resources Consultant
SMK CONSULTANTS
39 Frome Street │PO BOX 774
Moree NSW 2400
T 02 6752 1021 │F 02 6752 5070
marie@smk.com.au │ www.smk.com.au

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Appendix 14: AHIMS Search Results

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AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : 17-173

Client Service ID : 496603

SMK Consultants Pty Ltd - Moree

Date: 08 April 2020

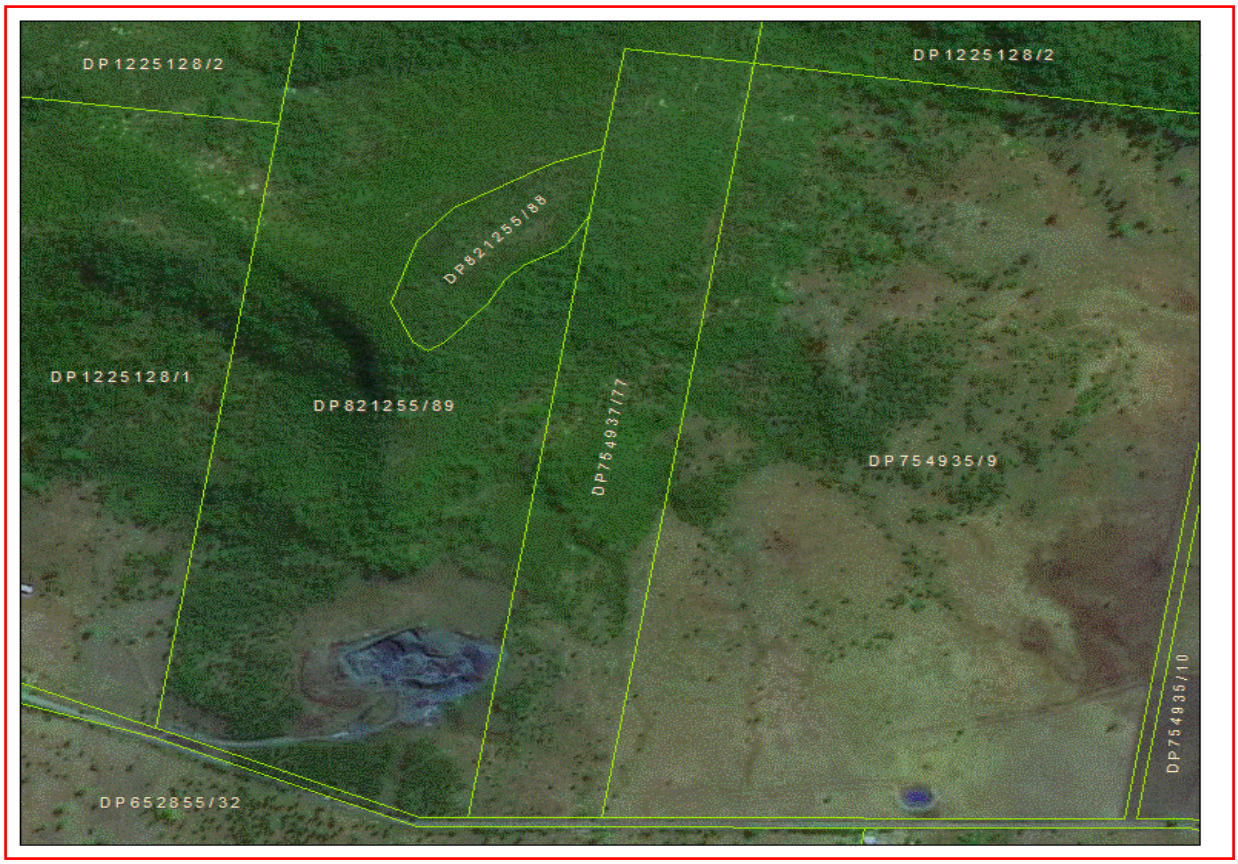
P O Box 774
Moree New South Wales 2400
Attention: Marie Duffy

Email: marie@smk.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 77, DP:DP754937 with a Buffer of 50 meters, conducted by Marie Duffy on 08 April 2020.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : 17-173

Client Service ID : 496623

SMK Consultants Pty Ltd - Moree

Date: 08 April 2020

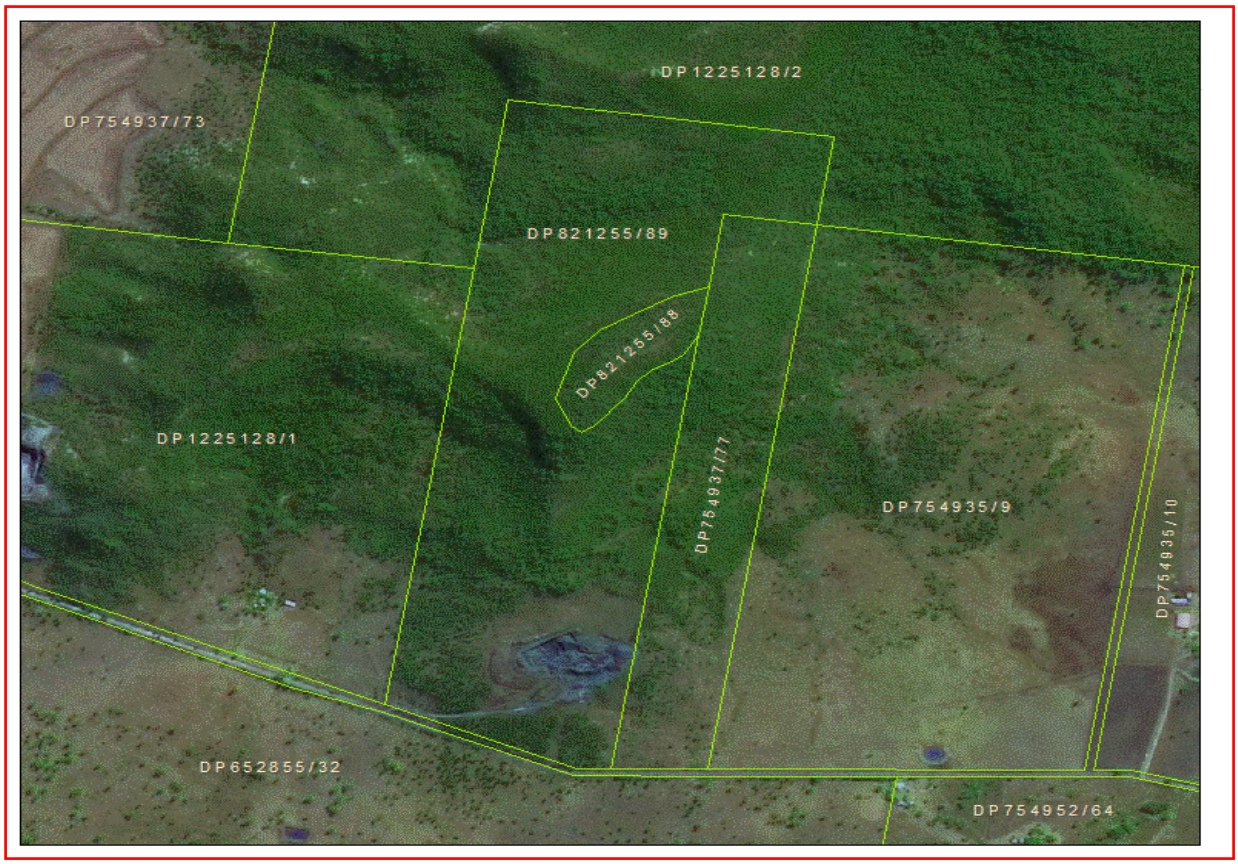
P O Box 774
Moree New South Wales 2400
Attention: Marie Duffy

Email: marie@smk.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 89, DP:DP821255 with a Buffer of 200 meters, conducted by Marie Duffy on 08 April 2020.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

1	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 19-279

Client Service ID : 505347

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
20-1-0157	SMK/IRP/WHQ/1	GDA	56	212245	6632058	Open site	Valid	Artefact : -		

Contact **Recorders** Advitech Pty Limited,Doctor.Rod Bennison **Permits**

Report generated by AHIMS Web Service on 15/05/2020 for Marie Duffy for the following area at Lot : 89, DP:DP821255 with a Buffer of 0 meters. Additional Info : EIS. Number of Aboriginal sites and Aboriginal objects found is 1

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

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