



**ANNUAL REVIEW FOR THE KARUAH EAST
HARD ROCK QUARRY, KARUAH, NSW**

***Review Period: 1 January, 2018 – 31 December
2018***

TABLE OF CONTENTS

1.0	STATEMENT OF COMPLIANCE	1
2.0	INTRODUCTION.....	3
2.1	Project Overview	3
2.2	Modifications	4
2.2.1	MOD 1	4
3.0	APPROVALS	7
3.1	Management Plans	7
3.2	Consent Conditions for Reporting in the Annual Review	8
3.3	Government Agencies Feedback	9
4.0	OPERATIONS SUMMARY	10
4.1	Land Preparation	10
4.2	Construction Activities	10
4.3	Quarry Operations	10
4.4	Operating Hours.....	12
4.5	Operating Equipment	13
4.6	Next Reporting Period	13
5.0	ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW	14
6.0	ENVIRONMENTAL PERFORMANCE	15
6.1	Meteorological Monitoring.....	15
6.2	Noise	16
6.2.1	EIS / Preferred Project Report Predictions	16
6.2.2	Approved Criteria	16
6.2.3	Key Environmental Performance or Management Issues	18
6.2.4	Management Measures	23
6.2.5	Proposed Improvements to Management Measures.....	24
6.3	Blasting	24
6.3.1	EIS Predictions.....	24
6.3.2	Approved Criteria	24
6.3.3	Key Environmental Performance or Management Issues	24
6.3.4	Management Measures	25
6.3.5	Proposed Improvements to Management Measures.....	25
6.4	Air Quality	26
6.4.1	EIS Predictions.....	26
6.4.2	Approved Criteria	26

6.4.3	<i>Key Environmental Performance or Management Issues</i>	27
6.4.4	<i>Management Measures</i>	30
6.4.5	<i>Proposed Improvements to Management Measures</i>	31
6.5	Biodiversity	31
6.5.1	<i>EIS Predictions</i>	31
6.5.2	<i>Approved Criteria</i>	31
6.5.3	<i>Key Environmental Performance or Management Issues</i>	31
6.5.4	<i>Management Measures</i>	35
6.5.5	<i>Proposed Improvements to Management Measures</i>	35
6.6	Heritage (Aboriginal and Non-Aboriginal)	35
6.6.1	<i>EIS Predictions</i>	35
6.6.2	<i>Approved Criteria</i>	36
6.6.3	<i>Key Environmental Performance or Management Issues</i>	36
6.6.4	<i>Management Measures</i>	36
6.6.5	<i>Proposed Improvements to Management Measures</i>	36
6.7	General Waste Management	37
6.7.1	<i>Environmental Management</i>	37
6.7.2	<i>Environmental Performance</i>	37
6.7.3	<i>Proposed Improvements to Management Measures</i>	37
6.8	Summary of Environmental Performance	37
7.0	WATER MANAGEMENT	38
7.1	Summary of Water Management at Site	38
7.1.1	<i>Environmental Management</i>	38
7.1.2	<i>MOD 1 and 2 Water Management Proposed Changes</i>	38
7.1.3	<i>Improvements to Management Measures</i>	39
7.2	EIS/Preferred Project Report Predictions	39
7.3	Surface Water Monitoring Results	40
7.3.1	<i>Approved Criteria</i>	40
7.3.2	<i>Surface Water Monthly Monitoring Results</i>	41
7.3.3	<i>Discharge Results</i>	49
7.4	Groundwater Monitoring Results	51
7.4.1	<i>Approved Criteria</i>	51
7.4.2	<i>Monitoring Results</i>	52
7.5	Water Take	53
7.6	Salinity Trading Scheme Credit Use	53
7.7	Compensatory Water to Other Users	53
8.0	REHABILITATION	54
8.1	Rehabilitation Performance During Reporting Period	54

8.2	Actions for the next Reporting Period	55
9.0	COMMUNITY	56
9.1	Community Engagement Activities	56
9.2	Community Contributions	56
9.3	Complaint Management.....	56
9.3.1	2018 Complaints	57
10.0	INDEPENDENT ENVIRONMENTAL AUDIT	58
11.0	INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD	59
11.1	Summary of Incidents	59
11.2	Summary of Non-compliance	59
11.3	Environmental Training	59
12.0	ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD.....	60
13.0	REFERENCES.....	61

TABLES

Table 1	Statement of Compliance	1
Table 2	DPE Compliance Status Key	1
Table 3	Non-Compliance	1
Table 4	Current Consents and Licences	7
Table 5	EPL Fee-Based Activity	7
Table 6	Checklist for Annual Review Reporting	8
Table 7	Monthly Production Summary (tonnes)	10
Table 8	Approved Operating Hours	12
Table 9	Forecast Operations for Next Reporting Period	13
Table 10	Actions Required from Previous Annual Review	14
Table 11	Annual Review Meteorological Data	15
Table 12	ICNG Construction Noise Management Levels	16
Table 13	Project Specific Construction Noise Goals (dBA LAeq(15minute))	17
Table 14	Operational Noise Criteria (dBA LAeq(15minute))	17
Table 15	EPL Noise Limits (dBA LAeq(15minute))	17
Table 16	Operator Attended Noise Survey Results (February 2018)	18
Table 17	Compliance Noise Assessment – Operations (February 2018)	19
Table 18	Operator Attended Noise Survey Results (May 2018)	19
Table 19	Compliance Noise Assessment – Operations (May 2018)	20
Table 20	Operator Attended Noise Survey Results (August 2018)	20
Table 21	Compliance Noise Assessment – Operation (August 2018)	21
Table 22	Operator Attended Noise Survey Results (November 2018)	21
Table 23	Unattended Continuous Monitoring Ambient Noise Levels (February 2018)	22

Table 24 Unattended Continuous Monitoring Ambient Noise Levels – Operations (May 2018)	22
Table 25 Unattended Continuous Monitoring Ambient Noise Levels – Operations (August 2018)	23
Table 26 Compliance Noise Assessment – Operations (November 2018)	23
Table 27 Project Approval Blasting Criteria	24
Table 28 Blast Results 2018	25
Table 29 Long-term impact assessment criteria for particulate matter	26
Table 30 Short-term impact assessment criteria for particulate matter	26
Table 31 Long-term impact assessment criteria for deposited dust	26
Table 32 Depositional Dust Monitoring Summary (g/m ² /month)	28
Table 33 High Volume Air Sampler Results (µg/m ³)	29
Table 34 Summary of Environmental Performance	37
Table 35 Discharge Surface Water Criteria	40
Table 36 Water Quality Data - ANZECC Guidelines	40
Table 37 Monthly Surface Water Quality Results for Dams	42
Table 38 Monthly Surface Water Quality Results for SW1-4	43
Table 39 Comparison between 2018 and 2017 Dam Averages	44
Table 40 Comparison between 2018 and 2017 SW Averages	46
Table 41 Discharge Monitoring Results 2018	49
Table 42 Groundwater Quality Results for Key Parameters in 2017 and 2018	52
Table 43 Average Groundwater Quality Results for Key Parameters	52
Table 44 Summary of Rehabilitation Performance During Reporting Period	54
Table 45 Disturbance and Rehabilitation Status	54
Table 46 Actions for the Next Reporting Period	55
Table 47 Summary of Non-Compliances	59
Table 48 Proposed Actions in the Next Annual Review	60

FIGURES

Figure 1	Karuah East Quarry – Site and Locality Plan.....	5
Figure 2	Current Water Management System	6

APPENDICES

APPENDIX 1 – Project Approval and Federal Approval

APPENDIX 2 – Environment Protection Licence

APPENDIX 3 – Key Figures/Plans

APPENDIX 4 – Noise Monitoring Reports

APPENDIX 5 – Ecological Monitoring Report

APPENDIX 6 – Water Monitoring Data

APPENDIX 7 – *Tetratheca juncea* Monitoring

APPENDIX 8 – Audit Action Plan Status Update

ABBREVIATIONS

CCC	Community Consultative Committee
DA	Development Application
DDG	Dust Deposition Gauge
DPE	NSW Department of Planning and Environment
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management Strategy
EPL	Environment Protection Licence
Ha	Hectare
km	Kilometre
L	Litre
LDP	Licensed Discharge Point
OEH	Office of Environment and Heritage
POEO Act	Protection of the Environment Operations Act 1997
NPWS	NSW National Parks and Wildlife Service, now part of OEH
RFS	NSW Rural Fire Service
SLR	SLR Consulting Australia Pty Ltd
SWMP	Site Water Management Plan
tpa	tonnes per annum

i PURPOSE OF THE REPORT

Karuah East Quarry Pty Ltd (Karuah East Quarry) has prepared this report which fulfils the Annual Review requirement of the Project Approval PA 09_0175 (Schedule 5, Condition 4).

This Annual Review covers the reporting period from the **1 January 2018 to 31 December 2018**.

This report provides specific detail on the project including a summary of environmental monitoring data and environmental performance during the reporting period. All environmental data in full can be supplied at request.

Name of Operation	Karuah East Quarry Pty Ltd
Name of Operator	Karuah East Quarry Pty Ltd
Development Consent / Project Approval #	PA 09_0175
Name of holder of Development Consent / Project Approval	Karuah East Quarry Pty Ltd
Mining Lease #	None
Water Licences	None
Annual Review start date	1 January 2018
Annual Review end date	31 December 2018
<p>I, Greg Dressler, certify that this audit report is a true and accurate record of the compliance status of Karuah East Hardrock Quarry for the period 1 January 2018 to 31 December 2018 and that I am authorised to make this statement on behalf of Karuah East Quarry Pty Ltd.</p> <p><i>Note.</i></p> <p><i>The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, \$1 million and for an individual, \$250,000.</i></p> <p><i>The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or \$22,000, or both).</i></p>	
Name of authorised reporting officer	Greg Dressler
Title of authorised reporting officer	Quarry Manager
Signature of authorised reporting officer	
Date	27/3/19

1.0 STATEMENT OF COMPLIANCE

Tables 1 - 3 outline the compliance status of the quarry operations at the end of the 2018 reporting period in accordance with relevant approval conditions.

Table 1 Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
Project Approval (PA 09_0175)	NO
Environment Protection Licence (No. 20611)	NO

Table 2 DPE Compliance Status Key

Risk level	Colour code	Description
High	Non – compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non – compliant	Non-compliance with: <ul style="list-style-type: none"> potential for serious environmental consequences, but is unlikely to occur; or potential for moderate environmental consequences, but is likely to occur
Low	Non – compliant	Non-compliance with: <ul style="list-style-type: none"> potential for moderate environmental consequences, but is unlikely to occur; or potential for low environmental consequences, but is likely to occur
Admin NC	Non – compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions)

Table 3 Non-Compliance

Relevant Approval	Condition #	Condition Description (Summary)	Compliance Status	Site Comment	Where Addressed in Annual Review
PA 09_0175	Schedule 3 Condition 3	Noise criteria	Non-compliance relating to monitoring noise levels at Location G.	The noise levels emitted by the site were above the requirements in the PA 09_0175 criteria during the operation phase at Karuah East Quarry during 2018. This occurred at location G for the February, May and August monitoring events.	Section 6.3
PA 09_0175	Schedule 3 Condition 7	Noise Management Plan requirements	Non-compliance relating to the noise bund not being installed. No enclosure of crushers or screens.	The site has been working on noise management improvements in 2018 and will continue to in 2019.	Section 6.3

Relevant Approval	Condition #	Condition Description (Summary)	Compliance Status	Site Comment	Where Addressed in Annual Review
PA 09_0175	Schedule 3 Condition 16	Air Quality Management Plan requirements	Non - compliance relating to no missed sample of HVAS.	Non - compliance relating to no sample of HVAS on 19 January 2018. Power failure.	Section 6.4.3
PA 09_0175	Schedule 3 Condition 19	Surface Water Discharges	Non-compliance relating to exceedance of concentration limits during the nine exceedances across two discharge points.	Exceedance of discharge criteria at LDP001 and 2.	Section 7.6 and Appendix 8
EPL 20611	Condition L2	Surface Water Discharges	Non-compliance relating to exceedance of concentration limits during the nine exceedances across two discharge points.	Exceedance of discharge criteria at LDP001 and 2.	Section 7.6 and Appendix 8

2.0 INTRODUCTION

This Annual Review covers the reporting period from the **1 January 2018** to **31 December 2018** for the Karuah East Quarry.

2.1 Project Overview

Karuah East Quarry is located on Lots 12 and 13 (DP 1024564) off the Pacific Highway, approximately three kilometres north of Karuah, NSW.

The approved development includes the following key elements:

- Staged extraction of approximately 29 million tonnes of “andesite” over a 20 year timeframe;
- Extraction of up to 1.5 million tonnes of andesite material per year;
- Removal and stockpiling of an estimated 380,000 m³ of overburden (approximately 750,000 tonnes) from the quarry extraction area. Removal of overburden is not included in the proposed annual extraction rate of 1.5 million tonnes of andesite;
- Haulage of up to 1.5 million tonnes of andesite per year from the site to market by 25 to 30 tonne haul trucks via the Pacific Highway;
- Up to 216 truckloads per day (at maximum production);
- Implementation of erosion and sediment and water management control works to ensure no loss of sediment, minimise dust generation and control discharges from the site to ensure that all discharges are within acceptable volumetric and water quality criteria;
- Roadworks to secure access to the site including upgrade and extension of Blue Rock Lane, realignment of Andesite Road and Blue Rock Lane intersection, and adjust road markings at Branch Lane and Andesite Road intersection;
- Employment of up to 28 onsite staff;
- Construction of a new haul road and access through adjoining Roads and Maritime Services (RMS) land;
- Staged clearing;
- Expansion of approved disturbance area (MOD 1 and 2);
- Drilling and blasting activities;
- Loading and hauling of extracted material;
- Crushing and screening of extracted material;
- Stockpiling of material onsite;
- Location of plant on Lot 13 comprised of office buildings, workshops, parking areas, crushing plant, wash plant, weigh bridge and product storage areas;

Operations commenced on 16 November 2017, with further details provided in **Section 4**. During 2018 construction and operations continued until 31 August 2018. Operations at the Karuah East have temporarily ceased to allow for the construction of Stage 2 of the crushing plant. It is proposed that operations will recommence late March to early April 2019. **Figure 1** presents the Karuah East Quarry site plan and layout. **Figure 2** outlines the water management system.

2.2 Modifications

Two modifications, being Modification 1 (MOD 1) and Modification 2 (MOD 2), were approved during 2018.

2.2.1 MOD 1

MOD 1 was approved by the DPE on the 27 April 2018 and amends the existing Project Approval to nominally expand the area of disturbance of the Karuah East Quarry. Following detailed quarry plant design, it was identified that a minor extension to the approved disturbance area would:

- Improve operational efficiencies associated with plant infrastructure within the quarry by reducing internal truck movements, allowing for better vehicle manoeuvrability and improved site security; and
- Allow for potential dust and noise generated by haul trucks to be confined to a smaller area of the quarry site, further separated from identified receivers to the east and south.

MOD 1 was minor in nature and it increased the area of disturbance (31.88ha) by an additional 2,500m² as shown in **Figure 1**. The resulting new total area of disturbance of the Karuah Quarry East Quarry was 31.88ha. This modification represented less than 1% increase in disturbance area when compared to the existing approval. MOD 2

MOD 2 was approved by the DPE on the 19 December 2018 and amends the existing Project Approval to expand the area of disturbance of the approved Karuah East Quarry. Following detailed quarry plant design and commencement of operations, it was identified that a minor extension to the western edge of the approved disturbance area (adjacent to the internal quarry haul road) will allow for improved environmental management, improved operational safety and increased efficiency.

MOD 2 was minor in nature and it increased the area of disturbance (31.88ha) by an additional 1.133ha as shown on **Figure 1**. The resulting new total area of disturbance of the Karuah East Quarry is 33.01ha. The modification represented less than a 3.6% increase in disturbance area when compared with the existing approval. The key purposes of MOD 2 was to:

- Widen the internal north south haulage road between the plant and southern stockpile area. Widening of the internal haulage road will substantially improve operational safety, in particular for passing vehicles;
- Allow water management along the north south internal haulage road and within the MOD 2 area (which is heavily disturbed) to be improved; and
- Make available area adjacent to the existing dwelling on Lot 12 for product stockpiling resulting in improved operational efficiencies and safety.

The area subject to MOD 2 is heavily disturbed and was devoid of any significant vegetation. It contains an existing dwelling, access track to the dwelling and an electricity easement.

Figure 1 Karuah East Quarry – Site and Locality Plan

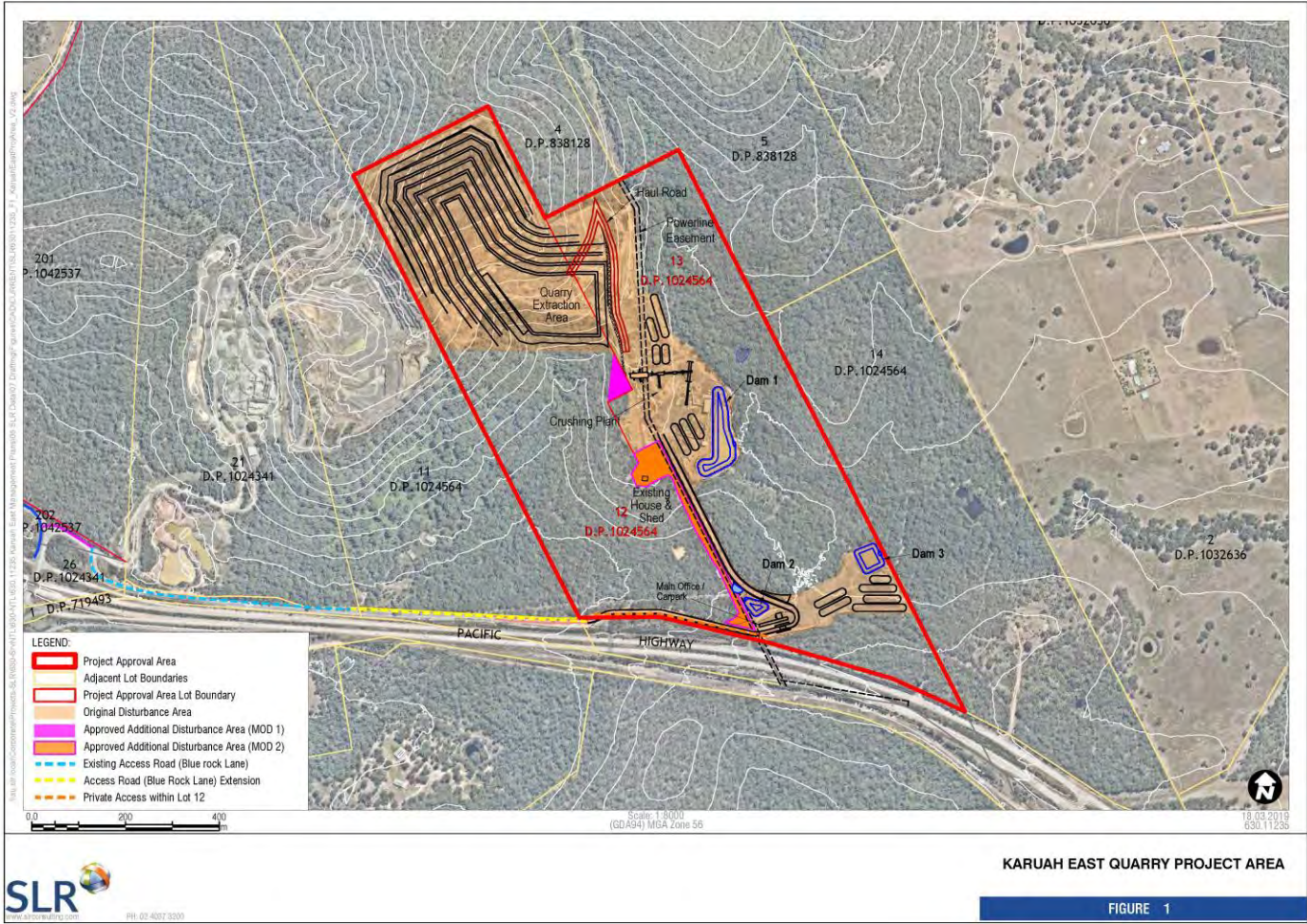
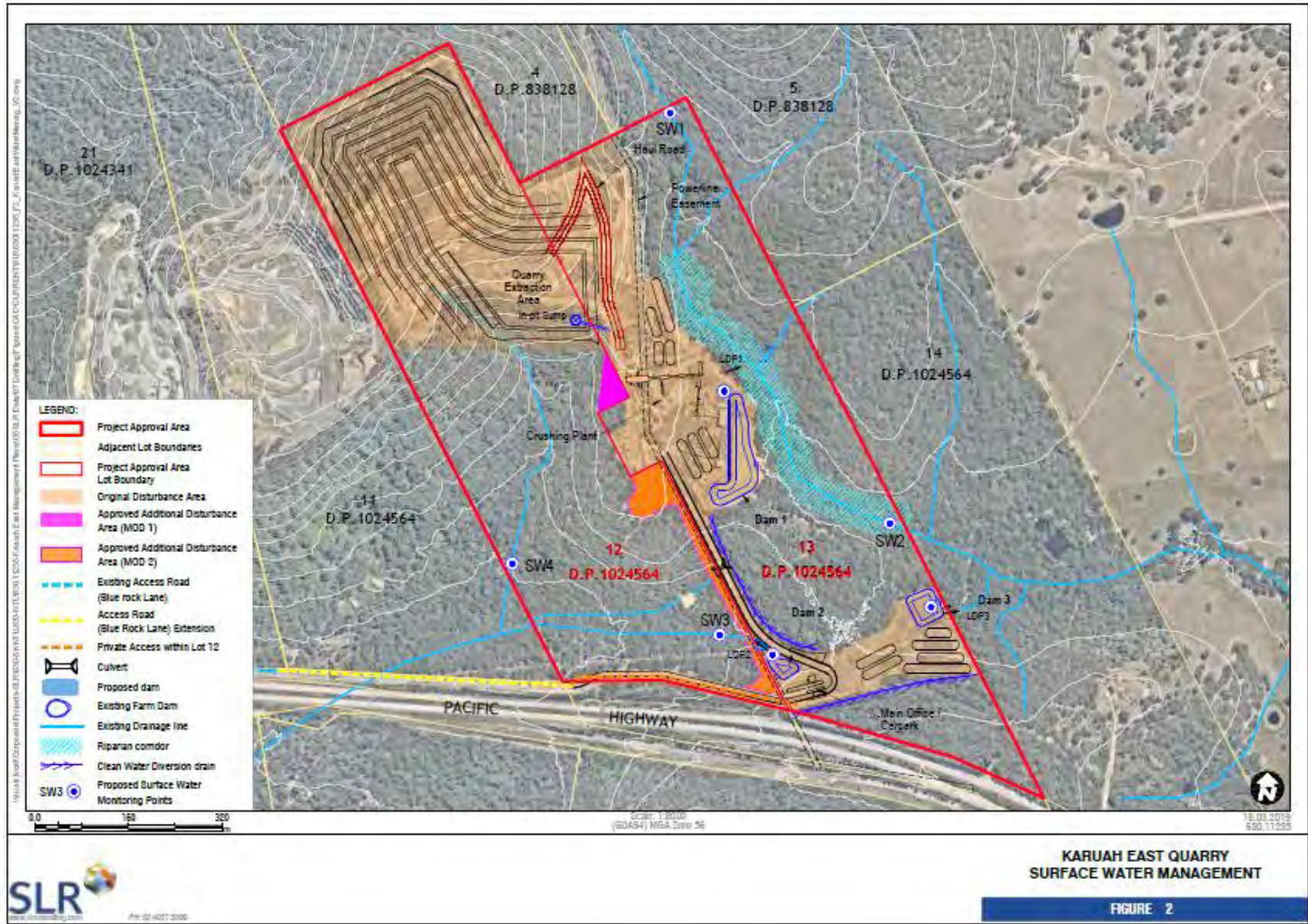


Figure 2 Current Water Management System



3.0 APPROVALS

The Karuah East Quarry is required to hold relevant approvals for the quarrying operations. These approvals are detailed in **Table 4** and attached as **Appendix 1 and 2**.

Table 4 Current Consents and Licences

Instrument	Date of Issue	Date of Expiration	Comments
Project Approval (PA 09_0175)	17 June 2014	31 December 2034	This is the main statutory document for the site
Federal Approval (EPBC 2014/7278)	20 March 2015	30 March 2045	Federal approval relating to the <i>Environment Protection Biodiversity Conservation (EPBC) Act 1999</i>
Environment Protection Licence (No. 20611)	26 August 2015	-	The EPL is a requirement of the <i>Protection of the Environment Operations Act (POEO Act) 1997</i>

MOD 1 was approved by the DPE on the 27 April 2018 and amends the existing Project Approval to nominally expand the area of disturbance of the Karuah East Quarry.

MOD 2 was approved by the DPE on the 19 December 2018 and amends the existing Project Approval to expand the area of disturbance of the approved Karuah East Quarry. It has been identified that a minor extension to the western edge of the approved disturbance area will improve environmental management, operational safety and increase efficiency. For more information regarding the approved modifications refer to **Section 2.2**.

The Karuah East Quarry Environment Protection Licence (EPL 20611) covers all activities at the Quarry. **Table 5** outlines the licensing limits for production and material handling.

Table 5 EPL Fee-Based Activity

EPL Fee-Based Activity	Current Scale (tpa)
Crushing, Grinding or Separating	> 500,000 t – 2,000,000 t processed
Land-based extractive activity	> 500,000 t – 2,000,000 t obtained

Copies of the approvals are attached as **Appendix 1 and 2**. An Annual Compliance Report for EPBC Approval 2014/7282 is prepared each year and is available on the Hunter Quarries website <http://hunterquarries.com.au/karuah-east-documents/>.

3.1 Management Plans

The site operates under a series of approved environmental management plans, including:

- *Environmental Management Strategy;*
- *Air Quality and Greenhouse Gas Management Plan;*
- *Biodiversity Offset Area Management Plan;*
- *Blast Management Plan;*
- *Heritage Management Plan;*
- *Landscape and Rehabilitation Management Plan;*
- *Noise Management Plan;*
- *Traffic Management Plan;*

- *Water Management Plan*; and
- *Tetratheca juncea Translocation Management Plan*.

The Landscape Management Plan, Biodiversity Offset Area Management Plan and the *Tetratheca juncea* Translocation Management Plan were updated in 2018 and approved by the DPE on 14 March 2019.

All the above management plans will be updated in 2019 to cover MOD 2.

3.2 Consent Conditions for Reporting in the Annual Review

The preparation of an Annual Review is required by Schedule 5, Condition 4 of PA 09_0175. This Annual Review has been prepared in accordance with the Department of Planning and Environment's (DPE) *Annual Review Guidelines* (2015).

Table 6 details the requirements of Condition 4 of Schedule 5 of PA 09_0175 and the respective section(s) in this document where these consent conditions are addressed.

Table 6 Checklist for Annual Review Reporting

Condition Number	Condition Requirement for Annual Review	Document Section
Schedule 5, Condition 4(a)	<i>By the end of March each year, the Proponent must review the environmental performance of the project to the satisfaction of the Planning Secretary. This review must:</i> <i>(a) describe the development (including rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year;</i>	This document. Annual Review
	<i>include a comprehensive review of the monitoring results and complaints records of the project over the previous calendar year, which includes a comparison of these results against:</i> <ul style="list-style-type: none"> • <i>the relevant statutory requirements, limits or performance measures/criteria;</i> • <i>the monitoring results of previous years; and</i> • <i>the relevant predictions in the EA;</i> 	Section 6
Schedule 5, Condition 4(b)	<i>identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;</i>	Section 1 and 11
Schedule 5, Condition 4(c)	<i>identify any trends in the monitoring data over the life of the project;</i>	No trends yet as less than one year of data
Schedule 5, Condition 4(d)	<i>identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and</i>	Section 6
Schedule 5, Condition 4(e)	<i>describe the measures that would be implemented over the current calendar year to improve the environmental performance of the project.</i>	Section 12

3.3 Government Agencies Feedback

Karuah East received a letter from the DPE dated 4 May 2018 which stated that the 2017 Annual Review had been reviewed and it generally satisfied the requirements of the Project Approval in relation to the Annual Review. No further updates or changes were required to the 2017 document.

A Show Cause letter was received from the DPE on 8 August 2018 regarding noise and vibration in relation to the potential non-compliance with PA 09_0175. Karuah East Quarry responded to the Show Cause Letter on the 24 August 2018 explaining Karuah East would utilise the approximate 5-month construction period between September 2018 and January 2019 to complete further works to mitigate noise emissions. An Official Caution letter was received from the DPE on 2 October 2018 regarding noise exceedance specifically non-compliance with Schedule 3, condition 3 of the PA 09_0175. **Section 6.2** contains further details on noise monitoring and management measures.

A Penalty Notice letter was received from DPE on 2 October 2018 regarding failure of Karuah East Quarry to comply with Schedule 2 Condition 2 of PA 09_0175. The failure specifically related to constructing 4 metre noise bunds around stockpile and stacker locations and failing to ensure all crushers and screens were enclosed. **Section 6.2** contains further details on noise monitoring and management measures.

A Warning letter was received from the DPE dated 2 October 2018 which stated Karuah East failed to comply with Schedule 5 condition 7 of PA 09_0175. This specifically related to failure of Karuah Quarry to notify the Secretary on Location G noise limit exceedances as soon as practicable. **Section 6.2** contains further details on noise monitoring and management measures.

4.0 OPERATIONS SUMMARY

The following section briefly describes the general operation and environmental performance of Karuah East Quarry during this 2018 reporting period.

4.1 Land Preparation

During the reporting period there was approximately 3.4 ha of land clearing, with this occurring in the upper extraction area from April to July. The ecological clearance was undertaken by a qualified ecologist including the supervision of habitat tree removal.

4.2 Construction Activities

During 2018, the following construction activities were undertaken:

- The excavation and capping of stockpile and crushing areas; and
- Stage 2 of the crushing plant commenced in July.

4.3 Quarry Operations

Karuah East Quarry operated from the start of the reporting period and ceased operations on the 31 August 2018 while the second stage of the crushing plant underwent construction. Operations involved progressive drilling and blasting, followed by crushing and screening to produce the required materials. Operations will recommence when stage two construction of the crushing plant is complete, which is anticipated to occur in the 2nd quarter of 2019.

There was no production from September 2018, however a small amount of product was transported offsite in October and December 2018.

The monthly production summary during the reporting period is included in **Table 7**.

Table 7 Monthly Production Summary (tonnes)

Month	Monthly total (tonnes)
Jan	9,893
Feb	12,075
Mar	14,668
Apr	15,395
May	20,606
Jun	13,768
Jul	17,295
Aug	13,918
Sep	0
Oct	38
Nov	0
Dec	36
Total:	117,692

Project Approval 09_0175 permits the extraction of up to 1.5 million tonnes per annum from Karuah East Quarry. As evident from Table 7, the 2018 production total was significantly below this annual limit.



Photo 1 –Dam 3 (November 2018)



Photo 2 – Stage 1 of the crushing plant. Stage 2 of the crushing plant under construction and can be seen to the far right. (December 2018).



Photo 3 – Stockpiles near Weighbridge and Office (December 2018)

4.4 Operating Hours

In accordance with Schedule 2, Condition 7 of the PA 09_0175, Karuah East Quarry operates during the following hours (see **Table 8**):

Table 8 Approved Operating Hours

Activity	Operating Hours
Quarrying Operations	7.00 am to 6.00 pm, Monday to Friday; and 7.00 am to 1.00 pm, Saturdays. No quarrying operations on Sundays or Public Holidays
Construction activities	7.00 am to 6.00 pm, Monday to Friday; and 8.00 am to 1.00 pm, Saturdays. Unless noise from the activities does not exceed 35 dB(A) _{L_{Aeq}(15minute)} at any privately-owned residence.
Maintenance activities	24 hours a day, 7 days per week, providing maintenance activities are inaudible at any privately-owned residence.

Note: This condition does not apply in the event of a direction from police or other relevant authority for safety or emergency reasons regarding works which may need to be undertaken to avoid loss of life, property loss and/or to prevent environmental harm.

4.5 Operating Equipment

When operational during the 2018 reporting period the following equipment was used:

- Excavator x 4;
- Bulldozer x 3;
- Mobile crusher (screening and crushing equipment);
- Front end loader x 4;
- 13,000 L water tanker;
- Onsite Haul trucks x 3; and
- Road Grader.

Upgrades around the crushing plant area will be undertaken in 2019.

4.6 Next Reporting Period

Table 9 outlines forecast operations for the next reporting period.

Table 9 Forecast Operations for Next Reporting Period

Aspect	Forecast for Next Reporting Period
Pit Expansion Areas	Further benching will be developed in the extraction area during 2019. A new haul road into the extraction area will be constructed.
Fleet Upgrades	There will be a requirement for additional quarrying fleet to be purchased as extraction rates increase.
Infrastructure	Completing infrastructure within Stage 2 of the crushing plant during 2019.
Quarrying	Recommencement of quarrying during 2019.

5.0 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The actions required as an outcome of the previous Annual Review (commitments from Karuah East), including any actions that have been undertaken and when the actions were completed are provided in Table 10.

Table 10 Actions Required from Previous Annual Review

Action Required from Previous Annual Review	Action taken by Operator	Where Discussed in Annual Review
DPE Requests – 2017 Annual Review		
Section 9.3.1 Complaints Management – please included a brief discussion on complaints trends for the reporting period compared to the previous reporting periods from the commencement of the Project. This may be presented as a graph.	Inclusion in 2018 Annual Review	Section 9.3
Karuah East Commitments – 2017 Annual Review		
Complete construction activities	Construction activities were ongoing in the 2018 reporting period.	Section 4
Continue environmental monitoring in accordance with management plans and approval requirements	On-going. To be continued in 2019.	Section 6
Continue CCC and community support	On-going. To be continued in 2019.	Section 9
Continue to update the website with monitoring data and key environment and community information	On-going. To be continued in 2019.	Section 9
Finalise updates to management plans in accordance with Independent Environmental Audit recommendations	The Landscape and Rehabilitation Management Plan, Biodiversity Offset Area Management Plan and <i>Tetratheca juncea</i> Translocation Management Plan has been updated. Further updates to the other management plans are required in 2019.	Section 3.1

6.0 ENVIRONMENTAL PERFORMANCE

Appendix 3 includes a number of Figures that identify the location of the environmental monitoring sites discussed in the following sections.

6.1 Meteorological Monitoring

Schedule 3, Condition 17 of PA 09_0175 requires:

For the life of the project, the Proponent shall ensure that there is a suitable meteorological station operating in the vicinity of the site that complies with the requirements in the Approved Methods for Sampling of Air Pollutants in New South Wales guideline.

A new meteorological station was installed in August 2016 which is used by both the Karuah Quarry and Karuah East Quarry. The location of the station is shown in **Appendix 3**. It should be noted that although the meteorological data has been presented for the full year, operational activities associated with Karuah East Quarry ceased on the 31 August 2018.

Table 11 presents a summary of the meteorological data collected by the meteorological station during the Annual Review reporting period.

Table 11 Annual Review Meteorological Data

Month	Temp (°C)			Rainfall			Wind
	Average (°C)	Min Temp (°C)	Max Temp (°C)	Total (mm)	Max Daily (mm)	No rain days < 1 mm	Max Wind Gust (km/h)
Jan-18	24.5	11.3	44.2	37.6	25.0	4	66.3
Feb-18	23.0	12.4	39.8	131.0	61.8	9	48.5
Mar-18	22.3	10.5	38.8	152.0	72.2	9	52.1
Apr-18	19.7	11.0	33.7	94.4	27.2	10	52.1
May-18	14.0	4.6	26.4	46.2	38.8	4	52.1
Jun-18	11.3	3.6	20.5	266.0	53.0	15	56.8
Jul-18	10.7	-0.5	23.6	8.8	4.0	2	59.2
Aug-18	11.6	1.0	25.1	15.4	10.4	2	53.3
Sep-18	14.6	4.2	32.5	92.8	30.2	10	55.6
Oct-18	17.9	6.5	32.2	124.4	33.2	9	47.3
Nov-18	20.4	9.4	37.0	74.0	31.2	4	69.8
Dec-18	23.5	12.1	38.7	88.0	31.6	7	53.3

Average monthly temperatures during the reporting period ranged from 10.7 degrees Celsius (°C) to 24.5°C, with a maximum of 44.2°C recorded in January 2018. Heavy rainfall events occurred in June 2018 (over 200 mm recorded for the month), with the rest of the year ranging from 8.8 mm to 152.0 mm per month. The maximum wind gust was recorded in November 2018 with a result of 69.8 Km per hour. 2018 total rainfall was 1130.6 mm as compared with 1098.8 mm in 2017.

6.2 Noise

6.2.1 EIS / Preferred Project Report Predictions

Construction

All predicted construction noise levels (stage 1 of quarry lifecycle) are below project specific noise criteria (SLR, 2012).

Operations

As part of the *Noise and Blasting Impact Assessment* (SLR, 2012), noise levels are predicted based on the three stages of the quarry lifecycle. All predicted levels were below the project specific noise criteria.

6.2.2 Approved Criteria

Approved noise criteria from PA 09_0175 are outlined in **Table 12** and are based on the *Interim Construction Noise Guidelines* (ICNG) (EPA, 2009).

Construction

Table 12 ICNG Construction Noise Management Levels

Time of Day	Management Level	How to apply
Recommended standard hours: Monday to Friday 7:00am to 6:00pm	Noise affected RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,(15mins)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
Saturday 8:00am to 1:00pm No work on Sundays or public holidays	Highly noise affected 75 dBA	The highly affected noise level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise levels of the works, and by describing any respite periods that will be provided.
Outside recommended standard hours	Noise affected RBL + 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

In accordance with the ICNG, **Table 13** presents the adopted construction noise goals for the project.

Table 13 Project Specific Construction Noise Goals (dBA LAeq(15minute))

Location	Adopted RBL ¹	Noise Management Level (dBA LAeq(15minute))	
		Noise Affected	Highly Noise Affected
Any approved Residence on Lot 11 DP 1024564 ²	44	54	75
A to E	44	54	
F	44	54	
G	34	44	

Note 1 – Adopted RBL as outlined in Noise Management Plan.

Note 2 – At present there is no approved residence on Lot 11.

Operational

Operational noise criteria are outlined in Schedule 3, Condition 3 of PA 09_0175 and state:

*The Proponent shall ensure that the operational noise generated by the project does not exceed the criteria in **Table 14**.*

Table 14 Operational Noise Criteria (dBA LAeq(15minute))

Location	Criteria (day)
Residence on Lot 11 DP 1024564	43
A	40
B	37
G	38
All other residences	35

The noise criteria in **Table 14** does not apply if the Proponent has an agreement with the relevant landowner to generate higher noise levels.

EPL Condition L4

The noise limits set out in Condition L4.1 of the EPL 20611 are reproduced in **Table 15** are generally consistent with the criteria detailed in PA 09_0175.

Table 15 EPL Noise Limits (dBA LAeq(15minute))

Location	Noise Limit dBA - Day LAeq(15minute)
Residence A on Lot 100 DP 785172	40
Residence B on Lot 3 DP 785172	37
Residence G on Lot 1 DP 1032636	38
Any other residence or sensitive receiver not subject to a private negotiated agreement	35
Any approved residence on Lot 11 DP 1024564	43

Operational Noise Limits on Lot 11

It is noted that the noise limits detailed in EPL 20611 for Lot 11 are for “any approved residence on Lot 11 DP 1024564”. Currently, there is not an approved residence on Lot 11, therefore it is considered that the noise limits do not currently apply at this location.

As outlined in Section 1.1 of the *Noise Management Plan*, the DPE agree that criteria only applies to ‘Residence on Lot 11’ if there is a Council approved residence within Lot 11. At this point in time, there is not a Council approved residence on Lot 11. Karuah East Quarry is committed to undertaking noise monitoring to determine compliance at ‘approved residences’ only. Should a residence be approved by Council on Lot 11, the *Noise Management Plan* will be updated to include noise monitoring at this location.

6.2.3 Key Environmental Performance or Management Issues

6.2.3.1 Attended Noise Monitoring

Both attended and unattended noise monitoring has been conducted at the nearest residential receivers to the quarry during the 2018 reporting period.

A summary of the results are provided in **Tables 16 to 24** below, with full copies of the noise monitoring reports appended to this Annual Review (see **Appendix 4**). Construction noise levels were within the consent condition criteria at all locations during the monitoring period.

February 2018 Operational Noise Monitoring

Table 16 Operator Attended Noise Survey Results (February 2018)

Date/Start Time Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels LAmax – dBA
	LAmax	LA1	LA10	LA90	LAeq	
Location F Day 14/2/2018 10:23am W= 2 m/s WSW Temp = 29oC	84	66	53	47	56	Local road traffic 56 to 84 dBA Pacific Highway 41 to 52 dBA insects 39 to 44 dBA Karuah East Project Inaudible
Location G Day 14/02/2018 9:56am W = 2 m/s WSW Temp = 29°C	56	52	50	45	48	Birds/Insects 32 to 47 dBA Aeroplane 43 to 45 dBA Karuah East Project Audible Crushing plant 39 to 46 dBA General drone 37 to 45 dBA Estimated LAeq(15 minute) noise contribution 43 dBA

Table 17 Compliance Noise Assessment – Operations (February 2018)

Location	Estimated LAeq(15minute) Contribution	Consent Conditions LAeq(15minute)	Compliance
Location F (Day)	Inaudible	35	Yes
G (NMP Monitoring Location)	43	38	No
G (Dwelling)	-	-	-

Results presented in **Table 16 and 17** indicate that compliance with the relevant consent conditions was achieved at Location F for February 2018 monitoring, however the site was above the operational noise criteria at Location G. The major noise source contributing to the exceedance of criteria at Location G can be attributed a number of factors including unenclosed mobile equipment.

Karuah East Quarry operational activities were found to be inaudible at Location F but audible at Location G. Therefore, results were found to be within the relevant consent condition criteria at location F but outside the consent criteria at location G.

Meteorological conditions at the time of operator attended noise measurements likely exacerbated Karuah East Quarry noise impacts at Location G. Meteorological data from the Karuah Quarry onsite weather station has shown stable light winds of approximately 2 m/s at 10 m above ground level travelling in a south west direction towards the monitoring location.

May 2018 Operational Noise Monitoring

Table 18 Operator Attended Noise Survey Results (May 2018)

Date/Start Time Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels LAmax – dBA
	LAmax	LA1	LA10	LA90	LAeq	
Location F Day 17/05/2018 12:24pm W = 1.5 m/s SSE Temp = 19°C	78	62	52	45	53	Local road traffic 62 to 78 dBA Pacific Highway 44 to 46 dBA Karuah East Project Inaudible
Location G Day 17/05/2018 10:46am W = 1.5 m/s Temp = 19°C	55	52	50	44	47	Pacific Highway 40 to 50 dBA Frogs 39 to 40 dBA Birds 40 to 41 dBA Karuah East Project Audible Jaw Crusher 48 - 54 dBA General processing plant 44 - 47 Estimated construction LAeq(15 minute) noise contribution 46 dBA¹

¹ Inclusive of 2 dB upward adjustment for low frequency noise.

Table 19 Compliance Noise Assessment – Operations (May 2018)

Location	Estimated LAeq(15minute) Contribution	Consent Conditions LAeq(15minute)	Compliance
Location F (Day)	Inaudible	35	Yes
G (NMP Monitoring Location)	46	38	No
G (Dwelling)	-	-	-

Results presented in **Table 18** and **19** indicate that compliance with the relevant consent conditions was achieved at Location F for May 2018 monitoring, however the site was above the operational noise criteria at Location G. The major noise source contributing to the exceedance of criteria at Location G can be attributed a number of factors including unenclosed mobile equipment.

August 2018 Noise Monitoring

Table 20 Operator Attended Noise Survey Results (August 2018)

Date/Start Time Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels LAmax – dBA
	LAmax	LA1	LA10	LA90	LAeq	
Location F Day 14/08/2018 11:14 W = 2m/s WSW Temp = 18°C	80	65	51	43	54	Local Traffic 62 to 80 dBA Pacific Highway 40 to 44 dBA Birds 45 to 53 dBA Karuah East Project Inaudible
Location G (NMP Monitoring Location) Day 14/08/2018 14:18 W = 2 m/s WSW Temp = 14°C	66	55	52	47	50	Local Traffic 50 to 66 dBA Birds 40 to 41 dBA Karuah East Project Audible Jaw Crusher 50 to 53 dBA General Processing Plant 48 to 53 dBA Estimated construction LAeq(15 minute) noise contribution 49 dBA
Location G (dwelling) Day 14/8/2018 09:59 W = 2 m/s WSW Temp = 14°C	75	52	50	46	49	Birds 48 to 49 dBA Domestic Noise 62 to 75 dBA Pacific Highway 46 to 51 dBA Karuah East Project Audible Jaw Crusher 49 to 51 dBA Reverse Beeper 49 to 50 dBA General Processing Plant 45 to 51 dBA Estimated LAeq(15minute) Contribution 47 dBA
Project Site (weighbridge)	77	74	64	57	63	Pacific Highway 59 to 65 dBA Karuah East Project Audible Truck on Weighbridge 57 to 61 dBA Truck Pass-by 74 to 77 dBA General Processing Plant 45 to 50 dBA Estimated LAeq(15minute) Contribution 56 dBA

Table 21 Compliance Noise Assessment – Operation (August 2018)

Location	Estimated LAeq(15minute) Contribution	Consent Conditions LAeq(15minute)	Compliance
F	Inaudible	35	Yes
G (NMP Monitoring Location)	49	38	No
G (Dwelling)	47	38	No

Results presented in **Table 20** and **21** indicate that compliance with relevant consent conditions were achieved at noise monitoring location F for operation, while monitoring results at location G (NMP Monitoring Location) and G (Dwelling) were not achieved. Noise generated by Karuah East Quarry was dominant at Location G with noise generated by traffic on the Pacific Highway as well as insects, birds and frog also contributing to the overall noise levels.

November 2018 Operational Noise Monitoring

A further operator-attended survey was conducted at the Karuah Quarry weighbridge during the December Noise Monitoring period (**Table 22**).

Table 22 Operator Attended Noise Survey Results (November 2018)

Date/Start Time Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels LAmax – dBA
	LAmax	LA1	LA10	LA90	LAeq	
Location F Day 22/11/2018 8:59 W = 2m/s SSW Temp = 25°C	84	69	47	40	57	Local Road Traffic 63 to 84 dBA Pacific Highway 38 to 40 dBA Birds 40 to 44 dBA Karuah East Project Inaudible
Location G (NMP Monitoring Location) Day 22/11/2018 8:25 W = 2.5 m/s WSW Temp = 31°C	66	57	49	32	46	Pacific Highway 33 to 35 dBA Birds 32 to 40 dBA Dogs 45 to 66 dBA Karuah East Project Inaudible
Location Karuah Quarry (weighbridge) Day 22/11/2018 09:32 W = 2 m/s SSE Temp = 25°C	77	74	66	56	64	Pacific Highway Traffic 55 to 58 dBA Other industry 52 to 77 dBA Karuah East Project Inaudible

Karuah East was inaudible for the November noise monitoring. Considering Karuah East ceased operation on the 31 August 2018 the compliance noise assessment table was not relevant and therefore not included in this document.

6.2.3.2 Unattended Noise Monitoring

The unattended noise monitoring February 2018 is outlined in the table below. Unattended noise monitoring was conducted at location G during the reporting period. **Table 23 to Table 26** outline unattended noise monitoring results.

Table 23 Unattended Continuous Monitoring Ambient Noise Levels (February 2018)

INP Period	LA1	LA10	LA90	LA _{eq}
Location G				
Daytime ¹	49	43	34	44
Evening ²	47	43	35	42
Night ³	48	46	36	48

It is unlikely Karuah East Quarry consistently exceeded the criteria at Location G. **Appendix 4** shows that the overall LA_{eq} at Location G was typically around 40 dBA during operational hours (7 am to 6 pm) and compliant weather conditions. The presence of other ambient noise sources such as birds, insects and road traffic on the Pacific Highway indicate that Karuah East noise contributions were likely to have been below this overall level and therefore in the region of compliance (no more than 38 dBA) at Location G during the monitoring period (i.e. the 5 dBA exceedance observed during the operator-attended survey was atypical).

Karuah East Quarry was deemed to be in exceedance of the noise criteria at Location G during the 15-minute operator-attended noise survey, however results from continuous unattended noise monitoring indicate that compliance was indicated during other periods throughout the week. The exceedance is considered to be due to prevailing wind conditions carrying sound towards the monitoring location. Compliance was achieved at Location F.

Unattended noise monitoring was conducted at Location G from Friday 4 May 2018 to Thursday 17 May 2018 inclusive.

Table 24 Unattended Continuous Monitoring Ambient Noise Levels – Operations (May 2018)

INP Period	LA1	LA10	LA90	LA _{eq}
Location G				
Daytime ¹	54	49	40	53
Evening ²	49	46	38	45
Night ³	48	45	35	44

Given the results of operator attended noise monitoring Karuah East Quarry contributes to overall noise levels at the Location G noise logger during the daytime operational period. However, it is noted that other noise sources such as road noise from the Pacific Highway, local road traffic and other noise sources such as birdsong, insects and livestock also contribute to overall noise levels at this location.

Unattended noise monitoring was conducted at Location G from Tuesday 14 August 2018 to Tuesday 21 August 2018 inclusive.

Table 25 Unattended Continuous Monitoring Ambient Noise Levels – Operations (August 2018)

INP Period	LA1	LA10	LA90	LA _{eq}
Location G				
Daytime ¹	55	51	39	53
Evening ²	51	47	38	46
Night ³	48	45	35	45

Unattended noise monitoring was conducted at Location G from Thursday 15 November 2018 to Thursday 22 November 2018 inclusive.

Table 26 Compliance Noise Assessment – Operations (November 2018)

INP Period	LA1	LA10	LA90	LA _{eq}
Location G				
Daytime ¹	50	46	34	54
Evening ²	51	46	39	46
Night ³	47	44	35	44

1. Daytime - 7.00 am to 6.00 pm Monday to Friday, 7.00 am to 1.00 pm Saturday, not operational on Sunday.

2. Evening - 6.00 pm to 10.00 pm.

3. Night - 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Given observations made during the operator attended noise survey at the monitoring location, it is likely that daytime noise levels at Location G were dominated by road traffic noise from the Pacific Highway and natural sources such as birdsong, insects, and livestock.

6.2.4 Management Measures

The following best practice noise control measures shall continue to be implemented:

- Adherence to operating hours;
- Noise monitoring will be undertaken on site and within the community;
- Keep plant and equipment well maintained;
- Regular inspection and maintenance of equipment to ensure it is in good working order and operating at the lowest feasible noise level;
- Equipment is not to be operated until it is maintained or repaired;
- Regular training for staff and contractors (i.e. toolbox talks) for the use of equipment in ways to minimise noise;
- Operate mobile plant in a quiet, efficient manner;
- Switching off vehicles and plant when not in use;
- A speed limit of 40 km/hour or less will be applied and enforced for all construction related vehicles onsite;
- Incorporate clear signage at the site including relevant contact numbers for community enquiries; and
- Prompt response to any community concerns.

6.2.5 Proposed Improvements to Management Measures

Noise monitoring indicates that the noise levels emitted by the site were above the requirements in the PA 09_0175 criteria during the operation phase at Karuah East Quarry during 2018. This occurred at location G for the February, May and August monitoring events. The site was not operational for the November monitoring event, with results being inaudible. The following is proposed in 2019 to reduce noise impacts from the site:

- Karuah East have engaged a noise specialist to assist with determining mitigation measures;
- A noise specialist has completed a Pollution Reduction Program, which was a requirement of the EPL; and
- Karuah East will be installing noise mitigation measures such as enclosures around areas of the plant which have a high noise potential.

6.3 Blasting

6.3.1 EIS Predictions

The Noise Impact Assessment (NIA) (SLR, 2012) prepared as part of the EIS, developed blasting site laws for Karuah East Quarry based on blast monitoring results from the existing Karuah Quarry. The site laws were utilised to determine limiting factors to blast design for the site in order to achieve the criteria described in **Section 6.3.2**. Based on the predicted blast results the blast emission criteria are predicted to be met without imposing any significant constraints on blast design throughout the life of the quarry.

6.3.2 Approved Criteria

Blasting criteria for the site are provided in Schedule 3, Condition 8 of PA 09_0175 and are summarised in **Table 27**.

Table 27 Project Approval Blasting Criteria

Location	Airblast overpressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance
Any residence on privately-owned land, or any public infrastructure	120	10	0%
	115	5	5% of the total number of blasts over a period of 12 months

Conditions L5.3 to 5.6 of EPL 20166 detail the blast limits for the project. The blast limits contained in the EPL are consistent with those presented in PA 09_0175.

6.3.3 Key Environmental Performance or Management Issues

There have been 8 blasts during the reporting period at Karuah East Quarry, the results of the blast monitoring undertaken are contained in **Table 28**. Note that Monitor 1 is located at the front gate of the quarry and is for internal monitoring purposes only.

Blast monitoring results for Monitor 2 (Location B) are shown in **Appendix 3**.

Table 28 Blast Results 2018

Date and time	Overpressure and vibration	Monitor 2 (Location B)
02-02-2018 12:53 PM	Overpressure dB(L)	103.9
	Vibration (mm/s)	0.42
02-03-2018 9:58 AM	Overpressure dB(L)	n/t
	Vibration (mm/s)	n/t
13-03-2018 12:43 PM	Overpressure dB(L)	108.1
	Vibration (mm/s)	0.29
27-03-2018 12:28 PM	Overpressure dB(L)	107.0
	Vibration (mm/s)	0.40
17-04-2018 12:32 PM	Overpressure dB(L)	n/t
	Vibration (mm/s)	n/t
10-05-2018 12:30 PM	Overpressure dB(L)	n/t
	Vibration (mm/s)	n/t
13-06-2018 12:34 PM	Overpressure dB(L)	113.5
	Vibration (mm/s)	0.91
19-07-2018 1:27 PM	Overpressure dB(L)	110.0
	Vibration (mm/s)	0.55

During the 2018 Annual Review reporting period:

- No blasts exceeded 120 dBL;
- No blast exceeded 115 dBL at the nearest residential dwelling or privately owned land; and
- All blasts were within the vibration criteria of <5 mm/s.

6.3.4 Management Measures

Section 6 of the *Blast Management Plan* outlines the proposed blasting controls on site. In summary these include:

- Considerations of explosive loading, initiation sequence and firing;
- Use of experienced blast contractors;
- Monitoring of meteorological conditions prior to blasting; and
- Notifying landowners (at their request) and occupiers of blast events.

Additionally, all blasting activities at Karuah East Quarry are monitored by a licensed blasting contractor.

6.3.5 Proposed Improvements to Management Measures

Karuah East Quarry will continue to monitor all blasts at Receptor B as per the approved *Blast Management Plan*. Blast design and management will be completed in accordance with the approved *Blast Management Plan*.

6.4 Air Quality

6.4.1 EIS Predictions

The revised Air Quality Impact Assessment (AQIA) (updated for the Preferred Project Report) indicates that Karuah East Quarry may operate without significant impact on the surrounding environment. In particular, the updated AQIA has confirmed that potential cumulative impacts of Karuah East Quarry and existing Karuah Quarry are well below acceptable criteria levels and will not impose adverse impacts. Overall, it has been demonstrated that the AQIA for Karuah East Quarry is acceptable in terms of air quality considerations for both the construction and operational phases.

6.4.2 Approved Criteria

AQIA criteria relevant to the Project are provided in Schedule 3, Condition 13 and Tables 3 to 5 of PA 09_0175 and have been reproduced in **Table 29**, **Table 30**, and **Table 31**. The criteria are prescribed by the NSW Environment Protection Authority (EPA) in their document, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005)* (Approved Methods).

All reasonable and feasible avoidance and mitigation measures are to be employed so that particulate matter emissions generated by the project do not exceed the criteria in **Table 29** to **Table 31** at any residence on privately owned land.

Table 29 Long-term impact assessment criteria for particulate matter

Pollutant	Averaging Period	^d Criterion
Total suspended particulate (TSP) matter	Annual	^a 90 µg/m ³
Particulate matter < 10 µm (PM ₁₀)	Annual	^a 30 µg/m ³

Table 30 Short-term impact assessment criteria for particulate matter

Pollutant	Averaging Period	^d Criterion
Particulate matter < 10 µm (PM ₁₀)	24 hour	^a 50 µg/m ³

Table 31 Long-term impact assessment criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
^c Deposited dust	Annual	^b 2 g/m ² /month	^a 4 g/m ² /month

Notes to **Table 29** to **Table 31** above:

- Total impact (i.e. incremental increase in concentrations due to the project plus background concentrations due to all other sources).
- Incremental impacts (i.e. incremental increase in concentrations due to the project on its own).
- Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003 Methods for Sampling and Analysis of Ambient Air – Determination of Particulate Matter - Deposited Matter - Gravimetric Method.
- Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed by the Director-General in consultation with EPA.

No specific limit conditions are specified for air quality emissions in EPL 20166.

6.4.3 Key Environmental Performance or Management Issues

The principle source of air pollution at the quarry is in the form of airborne dust, which arises from activities such as construction, quarrying, vehicle movements and crushing. Air quality monitoring has been performed to meet the *Approved Methods of Sampling and Analysis of Air Pollutants in NSW*.

Depositional Dust

Depositional dust results are outlined within **Table 32** . All dust gauges were below the annual average for Karuah East Quarry during the reporting period.

Table 32 Depositional Dust Monitoring Summary (g/m²/month)

Date	DDG 1	DDG 2	DDG 3	DDG 4	DDG 5
08-01-2018 to 05-02-2018	1.5	0.8	1.3	1.0	0.7
05-02-2018 to 05-03-2018	1.6	1.0	1.5	1.5	2.0
05-03-2018 to 03-04-2018	0.6	0.6	1.1	2.6	0.9
03-04-2018 to 01-05-2018	0.8	1.0	1.0	1.7	0.7
01-05-2018 to 30-05-2018	0.9	0.5	0.7	1.1	0.3
30-05-2018 to 27-06-2018	0.6	0.5	0.4	0.9	0.5
27-06-2018 to 26-07-2018	0.7	0.6	0.6	1.2	0.6
26-07-2018 to 23-08-2018	0.9	0.9	0.9	1.3	0.8
23-08-2018 to 20-09-2018	1.6	1.0	0.6	0.7	0.9
20-09-2018 to 26-10-2018	1.2	0.9	0.6	1.0	1.0
26-10-2018 to 23-11-2018	1.5	3.4	1.1	1.1	2.1
23-11-2018 to 21-12-2018	1.3	0.6	0.1	3.0	1.2
Annual Average (Jan 2018 to Dec 2018)	1.1	1.1	0.8	1.4	1.0
Minimum (Jan 2018 to Dec 2018)	0.6	0.5	0.1	0.7	0.3
Maximum (Jan 2018 to Dec 2018)	1.6	3.4	1.5	3.0	2.1

High Volume Air Sampler

Table 33 outlines the High Volume Air Sampler (HVAS) results during the 2018 reporting period.

Table 33 High Volume Air Sampler Results (µg/m³)

Date	TSP (µg/m³)	PM10 (µg/m³)	Comments
01-01-2018	31	22	
07-01-2018	31	20	
13-01-2018	40	23	
19-01-2018			Power failure
25-01-2018	22	14	
31-01-2018	36	17	
06-02-2018	25	8	
12-02-2018	35	20	
18-02-2018	27	15	
24-02-2018	29	11	
02-03-2018	19	12	
08-03-2018	13	8	
14-03-2018	23	11	
20-03-2018	65	40	
26-03-2018	21	12	
01-04-2018	39	30	
07-04-2018	43	27	
13-04-2018	71	47	
19-04-2018	69	38	
25-04-2018	25	19	
01-05-2018	19	15	
07-05-2018	46	16	
13-05-2018	16	8	
19-05-2018	16	10	
25-05-2018	18	12	
31-05-2018	19	10	
06-06-2018	5	4	
12-06-2018	7	4	
18-06-2018	7	4	
24-06-2018	8	7	
30-06-2018	10	5	
06-07-2018	20	6	
12-07-2018	8	5	
18-07-2018	50	33	
24-07-2018	33	16	
30-07-2018	18	10	
11-08-2018	43	21	
15-08-2018	20	11	
17-08-2018	25	14	

Date	TSP ($\mu\text{g}/\text{m}^3$)	PM ₁₀ ($\mu\text{g}/\text{m}^3$)	Comments
23-08-2018	10	9	
29-08-2018	16	10	
04-09-2018	10	8	
10-09-2018	15	10	
16-09-2018	34	16	
22-09-2018	20	9	
28-09-2018	21	11	
04-10-2018	15	11	
10-10-2018	17	10	
16-10-2018	17	11	
22-10-2018	15	11	
28-10-2018	28	13	
03-11-2018	47	25	
09-11-2018	21	12	
15-11-2018	28	16	
21-11-2018	49	18	
27-11-2018	34	19	
03-12-2018	50	26	
09-12-2018	20	13	
27-12-2018	21	12	
Annual Average (Jan 2018 to Dec 2018)	26.55	15.09	
Minimum (Jan 2018 to Dec 2018)	5	4	
Maximum (Jan 2018 to Dec 2018)	71	47	

Notes:

- ¹= Maximum criteria as specified in PA 09_0175

TSP was well below the annual average criteria of $90 \mu\text{g}/\text{m}^3$ during 2018. The highest TSP result for the reporting period was $71 \mu\text{g}/\text{m}^3$ which occurred on the 13 April 2018.

The annual average for PM₁₀ ($\mu\text{g}/\text{m}^3$) was below the long-term impact assessment criteria of $30 \mu\text{g}/\text{m}^3$. Additionally, there were no exceedances of the short-term impact assessment criteria of $50 \mu\text{g}/\text{m}^3$.

EPL 20611 Condition M2.2 and the *Air Quality Management Plan* (required by PA 09_0175 Schedule 3 Condition 16) requires monitoring of TSP and PM₁₀ every 6 days. On the 19 January 2018, there was a power failure resulting in no TSP or PM₁₀ being sampled for that date.

6.4.4 Management Measures

The following best practice air quality control measures will be implemented operational phase of the quarry:

- Disturb only the minimum area necessary for onsite activities;
- Exposed areas are rehabilitated as soon as practicable with inert material and vegetation;
- Perform regular inspections of weather conditions to identify conditions which would be unfavourable in terms of dust levels at nearest sensitive locations blowing in the direction of sensitive receptors and implement remedial measures where required;

- All trafficable areas and vehicle manoeuvring areas in or on the premises will be maintained in a condition that will minimise the emission of dust to the air, or emission from the premises of wind-blown or traffic generated dust;
- Trucks entering and leaving the premises that are carrying loads of dust generating materials will have their loads covered at all times, except during loading and unloading; and
- All plant and equipment to be installed at the site to be maintained and operated in a proper and efficient condition, in accordance with manufacturer's instructions and POEO Act and Regulation.

6.4.5 Proposed Improvements to Management Measures

The Karuah East Quarry will continue to monitor air quality in accordance with the conditions of PA 09_0175 and will also review measures for improving dust management on site. Air quality monitoring during this reporting period illustrated dust levels are compliant with PA 09_0175 criteria.

6.5 Biodiversity

6.5.1 EIS Predictions

Major design amendments were undertaken in an effort to substantially decrease potential flora and fauna impacts associated with the Karuah East Quarry. This has resulted in a significant reduction in potential direct impacts on two state and federally listed threatened flora species - *Tetratheca juncea* and *Grevillea parviflora ssp parviflora*.

No Endangered Ecological Communities or Critically Endangered Ecological Communities listed under the *Threatened Species Conservation Act 1995* (TSC Act) and EPBC Act were recorded.

6.5.2 Approved Criteria

There are no specific criteria associated with biodiversity management for the Karuah East Quarry. Activities are completed in accordance with the Preferred Project Report, Federal Approval, *Biodiversity Offset Area Management Plan* and *Land and Rehabilitation Management Plan* (LRMP).

6.5.3 Key Environmental Performance or Management Issues

Biodiversity Offset Area and Lot 12

The Biodiversity Offset Area (BOA) for the Karuah East Quarry is a 130.36 ha consolidated land parcel comprised of three lots:

- Lot 13 DP 1024564 (part);
- Lot 14 DP 1024564; and
- Lot 5 DP 838128.

Ecological monitoring for the Karuah East Quarry was completed by Kleinfelder in October 2018. A copy of the 2018 Ecological Monitoring Report is attached as **Appendix 5**.

A total of 18 vegetation monitoring sites were established and surveyed within the BOA and Lot 12 in October 2015. These permanent monitoring sites were surveyed in October 2016, October 2017 and October 2018 using the same methods as the baseline survey (see **Appendix 5**). A series of criteria have been developed as part of the overall ecological monitoring program, including:

- Fencing, gates and signage;
- Access tracks;
- Erosion, sedimentation and soil management;
- Existing dwellings;
- Revegetation and regeneration;

- Habitat augmentation;
- Threatened flora translocation;
- Weed control;
- Vertebrate pest management; and
- Fire management.

The results from the 2018 monitoring indicate that while some species are stressed from dry conditions, the vegetation and fauna habitats within the Karuah East Biodiversity Offset Area (BOA) and Lot 12 are in good condition and remain relatively unchanged since the baseline survey in 2016 (Kleinfelder, 2019).

The 2018 threatened species monitoring identified an overall decrease in threatened flora abundance at half of the monitoring locations. However, increases in threatened species was observed at MP 4, 7 and 12. There was no obvious association between the monitoring site proximity to the disturbance area and the level of decline in threatened species; decline was observed both close to and away from the disturbance area. Decline in threatened species abundance cannot be confidently attributed to the quarry disturbance as there is no correlation between monitoring points with higher percentage of decline and proximity to the quarry; high levels of decline (>10%) was observed at both sites close to and away from the impact area. A likely cause for the decrease in threatened species abundance is the below average rainfall experienced throughout 2018 in the region. Rainfall for the year was 182.4mm below average at the Nelson Bay weather station and vegetation in the region revealed signs of drought stress. (Kleinfelder, 2019).

It should be noted that the large increase in the number of *Grevillea parviflora* individuals at Monitoring Point 12 is most likely due to the flattening of clumps by fallen timber. Note the 120% increase in the number of individuals at this location may not reflect the actual state of the local population that has been in decline since the 2015 baseline for more information refer to the 2018 Ecological Monitoring Report (attached as **Appendix 5**).

Some sites did exhibit growth and had healthy plants. Typically, these sites were more protected, occurring in lower areas and along protected creek lines. Flowering and fruiting were generally higher than the previous survey events for both *Tetratheca juncea* and *Asperula asthenes*. *Grevillea parviflora* subsp. *parviflora* was not observed to be flowering or fruiting at any of the monitoring points. However, both fruit and flowers were observed on individuals within the vicinity of MP8.

Dense infestations of *Lantana* were primarily observed along the drainage lines in Lot 5. Two other Priority Weed species were also identified in the BOA: *Asparagus aethiopicus* (Ground Asparagus) and *Senecio madagascariensis* (Fireweed) are both listed as Priority Weeds within the Mid Coast LGA. These two species only occur as small discrete patches in a few locations in the BOA. A number of exotic grasses were identified including: *Setaria sphacelata* (South African Pigeon Grass), *Andropogon virginicus* (Whisky Grass), and *Axonopus fissifolius* (Narrow-leafed Carpet Grass) as well as other annual and perennial exotic herbs. These were predominately located around disturbed areas such as powerline easements, existing dwellings, track edges, perimeter of the quarry disturbance area and previously cleared regrowth areas on the southern part of Lot 14. Note the exotic grasses occurring in the areas of native regrowth are also likely to be shaded out over time as the canopy and midstorey cover continue (Kleinfelder, 2019).

It was observed during the 2018 annual monitoring event that weed density had reduced with signs of stress evident within Lot 5. Note, some areas further south in more sheltered locations, especially along creeklines have witnessed an increase in weed density. Overall reduction in weed density is most likely due to the dry conditions experienced onsite especially on higher poor soils when compared with areas further south (Kleinfelder, 2019).

Tetradthea juncea Translocation

In accordance with the Translocation Plan for *Tetradthea juncea* (*T.juncea*) (Firebird ecoSultants, 2018), monitoring of *T.juncea* was undertaken by Firebird ecoSultants (2018) to satisfy the requirements of the PA 09_0175 for the Karuah East Quarry.

The site was originally surveyed and found that the approved impact area had 243 clumps of *T.juncea*. However, at the time of translocation (May 2016) 367 individuals were recorded. Translocation of the *T.juncea* located within the impact area to the offset area will assist in protecting the genetic diversity of the population.

The 367 *T.juncea* individuals were translocated into prepared areas within the offset area which covered between 2,500m² and 3,000m². The offset area was selected to ensure that an appropriate vegetation community and aspect would replicate the source environment as much as practicable.

The collection method entailed digging within the offset before collecting a translocation section from the impact area and placing the section into the hole within the offset. Site preparation included the removal of threatening processes that may impact upon the success of plant survival. These include weed control, protection from herbivory and management of fire risks. An irrigation system was installed to ensure moisture levels remain adequate for plant survival.

In September 2018, monitoring of the *T. juncea* individuals was undertaken in accordance with the Translocation Plan for *T. juncea* (Firebird ecoSultants, 2018). Monitoring involved the following:

- Flower Counts;
- Observe general plant health;
- Identify all plants within each Section; and
- Photo points.

The monitoring of the *T. juncea* translocation as of September 2018 has shown a survival flowering rate of 37% for the third year of monitoring. Kleinfelder (2019) have also observed a decline in the *T. juncea* numbers within the Biodiversity Offset for the past three years. It is noted that the yearly rainfall totals as recorded by the Bureau of Meteorology's official weather station at Nelson Bay has been below the long-term average in 2016, 2017 and 2018. This suggests that the natural decline in *T. juncea* population is potentially related to the drier than normal conditions.

However, it should also be noted that the translocation site is considerably more overgrown with native vegetation than the previous year. *T. juncea* are quite difficult to find when they are not in flower, particularly in heavily vegetated areas. Thus, it is considered that there was a chance of potentially missing individual *T. juncea* during the survey effort which would result in a lower predicted rate of survival (Firebird ecoSultants, 2019).

A further two years of monitoring will be able to show more certainty of the success of translocation of *T. juncea*.



Photo 6 - *T. juncea* in flower in September 2018



Photo 7 - Unhealthy/browning of *T. juncea* in September 2018

Please see **Appendix 7** for the full report.

During 2017, the Independent Environmental Audit (**see Section 10**) identified that the translocation plan is compliant with conditions (a) through (d) and (f) of Schedule 3, Condition 27 of PA 09_0175. However, it is not compliant with (e) as it does not include performance criteria to measure the success of the program. The Audit Action Plan (**Appendix 8**) confirms that the translocation plan has been updated to satisfy this condition.

6.5.4 Management Measures

A large number of management strategies are proposed within the BOA based on the key aspects listed in **Section 6.5.3**. These are outlined in Section 3 of the BOA Management Plan (Kleinfelder 2015).

A large number of management strategies relating to land management and rehabilitation are outlined within the LRMP, including:

- Inductions;
- Controlling access to the site;
- Weed and feral animal management;
- Pre-clearing protocol;
- Salvaging of key resources during clearing (including removal of habitat trees);
- Fauna displacement and relocation; and
- Seed collection and propagation.

6.5.5 Proposed Improvements to Management Measures

The Karuah East Quarry will continue to implement the BOA Management Plan and LRMP during 2019. Kleinfelder (2019) recommend that the following actions will be undertaken in accordance with the relevant sections of the BOA Management Plan:

- Repair of erosion (to occur immediately);
- Fence repair (immediately as this task is outstanding);
- Fence installation;
- Salvaged habitat installation;
- Weed control (is recommended that weed control works are commenced as soon as possible to meet weed reduction targets prior to the end of Year 3);
- Complete a fire management strategy in 2019; and
- Complete vertebrate pest monitoring in 2019.

It should be noted that Karuah East has already completed the following activities in 2019:

- Feral pig trapping in Lot 14 as of March 2019.

6.6 Heritage (Aboriginal and Non-Aboriginal)

6.6.1 EIS Predictions

An Aboriginal Heritage Impact Assessment was completed as part of the EIS specialist report prepared by RPS (2012). A search of the Aboriginal Heritage Information Management System (AHIMS) database revealed no listed sites inside the project area and the pedestrian survey revealed no Aboriginal cultural heritage items. No evidence of Aboriginal cultural heritage was found during the survey and no impacts were predicted.

A Due Diligence Report was completed by RPS on 17 August 2018 as part of MOD 2. The inspection confirmed the MOD 2 Project Area contains low archaeological sensitivity. Recommendations from the report are contained in **Section 6.6.4**.

6.6.2 Approved Criteria

There are no specific Project Approval criteria associated with heritage relating to the project. Heritage is managed in accordance with the approved *Heritage Management Plan* (RPS, 2015).

The process for managing any unexpected heritage items is outlined in **Section 6.6.4**.

6.6.3 Key Environmental Performance or Management Issues

There were no issues relating to Aboriginal cultural heritage during the reporting period. Potential for Aboriginal heritage was assessed as part of the MOD 2 during 2018, with the extended Project Area containing low archaeological sensitivity.

6.6.4 Management Measures

The process for managing unexpected Aboriginal objects/items is outlined in the *Heritage Management Plan* (RPS, 2015).

In accordance with Condition 36(c) of Project Approval 09_0175 for the Karuah East Quarry and the approved HMP (RPS 2015), RAPs must be provided the option to monitor initial surface disturbance within the MOD 2 Project Area for the identification of unrecorded Aboriginal objects. RAPs must be notified 14 days in advance of work.

Should unexpected Aboriginal objects/features be encountered, work must stop immediately, and the area cordoned off with a high visibility barrier. The Quarry Manager is to then contact a heritage consultant and Registered Aboriginal Parties (RAPs). The heritage consultant, in consultation with the RAPs, is to conduct a field survey to assess the Aboriginal objects/features identified. The heritage consultant, in consultation with the RAPs, will then recommend appropriate mitigation measures.

The Quarry Manager is to implement the mitigation measures that are recommended by the heritage consultant and agreed to by the RAPs and in accordance with the Office of Environment and Heritage regulations. If additional visual inspection and salvage is recommended, the Quarry Manager is to arrange for the heritage consultant and RAPs to undertake those works.

If human remains are identified, work must cease immediately within that area and the area cordoned off. The Karuah East Quarry Manager must contact the NSW Police. The NSW Police will assess if the remains are part of a crime scene or possible Aboriginal remains. If determined to be Aboriginal remains, the NSW Police will contact OEH and OEH will confirm the determination in writing. If determined to be a NSW Police matter, NSW Police instructions must be followed. Clearance to recommence work must be sought from the NSW Police. If OEH confirms the remains are Aboriginal, OEH in consultation with RAPs will develop a management plan. The Karuah East Quarry Manager will document the implementation of the plan.

Provided that these heritage contingency protocols have been followed, works within the project area may proceed.

6.6.5 Proposed Improvements to Management Measures

There are no further proposed management responses other than those outlined in the *Heritage Management Plan* (RPS, 2015).

6.7 General Waste Management

6.7.1 Environmental Management

Karuah East Quarry uses a licensed contractor for waste removal at the site. There has been minimal waste generated as part of the construction process in the reporting period

Typical waste generation at the quarry now the site is operational has consisted of non-hazardous and general wastes, as well as oily wastes. The general and non-hazardous wastes were placed in a skip bin and removed from site.

Approximately 35 cubic meters related to construction were removed from site during 2018.

6.7.2 Environmental Performance

JR Richards, a waste contractor, removes waste from a 3 metre cubed waste bin at the site. Over the year, approximately 60 cubic metres of waste (including construction waste) was removed from the site.

6.7.3 Proposed Improvements to Management Measures

The Karuah East Quarry will continue to implement a waste management strategy similar to the adjacent Karuah Quarry.

6.8 Summary of Environmental Performance

Table 34 provides a summary of the environmental performance at the site for the reporting period.

Table 34 Summary of Environmental Performance

Aspect	Approval Criteria/EIS Prediction	Performance During the Operating Period	Trend/Key Management Implications	Implemented / Proposed Management Actions
Noise	See Section 6.2.1	Non - Compliant	Not within criteria	Continued monitoring
Blasting	See Section 6.3.1	Compliant	Within criteria	Continued monitoring
Air Quality	See Section 6.4.1	Non - Compliant	Within criteria, however one missed HVAS monitoring event.	Continued monitoring
Biodiversity	See Section 6.5.1	Compliant	Within criteria	Continued monitoring
Heritage	See Section 6.6.1	Compliant	No specific criteria.	Continued monitoring
Waste	No predictions	Compliant	Minimal change over successive years	Continued monitoring

7.0 WATER MANAGEMENT

7.1 Summary of Water Management at Site

7.1.1 Environmental Management

Surface water at Karuah East Quarry is managed in accordance with the *Water Management Plan (WMP)*. The primary objective of water management is to remain compliant with EPL 20166 and ensure there is no uncontrolled discharge of water from the site. The goal for any water that leaves the site from a controlled or uncontrolled discharge is that this water meets the required EPL criteria. This objective is intrinsic to erosion and sedimentation designs and controls for the quarry. As such, the following specific objectives of this WMP have been established as part of the construction and operational phases:

- Conducting best practice land clearing procedures for all proposed disturbance areas;
- Implementation of erosion and sediment controls during construction and operation at per the Blue Book and WMP;
- Separating undisturbed runoff from disturbed runoff where possible to minimise and isolate the amount of disturbed or dirty water runoff;
- Directing sediment-laden runoff into designated sediment control dams;
- Diverting clean runoff from areas upstream of the operation into natural depressions and creeks;
- Allowing sediments to settle in sediment control dams so that the water can be re-used for onsite dust suppression, thereby maintaining dam capacities for subsequent rainfall events;
- Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments; and
- Implementing an effective revegetation and maintenance program for the site.

Water Storage and Use

The Karuah East Quarry has three sediment dams, including:

- Dam 1 - Catchment (crushing plant and product stockpiles);
- Dam 2 - Catchment (product stockpiles and office infrastructure area); and
- Dam 3 - Catchment (product stockpiles area).

7.1.2 MOD 1 and 2 Water Management Proposed Changes

MOD 1 – Water management and erosion and sediment control measures will be implemented to maximise drainage of water from the proposed MOD 1 additional disturbance area into the water management system of the approved Karuah East Quarry. Once shaping has been completed the water from the proposed additional disturbance area will flow to Dam 1 of the approved water management system. The additional disturbance will result in a 3.5% increase in the catchment of Dam 1, based on the catchment outlined in the Water Management Plan (SLR, 2015).

Key aspects erosion and sediment control measures associated with the disturbance footprint of MOD 1 include:

- Construction of a rock pitched batter, 1.5m (horizontal) to 1m (vertical);
- Generally larger diameter rocks at the base;
- Land graded back to the existing dam; and
- Completion of a geotechnical report prior to the area being made operational.

It is expected that MOD 1 will not impact on groundwater.

MOD 2 - Will allow water management along the north south internal haulage road and within the MOD 2 area (which is heavily disturbed) to be improved. Erosion and sediment controls will be implemented that will involve changing the grade of the MOD 2 extension area to maximise the drainage of water into the disturbed area of the site (dirty water catchment) established as part of the original Project Approval. The shaping will ensure water from the haulage road as well as the MOD 2 area flows to Dam 1 and Dam 2.

Sediment basin sizing calculations in accordance with Managing Urban Stormwater (Blue Book) were undertaken by SLR and it is confirmed that Dam 2 has adequate capacity to accommodate the minor MOD 2 extension area. Dam 2 will also be reshaped (to be partially located within the MOD 2 area) and nominally modified.

The conceptual design detail erosion and sediment control measures for MOD 2 contain the following key aspects:

- Batter design in accordance with engineering design requirements;
- A mulched or stone pitched batter, generally with larger diameter rocks towards the base; and
- Road surface graded back towards the existing Dam 1 and Dam 2.

The engineering design for the proposed works associated with MOD 2 may also include appropriate details for scour protection at the clean water culvert headwall and sediment dam spillway and scour protection along steep sections of the dirty water drain alongside the road surface.

7.1.3 Improvements to Management Measures

Additional water management structures were completed during 2018 as part of the construction phase, with this including some temporary surface water works in the vicinity of Dam 2.

There are likely to be some upgrades to water management in 2019 within the existing disturbance footprint associated with MOD 1 and 2 described in **Section 7.1.2**.

The current water management system and location of dams are shown in **Figure 2**.

7.2 EIS/Preferred Project Report Predictions

Surface water was assessed for the Karuah East Quarry EIS and then updated for the Preferred Project Report (2013).

The only direct disturbance to occur to the local drainage system will be in the upper reaches of the northern most drainage line in Lot 12. The length of the channel which will be disturbed as a result of excavation is located in the upper reaches of the catchment with no clearly defined bed or banks. Therefore, the impact on the wider catchment as a result of disturbance to the upper reaches of this drainage line is not anticipated to be significant.

With regards to offsite discharges, a water balance model has been developed to predict the frequency and volume of discharges from the project. The water balance predicts that uncontrolled discharges will be minimal, averaging only one discharge day per year in Stage 2 (which represents approximately half of the total disturbance area) and two days in Stage 5 (at full disturbance).

7.3 Surface Water Monitoring Results

7.3.1 Approved Criteria

Discharge criteria for the Karuah East Quarry is provided in Condition L2.4 of EPL 20166 and outlined in **Table 35**. These pollutants will be tested during discharge events from LDP001, LDP002 and LDP003. Discharge events are discussed in **Section 7.6**.

Table 35 Discharge Surface Water Criteria

Pollutant	Units of Measure	50 Percentile Concentration Limit	90 Percentile Concentration Limit	3DGM Concentration Limit	100 Percentile Concentration Limit
Oil and Grease	Milligrams per litre	-	-	-	5 and/or none visible
pH	pH	-	-	-	6.5 - 8.5
Total Suspended Solids	Milligrams per litre	-	-	-	40

The approved WMP refers to several water quality parameters being tested during the first twelve months of operations. The ANZECC Guidelines provide guidance criteria which are outlined in **Table 36**.

Table 36 Water Quality Data - ANZECC Guidelines

Parameter	Unit	ANZECC Guidelines ¹
Conductivity (Field)	uS/cm	125 – 2200
Conductivity (Lab)	uS/cm	125 – 2200
Total Dissolved Solids	mg/L	-
Total Phosphorus	mg/L	0.025
Ammonia	mg/L	0.02
Nitrogen (Nitrate)	mg/L	0.350
Total Hardness (as CaCO ₃)	mg/L	--
Arsenic	mg/L	0.024
Cadmium	mg/L	0.0002
Calcium	mg/L	--
Chromium	mg/L	0.001
Copper	mg/L	0.0014
Lead	mg/L	0.0034
Magnesium	mg/L	--
Manganese	mg/L	1.9
Nickel	mg/L	0.011
Potassium	mg/L	--
Sodium	mg/L	--
Vanadium	mg/L	--
Zinc	mg/L	0.0312

Note 1 - Key default trigger values presented in ANZECC 2000 for slightly disturbed upland rivers in NSW. Heavy metals based on hard water (120-179 mgCaCO₃/L)

As detailed in the WMP, surface water monitoring is undertaken at the following locations:

- Dam 1;
- Dam 2;
- Dam 3;
- SW 1 and SW 2 - Existing second order drainage line (within Lot 13 flowing along the eastern boundary of the PA Area); both upstream and downstream of the quarry;
- SW 3 - Existing drainage line downstream of Dam 2; and
- SW 4 - Existing drainage line downstream of the quarry extraction area.

SW 1-4 will be tested biannually (when flowing) during operations to determine ongoing compliance with the water quality performance criteria. SW2 and SW3 will be tested within 24 hours any discharge.

7.3.2 Surface Water Monthly Monitoring Results

The tables in this section summarise the surface water quality results. A full list of monitoring results is outlined in **Appendix 6**. Discharge results are outlined separately in **Section 7.3.3**. A summary of monitoring frequency is outlined below:

- Dam 1 and Dam 2 and 3 were sampled every month from January 2018. All dams are required to be monitored monthly for the first year of operations to determine a diagnostic set of analytes adopted for ongoing monitoring. Following determination of appropriate analytes, monitoring will be undertaken biannually to determine ongoing compliance with the water quality performance criteria with a requirement to sample;
- SW1 was not monitored in 2018, with the requirement to monitor monthly if the creek is flowing as per the Water Management Plan. There were no times that SW1 was flowing during monthly monitoring events;
- SW2 was monitored monthly from April to December (nine occasions) in 2018, with the requirement to monitor monthly if the creek is flowing and within 24 hours of any discharge as per the Water Management Plan;
- SW3 was monitored in May, June, October and December (four occasions), with the requirement to monitor monthly if the creek is flowing and within 24 hours of any discharge as per the Water Management Plan. There were some months where there was no flow in the creek; and
- SW4 in June 2018 (one occasion), with the requirement to monitor monthly if the creek is flowing as per the Water Management Plan. SW4 rarely flows and was not flowing during other monitoring sampling events.

Table 37 Monthly Surface Water Quality Results for Dams

Parameter	Criteria	Dam 1			Dam 2			Dam 3		
		Min	Max	Average	Min	Max	Average	Min	Max	Average
pH (pH unit)	6.5 - 8.5	5.9	7.7	6.9	4.6	7.7	6.6	6.5	8.1	7.3
TSS (mg/L)	40	5	98	36	4	828	108	6	418	96
TDS (mg/L)	-	321	514	396	167	428	289	299	567	431
Turbidity (NTU)	125-2200	18	276	86	0	0	-	31	669	177
EC (µS/cm)	0.35	496	1035	609	171	604	416	347	833	661
Nitrogen (Nitrate) (mg/L)	0.025	4.5	12.2	8.8	0.032	1.8	0.8	2.4	5.1	3.9
Total Nitrogen (mg/L)	0.02	6.1	12.8	9.810	0.3	2.7	1.233	3.5	5.6	4.500
Total Phosphorous (mg/L)	5	0.01	0.05	0.02	0.01	0.18	0.05	0.01	0.18	0.07
Ammonia (mg/L)	-	0.01	0.2	0.08	0.01	0.18	0.06	0.01	0.2	0.08
Oil and Grease (mg/L)	-	5	5	5	5	5	5	5	7	5.2
Calcium (mg/L)	-	2	10	3.5	2	46	16.5	5	27	17
Magnesium (mg/L)	-	3	6	4.9	2	10	5	4	12	9.3
Sodium (mg/L)	-	90	110	100.8	26	89	51.1	58	140	101.3
Potassium (mg/L)	0.024	1	3	2.07	0.8	2.7	1.43	1	2.5	1.65
Total Hardness (as CaCO ₃)	0.0002	17	49	27.5	13	135	59.7	29	97	78.3
Arsenic (mg/L)	0.001	0.001	0.004	0.001	0.001	0.004	0.001	0.001	0.002	0.001
Cadmium (mg/L)	0.001	0.0001	0.006	0.0006	0.0001	0.007	0.0007	0.0001	0.0002	0.0001
Chromium (mg/L)	0.011	0.001	0.003	0.001	0.001	0.021	0.004	0.001	0.014	0.003
Copper (mg/L)	0.003	0.001	0.12	0.01	0.001	0.12	0.01	0.001	0.08	0.01
Nickel (mg/L)	1.9	0.001	0.034	0.004	0.001	0.024	0.004	0.001	0.01	0.003
Lead (mg/L)	-	0.001	0.003	0.001	0.001	0.014	0.002	0.001	0.006	0.002
Manganese (mg/L)	0.021	0.01	0.26	0.1	0.02	0.37	0.1	0.018	0.39	0.1
Vanadium (mg/L)	-	0.001	0.01	0.007	0.001	0.07	0.01	0.005	0.05	0.02
Zinc (mg/L)	0.021	0.006	0.2	0.03	0.005	0.16	0.03	0.007	0.11	0.04

Table 38 Monthly Surface Water Quality Results for SW1-4

Parameter	Criteria	SW1			SW2			SW3			SW4		
		Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
pH (pH unit)	6.5 - 8.5	-	-	-	5.7	7.1	6.5	3.3	7.0	5.5			6.5
TSS (mg/L)	40	-	-	-	5	72	25	12	270	186			61
TDS (mg/L)	-	-	-	-	243	456	360	370	816	505			224
Turbidity (NTU)	-	-	-	-	47	145	82	81	488	309			105
EC (µS/cm)	125-2200	-	-	-	255	568	451	112	412	274			259
Nitrogen (Nitrate) (mg/L)	0.35	-	-	-	<0.35	8.2	2.6	0.01	0.46	0.2			0.002
Total Nitrogen (mg/L)		-	-	-	0.7	9	3.9	0.8	1.4	1.1			0.8
Total Phosphorous (mg/L)	0.025	-	-	-	0.01	0.18	0.05	0.08	0.17	0.12			0.02
Ammonia (mg/L)	0.02	-	-	-	<0.02	0.13	0.05	0.01	0.09	0.05			0.15
Oil and Grease (mg/L)	5	-	-	-	<5	<5	<5	<5	<5	<5			<5
Calcium (mg/L)	-	-	-	-	2	4.8	3.3	2	3	2.5			4.0
Magnesium (mg/L)	-	-	-	-	3	5.9	4.5	1	5	2.7			6.0
Sodium (mg/L)	-	-	-	-	43	95	75.9	25	54	37.7			39
Potassium (mg/L)	-	-	-	-	1.7	3	2.1	1	2	1.2			2.0
Total Hardness (as CaCO ₃)	-	-	-	-	17	36	25.3	9	30	18			35
Arsenic (mg/L)	0.024	-	-	-	0.001	0.001	0.001	0.001	0.002	0.001			0.001
Cadmium (mg/L)	0.0002	-	-	-	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001			0.0001
Chromium (mg/L)	0.001	-	-	-	0.001	0.005	0.002	0.001	0.017	0.01			0.001
Copper (mg/L)	0.001	-	-	-	0.001	0.007	0.0020	0.002	0.019	0.0105			0.001
Nickel (mg/L)	0.011	-	-	-	0.001	0.003	0.001	0.001	0.009	0.005			0.001
Lead (mg/L)	0.003	-	-	-	0.001	0.002	0.001	0.001	0.011	0.007			0.001
Manganese (mg/L)	1.9	-	-	-	0.01	0.16	0.06	0.03	0.18	0.12			0.04

Parameter	Criteria	SW1			SW2			SW3			SW4		
		Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
Vanadium (mg/L)	-	-	-	-	0.005	0.01	0.009	0.01	0.06	0.035			<0.01
Zinc (mg/L)	0.021	-	-	-	0.006	0.028	0.014	0.015	0.092	0.054			0.005

Table 39 Comparison between 2018 and 2017 Dam Averages

Parameter	Dam 1 2018 Average	Dam 1 2017 Average	Dam 2 2018 Average	Dam 2 2017 Average	Dam 3 2018 Average	Dam 3 2017 Average
pH (pH unit)	6.9	6.5	6.6	6.2	7.34	6.5
TSS (mg/L)	36	68	108	97	96	276
TDS (mg/L)	3967	641	289	443.8	432	1073
Turbidity (NTU)	86	-	-	-	178	
EC (µS/cm)	609	530	417	443	661	492
Nitrogen (Nitrate) (mg/L)	8.763	4.7	0.858	1.2	3.897	5.2
Total Nitrogen (mg/L)	9.810	-	1.233	-	4.500	-
Total Phosphorous (mg/L)	0.02	0.1	0.04	0.1	0.07	0.3
Ammonia (mg/L)	0.08	0.1	0.05	0.1	0.08	0.06
Oil and Grease (mg/L)	<5.0	10.6	<5.0	8.3	<5.0	11.9
Calcium (mg/L)	3.6	5.2	16.5	5.2	17	8.9

2018 Annual Review
Karuah East Quarry Pty Ltd

Parameter	Dam 1 2018 Average	Dam 1 2017 Average	Dam 2 2018 Average	Dam 2 2017 Average	Dam 3 2018 Average	Dam 3 2017 Average
Magnesium (mg/L)	4.9	5.4	5	6.7	9.3	11.6
Sodium (mg/L)	100.8	87.7	51.1	81.5	101.3	82.9
Potassium (mg/L)	2.07	2.3	1.43	2.3	1.65	3.3
Total Hardness (as CaCO ₃)	27.5	35.3	59.7	40	78.3	70.3
Arsenic (mg/L)	0.001	0.002	0.001	0.002	0.001	0.004
Cadmium (mg/L)	0.0006	0.0001	0.0007	0.0001	0.0001	0.0001
Chromium (mg/L)	0.001	0.01	0.004	0.005	0.003	0.014
Copper (mg/L)	0.012	0.01	0.015	0.007	0.014	0.01
Nickel (mg/L)	0.004	0.003	0.004	0.004	0.003	0.008
Lead (mg/L)	0.001	0.01	0.003	0.004	0.002	0.01
Manganese (mg/L)	0.1	0.2	0.1	0.1	0.1	0.6
Vanadium (mg/L)	0.01	0.03	0.01	0.02	0.02	0.05
Zinc (mg/L)	0.03	0.1	0.03	0.09	0.04	0.1

Table 40 Comparison between 2018 and 2017 SW Averages

Parameter	SW 1 2018 Average	SW 1 2017 Average	SW 2 2018 Average	SW 2 2017 Average	SW 3 2018 Average	SW 3 2017 Average	SW 4 2018 Average	SW 4 2017 Average
pH (pH unit)	-	6.5	6.5	5.9	5.5	5.4	6.5	5.5
TSS (mg/L)	-	68	25	26	186	803	61	7
TDS (mg/L)	-	641	360	396	505	501	224	186
Turbidity (NTU)	-		82	-	309	-	105	-
EC (µS/cm)	-	530	451	385	274	222.3	259	261
Nitrogen (Nitrate) (mg/L)	-	4.7	2.6	0.5	0.2	0.09	0.002	0.005
Total Nitrogen (mg/L)	-	-	3.9	-	1.1	-	0.8	-
Total Phosphorous (mg/L)	-	0.1	0.05	0.3	0.12	0.8	0.02	0.02
Ammonia (mg/L)	-	0.1	0.05	0.1	0.05	0.03	0.15	0.02
Oil and Grease (mg/L)	-	10.6	<5	6.5	<5	13.3	<5	60.5
Calcium (mg/L)	-	5.2	3.3	8.9	2.5	4.8	4.0	3.7
Magnesium (mg/L)	-	5.4	4.5	12.5	2.7	10.2	6.0	5.3
Sodium (mg/L)	-	87.7	75.9	86.6	37.7	29.3	39	27.5
Potassium	-	2.3	2.1	5.5	1.2	3.4	2.0	2

2018 Annual Review
Karuah East Quarry Pty Ltd

Parameter	SW 1 2018 Average	SW 1 2017 Average	SW 2 2018 Average	SW 2 2017 Average	SW 3 2018 Average	SW 3 2017 Average	SW 4 2018 Average	SW 4 2017 Average
(mg/L)								
Total Hardness (as CaCO ₃)	-	35.3	25.3	73.7	18	53.7	35	30.5
Arsenic (mg/L)	-	0.002	0.001	0.001	0.001	0.004	0.001	0.001
Cadmium (mg/L)	-	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium (mg/L)	-	0.01	0.002	0.003	0.01	0.02	0.001	0.001
Copper (mg/L)	-	0.01	0.002	0.004	0.01	0.02	0.001	0.001
Nickel (mg/L)	-	0.003	0.001	0.002	0.005	0.01	0.001	0.001
Lead (mg/L)	-	0.01	0.001	0.002	0.007	0.02	0.001	0.001
Manganese (mg/L)	-	0.2	0.06	0.09	0.12	0.3	0.04	0.01
Vanadium (mg/L)	-	0.03	0.009	0.01	0.035	0.06	<0.01	0.001
Zinc (mg/L)	-	0.1	0.014	0.03	0.054	0.08	0.005	0.007

Summary of Dams:

Dam 1 - Slight increase in pH between 2017 and 2018 from 6.5 to 6.9. Slight decrease in TSS from 68 mg/L to 36 mg/L and a slight increase in EC from 530 us/cm in 2017 to 609 us/cm in 2018. For other parameters the main changes included a decrease of Oil and Grease from 8.3 mg/L in 2017 to less than 5.0 mg/L in 2018 and a decrease of TDS from 641 mg/L in 2017 to 397 mg/L in 2018.

Dam 2 - Slight increase in pH between 2017 and 2018 from 6.2 to 6.6. Increase in TSS from 97 mg/L to 108 mg/L and a slight decrease in EC from 443 us/cm in 2017 to 417 us/cm in 2018. For other parameters the main changes included a decrease of Oil and Grease from 10.6 mg/L in 2017 to less than 5.0 mg/L in 2018 and a decrease of TDS from 443.8 mg/L in 2017 to 289 mg/L in 2018. Additionally, Calcium increased from 5.2 mg/L to 16.5 mg/L in 2018, while Sodium decreased from 81.5 mg/L to 51.1 mg/L.

Dam 3 - Slight increase in pH between 2017 and 2018 from 6.5 to 7.34. Slight increase in TSS from 276 mg/L to 96 mg/L and a slight increase in EC from 492 us/cm in 2017 to 661 us/cm in 2018. For other parameters the main changes included a decrease of Oil and Grease from 11.9 mg/L in 2017 to less than 5.0 mg/L in 2018 and a decrease of TDS from 1073 mg/L in 2017 to 432 mg/L in 2018. Additionally, Calcium increased from 8.9 mg/L in 2017 to 17 mg/L in 2018, while Sodium increased from 82.9 mg/L to 101.3 mg/L and Magnesium decreased slightly from 11.6 mg/L to 9.2 mg/L.

Summary of Creeks:

SW1 was not monitored during 2018 due to no flow in the creek at the monitoring location. As required, SW 2-3 were monitored monthly during creek flow.

SW 2 - Slight increase in pH between 2017 and 2018 from 5.9 to 6.5. TSS remained the same while a slight increase was recorded in EC from 385 us/cm in 2017 to 451 us/cm in 2018. For other parameters the main changes included a decrease of Oil and Grease from 6.5 mg/L in 2017 to <5 mg/L in 2018 and a decrease of TDS from 396 mg/L to 360 mg/L. Additionally, Calcium decreased from 8.9 mg/L to 3.3 mg/L and magnesium decreased from 12.5 mg/L to 4.5 mg/L. Total Hardness (as CaCO₃) decreased from 73.7 to 25.3.

SW 3 - Slight increase in pH at SW3 between 2017 and 2018 from 5.4 to 5.5. Decrease in TSS from 803 mg/L to 186 mg/L and a slight increase in EC from 222 us/cm in 2017 to 274 us/cm in 2018. For other parameters the main changes included a decrease of Oil and Grease from 13.3 mg/L in 2017 to <5 mg/L in 2018. Additionally, Calcium decreased from 8.9 mg/L in 2017 to 3.3 mg/L in 2018, and Magnesium decreased from 10.2 mg/L to 2.7 mg/L while sodium increased from 29.3 to 37.7 mg/L. Total Hardness (as CaCO₃) decreased from 53.7 in 2017 to 18 in 2018.

SW4 - Slight increase in pH between 2017 and 2018 from 5.5 to 6.5. Significant increase in TSS from 7 mg/L to 61 mg/L occurred while EC remained the same. For other parameters the main changes included a decrease of Grease and Oil from 60.5 mg/L in 2017 to <5 mg/L in 2018 and a slight increase in TDS from 186 mg/L in to 224 mg/L. Calcium, Sodium and Magnesium levels remained very similar between 2017 and 2018.

7.3.3 Discharge Results

Controlled and uncontrolled discharges from each licenced discharge point is summarised below:

- LDP001 - 6 discharges including 0 controlled discharges and 6 uncontrolled discharges;
- LDP002 - 12 discharges including 11 controlled discharges and 1 uncontrolled discharge; and
- LDP003 - 14 discharges including 13 controlled discharges and 1 uncontrolled discharge.

pH and TSS exceedances for each licenced discharge point is summarised below:

- LDP001 - 3 pH exceedances and 3 TSS exceedances;
- LDP002 - 3 pH exceedances and 0 TSS exceedances; and
- LDP003 - No exceedances.

There have been 32 discharge events during 2018 from the combined LDP001, LDP002 and LDP003.

There was a total of 8 uncontrolled discharges and 24 controlled discharges.

There was a total of 6 pH exceedances and 3 TSS exceedances from the combined LDP001, LDP002 and LDP003 discharges.

The monitoring results for these discharge events are presented in **Table 41**

Table 41 Discharge Monitoring Results 2018

Discharge Point	Date	pH	EC (µS/cm)	Turbidity (NTU)	TSS (mg/L)	Oil and Grease (mg/L)	Comment
	EPL Criteria	6.5 - 8.5	-	-	40	5	
LDP001	22-March-18	6.1	573	55	36	<5	Uncontrolled discharge. Non-Compliant
	14-May-2018	6.37			38	<5	Uncontrolled discharge Non-Compliant
	05-June-2018	6.3			15	<5	Uncontrolled discharge Non-Compliant
	08-October-2018	6.6	566	260	91	<5	Uncontrolled discharge Non-Compliant
	09-October-2018	6.8	558	240	81	<5	Uncontrolled discharge Non-Compliant
	11-October-2018	6.6	567	200	63	<5	Uncontrolled discharge Non-Compliant
LDP002	15-March-2018	6.9	594	16	12	<5	Controlled discharge.
	16-March-2018	6.6	549	14	9	<5	Controlled discharge. Total volume ~0.5ML
	22-March-2018	5.2	532	22	17	<5	Non-Compliant Uncontrolled discharge.
	07-May-2018	6.5			17	<5	Controlled discharge
	08-May-2018	6.1			25	<5	Non-Compliant Controlled discharge.

Discharge Point	Date	pH	EC (µS/cm)	Turbidity (NTU)	TSS (mg/L)	Oil and Grease (mg/L)	Comment
							Total volume ~0.5ML
							Non-Compliant
	16-May-2018	5.9			4	5	Controlled discharge. Total volume ~0.5ML
	26-June-2018	8	270	40	8	<5	Controlled discharge.
	27-June-2018	7.7	284	40	8	<5	Controlled discharge. Total volume ~0.5ML
	05-September-2018	6.6	381	50	20	<5	Controlled discharge.
	06-September-2018	6.5			10	<5	Controlled discharge.
	05-November-2018	6.9	287	80	25	<5	Controlled discharge.
	04-December-2018	6.6	474	11	9	<5	Controlled discharge.
LDP003	07-February-2018	7.8	1060	55	28	<5	Controlled discharge
	08-February-2018	7.8	1050	60	26	<5	Controlled discharge. Estimated volume 0.5ML
	03-March-2018	7.8	851	95	33	<5	Controlled discharge
	04-March-2018	8.2	841	75	36	<5	Controlled discharge. Total volume 290,000L
	23-August-2018	7.6			16	<5	Controlled discharge. Total volume 300,000L
	04-September-2018	7.6	701	40	27	<5	Controlled discharge
SW2 (Bulga Creek) <i>Monitoring during discharge events</i>	22-March-18	5.60	552	405	233	<5	Light flow
	14-May-18	6.26			22	<5	Mod flow, LDP1 discharging
	05-June-18	5.80			102	<5	Mod flow, LDP1 discharging
	08-October-18	6.20	543	200	62	<5	Light flow.
	09-October-18	6.20	551	160	54	<5	Light flow.
	11-October-18	6.20	553	180	54	<5	Mod flow.
SW3 (Yalimbah Creek) <i>Monitoring during discharge events</i>	16-March-18	5.50	593	25	12	<5	LDP2 controlled discharge.
	22-March-18	5.90	284	750	516	<5	Mod flow
	08-May-18	5.80			19	<5	LDP2 controlled discharge.
	27-June-18	6.20	274	55	11	<5	Light/Mod flow
	06-September-18	6.00		40	17	<5	Light flow. LDP2 discharge

Discharge Analysis

- All three pH exceedances for LDP001 occurred between March and June 2018, the largest exceedance of 6.1 was recorded on the 22 March 2018;
- All three TSS exceedances for LDP001 occurred during October 2018 with the largest exceedance recorded at 91 mg/L on the 8 October 2018;
- All three pH exceedances for LDP002 occurred between March and May 2018, the largest exceedance of 5.2 was recorded on the 22 March 2018; and
- LDP003 results were within EPL 20611 discharge criteria.

The main reason for the discharges in 2018 has been that the water management system is designed for a quarry operating at maximum capacity where water is used for dust suppression and processing. With less water being used in 2018, there is a higher likelihood of discharge events.

7.4 Groundwater Monitoring Results

7.4.1 Approved Criteria

There are no criteria applicable to groundwater monitoring in Project Approval 09_0175 or EPL 20611.

In accordance with the approved WMP, groundwater levels are monitored on a quarterly basis to identify any adverse impacts arising from the operation of the quarry in the future, and to identify long-term groundwater level trends. Groundwater samples will be collected for laboratory analysis on a 6-monthly basis. The groundwater quality results will be laboratory analysed for the parameters below and compared to background water quality results:

- pH, EC, Total Dissolved Solids (TDS); Alkalinity;
- Total nitrogen, total phosphorus;
- Major ions, calcium, magnesium, sodium, potassium, chloride, sulphate, carbonate, bicarbonate;
- Total Petroleum Hydrocarbon (TPH); and
- BTEX (benzene, toluene, ethyl benzene, exylene). Additional Analysis – 12 monthly (every second sample only):
- Nutrient suite: total nitrogen, nitrate, total Kjeldahl nitrogen, total phosphorus, phosphate;
- Metals (arsenic, cadmium, chromium, copper, lead, zinc, nickel, manganese, mercury, total iron, filterable iron);
- Polycyclic Aromatic Hydrocarbon (PAH); and
- Organophosphorus pesticides, phenoxy acid herbicides.

The existing monitoring bores at BH205, BH207, BH208 and BH303 are used for monitoring groundwater of the quarry area. BH207 was relocated in September 2016 and BH205 was relocated on 11 March 2017. Both of these piezometers were relocated within 30m to their original locations to allow construction to progress.

New monitoring bores will be installed if any existing monitoring bores are destroyed during the quarry operations or are subject to general failure. The locations of new bores will be added to the Water Management Plan and provided to DPE and DoI Water.

7.4.2 Monitoring Results

Groundwater Level

Table 42 shows a comparison of groundwater levels in 2017 and 2018. All GW points were monitored twice during 2018 with a requirement for quarterly monitoring of groundwater levels as per the WMP. This is a non-compliance relating to Schedule 3 Condition 21 iii. As evident, water levels have remained relatively consistent across all locations, with only BH205 showing a consistent decrease in water level since the start of monitoring.

Table 42 Groundwater Quality Results for Key Parameters in 2017 and 2018

Date	Groundwater level (metres below ground level)			
	BH205	BH207	BH208	BH303
April 2017	25.3	9.4	20.0	30.7
October 2017	22.9	8.9	19.9	30.6
January 2018	21.9	9.1	20.3	30.7
April 2018	21.7	9.2	20.5	30.8
July 2018	20.5	8.9	20.5	30.9
October 2018	20.4	9.3	19.9	30.8

Groundwater Quality

Sampling of groundwater monitoring locations occurred on 18 April 2018 and 30 October 2018 in accordance with GW the six-monthly requirement to monitor groundwater quality data as per the WMP. Note: BH 208 was only monitored once during 2018 due to insufficient water levels on the 30 October 2018. Results have been compared against data sampled from 2010 (pre-Karuah East Quarry) in **Table 43**

Table 43 Average Groundwater Quality Results for Key Parameters

Monitoring Location	pH	TDS (mg/L)	EC (µS/cm)	Number of Samples
Pre Karuah East (Average results from 2010 data)				
BH 205	7.2	665	Not sampled	2
BH207	7.4	1540	Not sampled	1
BH303	6.3	600	Not sampled	1
Average Results 2016				
BH 205	7.3	1182	2015	2
BH 207	6.9	1578	2780	2
BH 208	6.4	2000	3010	2
BH303	6.4	889	1555	2
Average Results 2017				
BH 205	8.7	1200	2230	2
BH 207	7.2	1800	3600	2
BH 208	6.6	1900	3500	2

Monitoring Location	pH	TDS (mg/L)	EC (µS/cm)	Number of Samples
BH 303	6.9	1175	2350	2
Average Results 2018				
BH 205	8.8	1150	2500	2
BH 207	7.15	1020	1940	2
BH 208	7.10	3000	3000	1
BH 303	7.5	1250	2550	2

The pH results in 2018 are slightly higher than those recorded in pre-Karuah East and results from 2017. TDS levels continued to be highly variable across the years. In 2018 the highest longterm TDS level was recorded, being 3000 mg/L at BH 208.

Average EC was lower at BH 207 and BH 208 in 2018 as compared with 2017 and higher at BH 205 and BH 303. EC was not sampled during 2010 monitoring.

Karuah East will continue to monitor groundwater quality during 2019.

7.5 Water Take

There is no Water Take at the Karuah East Quarry, with the site having no groundwater extraction licences.

7.6 Salinity Trading Scheme Credit Use

Not applicable to Karuah East Quarry.

7.7 Compensatory Water to Other Users

Not applicable to Karuah East Quarry.

8.0 REHABILITATION

There have been no opportunities to establish rehabilitation at the quarry site in its current form. Future rehabilitation activities will be undertaken in accordance with the approved LRMP.

8.1 Rehabilitation Performance During Reporting Period

A summary of rehabilitation at Karuah East Quarry is outlined in **Table 44**.

Table 44 Summary of Rehabilitation Performance During Reporting Period

Guideline Requirement	Site Comment
Extent of the operations and rehabilitation at completion of the reporting period	No Rehabilitation.
Agreed post- rehabilitation land use	Final landuse is outlined within the LRMP. The vegetation at closure will be native woodland consistent with the surrounding bushland.
Key rehabilitation performance indicators	No Rehabilitation.
Renovation or removal of buildings	No Rehabilitation.
Any other Rehabilitation Taken including: <ul style="list-style-type: none"> • Exploration activities; • Infrastructure; • Dams; and • The installation or maintenance of fences, bunds and any other works. 	No Rehabilitation.
Any rehabilitation areas which have received formal sign off from the Resources Regulator.	No Rehabilitation.
Variations to activities undertaken to those proposed (including why there were variations and whether the Resources Regulator was notified)	No Rehabilitation.
Outcomes of trials, research projects and other initiatives	No Rehabilitation.
Key issues that may affect successful rehabilitation	No Rehabilitation.

Table 45 Disturbance and Rehabilitation Status

Quarry Area Type	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
Total Quarry Footprint (including access road in)	21.4 ha	24.8 ha	27 ha
Total Active Disturbance	21.4 ha	24.8 ha	27 ha
Land Being Prepared for Rehabilitation	0	0	0
Land Under Active Rehabilitation	0	0	0
Completed Rehabilitation	0	0	0

8.2 Actions for the next Reporting Period

The DPE (2015) *Annual Review Guidelines* requires an outline of the rehabilitation actions proposed during the next reporting period. These actions are detailed in **Table 46**.

Table 46 Actions for the Next Reporting Period

Action	Site Comment
Describe the steps to be undertaken to progress agreement during next reporting period, where final rehabilitation outcomes have not yet been agreed between stakeholders.	There is no planned additional rehabilitation at the site in the next Annual Review period.
Outline proposed rehabilitation trials, research projects and other initiatives to be undertaken during next reporting period.	There are no additional rehabilitation trials during the next Annual Review period.
Summary of rehabilitation activities proposed for next report period.	There is no planned additional rehabilitation at the site in the next Annual Review period.

9.0 COMMUNITY

9.1 Community Engagement Activities

A Community Consultative Committee (CCC) was formed for the Karuah East Quarry in accordance with Schedule 5, Condition 6 of PA 09_0175, which states:

The Proponent shall establish and operate a Community Consultative Committee (CCC) for the project. The CCC must:

- (a) be established and operated in general accordance with the Guidelines for Establishing and Operating Community Consultative Committees for Mining Projects (Department of Planning, 2007, or its latest version); and*
- (b) be established prior to the commencement of construction activities, to the satisfaction of the Secretary.*

Meetings were held on the following dates:

- 5 March 2018; and
- 3 September 2018.

The CCC comprises of an independent chair, three community members, two company representatives and two environmental consultants. Other attendees include a representative from the Midcoast council. Meeting minutes are found on the website <http://hunterquarries.com.au/karuah-east-documents/>.

Key aspects discussed include:

- Site inspection;
- Current offset monitoring;
- Water testing – methodology;
- Explanation and updates on proposed modifications;
- Discussion of monitoring results;
- EPBC Approval Amendment;
- Proposed EA modifications;
- Translocation of some *Tetratheca juncea* plants into the established translocation area; and
- Noise exceedances – Karuah East is working to resolve these issues.

9.2 Community Contributions

The Karuah East Quarry feels strongly about supporting the local community and has a history of community contributions. Community contributions are being made through Hunter Quarries Pty Limited.

9.3 Complaint Management

If a complaint is received, it is logged and investigated by the Quarry Manager. Feedback is then provided to the complainant and government agencies, as required. This process forms a part of the Karuah East Environmental Management Strategy (EMS).

A telephone number has been established for the purpose of receiving complaints and enquiries from the community and this number is available on the Karuah East Quarry website (www.hunterquarries.com.au) and is provided on a sign at the entrance to the quarry. The community can contact the quarry on (02) 4997 5966 as well as through the Karuah East Quarry website.

9.3.1 2018 Complaints

There were two complaints received regarding Karuah East Quarry during this Annual Review reporting period. This is the same number of complaints received in the 2017 reporting period.

A complaint was received at 12.45 pm on 13 April 2018 regarding excess noise from what was believed to have been from the jaw crusher. The complainant described the noise as an ongoing 'thumping sound'. Karuah Quarries contacted the complainant on 16 April and have begun an investigation into the matter. Karuah East have identified Noise is loudest in the morning generally before 10am when the temperature is mild. Karuah Quarries are continuing to investigate the issue of excessive noise associated with the jaw crusher.

A complaint was received at 12.42 pm on 22 June 2018 regarding a blast which distressed the complainant's horse on Halloran Road, North Arm Cove. It was noted that this was an unusual occurrence as blast monitoring instruments recorded vibration and overpressure which was within the required criteria during the blast. Therefore, the associated impacts of the blast could be attributed to the unusual weather conditions experienced at the time. As an outcome, all residents of Halloran and Huntview Roads, North Arm Cove, have been added to the Quarry's blast register. Residents on the blast register receive SMS notifications 24 hours before the blast and within 1 hour of the blast.

10.0 INDEPENDENT ENVIRONMENTAL AUDIT

An Independent Environmental Audit is required for at Karuah East Quarry in accordance with Schedule 5 Condition 9 of PA 09_0175. This is to be completed “within 12 months of the commencement of development on the site, and every 3 years thereafter”. The first Independent Environmental Audit was completed in July 2017 by EMM Consulting. A copy of the Independent Environmental Audit is available on the website <http://hunterquarries.com.au/karuah-east-documents/>.

The Audit Action Plan and current progress against the recommendations is contained in **Appendix 8**.

11.0 INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

11.1 Summary of Incidents

A small oil spill of approximately 1 litre occurred near the stockpile area at 4pm on the 1 February 2018. The spill was the result of a burst hydraulic hose on the bucket of an excavator. The spill was contained, and spill kits were used. Due to the minor nature of this incident, Karuah East did not need to activate the Pollution Incident Response Management Plan or report the spill to authorities.

A small oil spill of approximately 10 litres occurred at the stemming area near the top of Karuah East Quarry at 9.20 am on the 11 April 2018. The spill was the result of a burst hydraulic hose on an articulated dump truck. The spill was contained, and spill kits were used. Due to the minor nature of this incident, Karuah did not need to activate the Pollution Incident Response Management Plan or report the spill to authorities.

11.2 Summary of Non-compliance

A summary of other non - compliances is outlined below:

Table 47 Summary of Non-Compliances

Date	Incident/Non-Compliance	Action/Comment
February, May and August Noise Monitoring	The noise levels emitted by the site were above the requirements in the PA 09_0175 criteria during the operation phase at Karuah East Quarry during 2018. This occurred at location G for the February, May and August monitoring events.	Karuah East are working on solutions to reduce noise form the operations.
Throughout the period	Noise Management Plan requirement – Non-compliance relating to the noise bund not being installed. No enclosure of crushers and screens.	Karuah East are working on solutions to reduce noise from the operations.
18 January 2018	Non - compliance relating to no sample of HVAS on 19 January 2018	This was a one-off occurrence due to power failure.
Several occasions. See Section 7.3.3	Non-compliance relating to exceedance of concentration limits during the nine exceedances across two discharge points.	Continuation of monitoring. With the recommencement of operations more water will be used for processing and dust suppression which reduces the risk of discharge.

11.3 Environmental Training

Training of Quarry employees and contractors are undertaken through the year with a focus on environmental incidents. On 17 October 2018, an emergency simulation exercise was conducted to review the response to a vehicle fire that led to a diesel and oil spill. This scenario was conducted in conjunction with the North Arm Cover Rural Fire Service and it enabled the Pollution Incident Response Management Plan (PIRMP) to be tested and reviewed.

12.0 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Table 48 outlines the proposed actions in the next Annual Review.

Table 48 Proposed Actions in the Next Annual Review

Proposed Action	Timeline	Management Plan Requires Revision
Complete construction activities	On-going	Possibly
Continue environmental monitoring in accordance with management plans and approval requirements	On-going	Possibly
Continue CCC and community support	On-going	No
Continue to update the website with monitoring data and key environment and community information	On-going	No
Update the management plans	Q2 2019	Yes

13.0 REFERENCES

The following documents and reports have been used to assist in writing the quarry's Annual Review:

Management Plans

- *Air Quality and Greenhouse Gas Management Plan (SLR 2015);*
- *Biodiversity Offset Area Management Plan (Kleinfelder 2018);*
- *Blast Management Plan (SLR 2015);*
- *Environmental Management Strategy (SLR 2015);*
- *Heritage Management Plan (RPS 2015);*
- *Landscape and Rehabilitation Management Plan (Kleinfelder and SLR 2018);*
- *Noise Management Plan (SLR 2015);*
- *Tetratheca juncea Translocation Program (Firebird 2018);*
- *Traffic Management Plan (Streetwise 2015); and*
- *Water Management Plan (SLR 2015).*

Statutory Documents

- *Section 75W Application (MOD 1) to amend Part 3A Project Approval 09_0175 Minor Increase to Approved Disturbance Area (ADW Johnson 2018a);*
- *Section 75W Application (MOD 2) to amend Part 3A Project Approval 09_0175 Minor Increase to Approved Disturbance Area (ADW Johnson 2018b);*
- *Environmental Assessment Report – Proposed Karuah East Quarry (ADW Johnson 2013);*
- *Environment Protection Licence (No. 20611);*
- *Preferred Project Report - Proposed Karuah East Quarry (ADW Johnson July 2013);*
- *Project Approval (PA 09_0175); and*
- *Federal Approval (EPBC 2014/7278).*

APPENDIX 1 – Project Approval and Federal Approval

Project Approval

Section 75J of the *Environmental Planning and Assessment Act 1979*

As delegate of the Minister for Planning, the Planning Assessment Commission approves the project application referred to in Schedule 1, subject to the conditions in Schedules 2 to 5.

These conditions are required to:

- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the project.

Alan Coutts
Member of the Commission

David Johnson
Member of the Commission

Sydney

17 June 2014

SCHEDULE 1

Application Number:	09_0175
Proponent:	Karuah East Quarry Pty Limited
Approval Authority:	Minister for Planning
Land:	Lot 12 DP 1024564 Lot 13 DP 1024564 Lot 202 DP 1042537 Lot 26 DP 1024341 Lot 27 DP 1024341 Lot 16 DP 1024564 Lot 17 DP 1024564
Project:	Karuah East Quarry Project

Green text represents Mod 1 (Increased disturbance area) – April 2018

Red text represents Mod 2 (Increased disturbance area) – December 2018

TABLE OF CONTENTS

DEFINITIONS	i
ADMINISTRATIVE CONDITIONS	1
Obligation to Minimise Harm to the Environment	1
Terms of Approval	1
Limits on Approval	1
Structural Adequacy	2
Demolition	2
Protection of Public Infrastructure	2
Planning Agreement	2
Road Maintenance	2
Operation of Plant and Equipment	3
Staged Submission of any Strategy, Plan or Program	3
Production Data	3
Compliance	3
Applicability of Guidelines	3
Evidence of Consultation	3
ENVIRONMENTAL PERFORMANCE CONDITIONS	4
Identification of Approved Limits of Extraction	4
Noise	4
Blasting	6
Air Quality	7
Meteorological Monitoring	8
Soil & Water	8
Transport	10
Landscape	11
Heritage	15
Visual	15
Emergency and Hazard Management	15
Waste	16
ADDITIONAL PROCEDURES	17
Notification of Landowners	17
Independent Review	17
ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING	18
Environmental Management	18
Reporting	20
Independent Environmental Audit	20
Access to Information	20
APPENDIX 1: PROJECT LAYOUT	22
APPENDIX 2: RECEIVER LOCATIONS PLAN	24
APPENDIX 3: NOISE COMPLIANCE ASSESSMENT	25
APPENDIX 4: CONCEPTUAL BIODIVERSITY OFFSET STRATEGY	26
APPENDIX 5: REHABILITATION AND FINAL LANDFORM PLAN	27
APPENDIX 6: STATEMENT OF COMMITMENTS	28

DEFINITIONS

Annual review	The review required under condition 4 of Schedule 5
BCA	Building Code of Australia
Biodiversity offset strategy	The conservation and enhancement strategy described in the EA, and depicted conceptually in the figure in Appendix 4
CCC	Community Consultative Committee
Conditions of this approval	Conditions contained in Schedules 2 to 5 inclusive
Council	MidCoast Council
CPI	Australian Bureau of Statistics Consumer Price Index
Department	Department of Planning and Environment
Dol-Water	Department of Industry – Crown Lands and Water Division
DRG	Division of Resources and Geoscience within the Department
EA	Environmental Assessment titled <i>Environmental Assessment Report, Proposed Karuah East Hard Rock Quarry</i> , prepared by ADW Johnson Pty Limited and dated 31 January 2013, including the response to submissions prepared by ADW Johnson Pty Limited and dated 31 May 2013 and the Preferred Project Report titled <i>Preferred Project Report Proposed Karuah East Quarry</i> , prepared by ADW Johnson Pty Limited and dated 30 July 2013
EA (MOD 1)	Environmental Assessment titled <i>Karuah East Quarry Section 75W Application (MOD 1) Minor Increase to Approved Disturbance Area</i> prepared by ADW Johnson Pty Limited and dated 18 January 2018; including the response to submissions prepared by ADW Johnson Pty Limited and dated 9 March 2018
EA (MOD 2)	Environmental Assessment titled <i>Karuah East Quarry Section 75W Application (MOD 2) Minor Increase to Approved Disturbance Area</i> prepared by ADW Johnson Pty Limited and dated 30 August 2018, including the response to submissions prepared by ADW Johnson Pty Limited and dated 25 October 2018
EPA	NSW Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPL	Environment Protection Licence under the <i>POEO Act</i>
Extraction Area	Extraction Area shown in Figure 1 in Appendix 1
Feasible	Feasible relates to engineering considerations and what is practical to build
Incident	The occurrence of a set of circumstances that causes or threatens to cause material harm which may or may not be or cause a non-compliance
Land	As defined in the EP&A Act, except where used in the noise and air quality conditions in schedules 3 and 4 of this approval where it is defined to mean the whole of a lot, or contiguous lots, owned by the same landowner, in a current plan registered at the Land Titles Office at the date of this approval
Material harm	<p>Is harm that:</p> <ul style="list-style-type: none"> involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial; or results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding \$10,000, (such loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment)

	This definition excludes “harm” that is authorised under either this consent or any other statutory approval.
Minister	Minister for Planning, or delegate
Mitigation	Activities associated with reducing the impacts of the project
Modification 1	The modification to the project, as described in EA (MOD 1)
Modification 2	The modification to the project, as described in EA (MOD 2)
Planning Secretary	Planning Secretary under the EP&A Act, or nominee
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
Privately-owned land	Land that is not owned by a public agency or the Proponent (or its subsidiary)
Project	The development as described in the EA
Project layout	The layout of the project as shown in the figures in Appendix 1
Proponent	Karuah East Quarry Pty Limited, or its successors in title, or any other person who seeks to carry out the project
Public infrastructure	Linear and other infrastructure that provides services to the general public, such as roads, railways, water supply, drainage, sewerage, gas supply, electricity, telephone, telecommunications, etc.
Quarrying operations	Includes the removal of overburden and extraction, processing, handling, storage and transportation of quarry products on the site
Quarry products	Extractive material which extracted from and transported from the site
Reasonable	Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements
Rehabilitation	The treatment or management of land disturbed by the project for the purpose of establishing an appropriately revegetated, safe, stable and non-polluting environment
Residence	Existing or approved dwelling at the date of approval of Modification 1
RMS	Roads and Maritime Services
Site	The land listed under “Land” in schedule 1
Statement of commitments	The Proponent’s commitments in Appendix 6
Waste	Has the same meaning as the definition of the term in the Dictionary to the POEO Act

SCHEDULE 2 ADMINISTRATIVE CONDITIONS

OBLIGATION TO MINIMISE HARM TO THE ENVIRONMENT

1. In addition to meeting the specific performance criteria established under this approval, the Proponent **must** implement all reasonable and feasible measures to prevent and/or minimise any material harm to the environment that may result from the construction, operation, or rehabilitation of the project.

TERMS OF APPROVAL

2. The Proponent **must** carry out the project generally in accordance with the:
 - (a) EA;
 - (b) statement of commitments;
 - (c) EA (MOD 1); **and**
 - (d) EA (MOD 2).
- 2A The Proponent **must** carry out the project in accordance with the conditions of this approval.
3. The conditions of this approval and directions of the **Planning** Secretary prevail to the extent of any inconsistency, ambiguity or conflict between them and a document referenced in condition 2 of this Schedule. If there is any inconsistency between the above documents, the most recent document shall prevail to the extent of the inconsistency.

*Note: For the purposes of this condition, there will be an inconsistency between documents if it is not possible to comply with both documents, or in the case of a condition of approval or direction of the **Planning** Secretary, and a document, if it is not possible to comply with both the condition or direction, and the document.*

4. Consistent with the requirements of this approval, the **Planning** Secretary may make written directions to the Proponent in relation to:
 - (a) the content of any strategy, study, system, plan, program, review, audit, notification, report or correspondence submitted under or otherwise made in relation to this approval, including those that are required to be, and have been, approved by the **Planning** Secretary; and
 - (b) the implementation of any actions or measures contained in any such document referred to in (a) above.

LIMITS ON APPROVAL

Quarrying Operations

5. The Proponent may carry out quarrying operations on the site until 31 December 2034.

*Note: Under this approval, the Proponent is required to rehabilitate the site and carry out additional undertakings to the satisfaction of the **Planning** Secretary. Consequently, this approval will continue to apply in all other respects other than the right to conduct quarrying operations until the rehabilitation of the site and those undertakings have been carried out to a satisfactory standard.*

Production Limit

6. The Proponent **must** not extract, process and transport more than 1.5 million tonnes of quarry products from the site in any calendar year.

Hours of Operation

7. The Proponent **must** comply with the operating hours in Table 1.

Table 1: Operating hours

Activity	Operating Hours
Quarrying Operations	7.00 am to 6.00 pm, Monday to Friday; and 7.00 am to 1.00 pm, Saturdays. No quarrying operations on Sundays or Public Holidays.
Construction activities	7.00 am to 6.00 pm, Monday to Friday; and 8.00 am to 1.00 pm, Saturdays, unless noise from these activities does not exceed 35dB(A) $L_{Aeq}(15\text{ min})$ at any privately-owned residence.
Maintenance activities	24 hours a day, 7 days per week, providing maintenance activities are inaudible at any privately-owned residence

Note: This condition does not apply in the event of a direction from police or other relevant authority for safety or emergency reasons regarding works which may need to be undertaken to avoid loss of life, property loss and/or to prevent environmental harm.

STRUCTURAL ADEQUACY

8. The Proponent **must** ensure that any new buildings and structures, and any alterations, or additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the BCA.

Notes:

- Under Part 6 of the EP&A Act, the Proponent is required to obtain construction and occupation certificates for proposed building works.
- Part 8 of the EP&A Regulation sets out the requirements for the certification of the project.

DEMOLITION

9. The Proponent **must** ensure that all demolition work on site is carried out in accordance with AS 2601-2001: *The Demolition of Structures*, or its latest version.

PROTECTION OF PUBLIC INFRASTRUCTURE

10. The Proponent **must**:
- repair, or pay the full costs associated with repairing, any public infrastructure that is damaged by the project; and
 - relocate, or pay the full costs associated with relocating, any public infrastructure that needs to be relocated as a result of the project.

DEVELOPER CONTRIBUTIONS

11. The Proponent **must** pay Council, in accordance with Council's *Great Lakes Wide Development Contributions Plan (November 2007) – Amended*:
- a one-off Headquarters Building contribution of \$1.00 per \$1,000.00 of capital value of the project; and
 - annual road maintenance contributions of \$.037 per tonne per km, for every tonne of quarry products transported from the site on local roads in accordance with Council's *Great Lakes Wide Development Contributions Plan (November 2007) – Amended*. Each payment must be:
 - paid to Council at the end of each calendar year;
 - based on weighbridge records of the quantity of quarry products transported from the site; and
 - increased annually over the life of the project in accordance with the CPI.

*Note: If the parties are not able to agree on any aspect of the road maintenance contributions, either party may refer the matter to the **Planning** Secretary for resolution.*

OPERATION OF PLANT AND EQUIPMENT

12. The Proponent **must** ensure that all plant and equipment used at the site is:
- (a) maintained in a proper and efficient condition; and
 - (b) operated in a proper and efficient manner.

STAGED SUBMISSION OF ANY STRATEGY, PLAN OR PROGRAM

13. With the approval of the **Planning** Secretary, the Proponent may submit any strategy, plan or program required by this approval on a progressive basis.

Notes:

- *While any strategy, plan or program may be submitted on a progressive basis, the Proponent will need to ensure that the existing operations on site are covered by suitable strategies, plans or programs at all times; and*
- *If the submission of any strategy, plan or program is to be staged, then the relevant strategy, plan or program must clearly describe the specific stage to which the strategy, plan or program applies, the relationship of this stage to any future stages, and the trigger for updating the strategy, plan or program.*

PRODUCTION DATA

14. The Proponent **must**:
- (a) provide annual quarry production data to **DRG** using the standard form for that purpose; and
 - (b) report this data in the Annual Review (see condition 4 of Schedule 5).

COMPLIANCE

15. The Proponent **must** ensure that all employees, contractors and sub-contractors are made aware of, and instructed to comply with, the conditions of this approval relevant to activities they carry out in respect of the development.

APPLICABILITY OF GUIDELINES

16. References in the conditions of this approval to any guideline, protocol, Australian Standard or policy are to such guidelines, protocols, standards or policies in the form they are in as at the date of this approval.

However, consistent with the conditions of this approval and without altering any limits or criteria in this approval, the **Planning** Secretary may, when issuing directions under this approval in respect of ongoing monitoring and management obligations, require compliance with an updated or revised version of such a guideline, protocol, standard or policy, or a replacement of them.

EVIDENCE OF CONSULTATION

17. Where conditions of this approval require consultation with an identified party, the Proponent **must**:
- (a) consult with the relevant party prior to submitting the subject document for approval; and
 - (b) provide details of the consultation undertaken including:
 - (i) the outcome of that consultation, matters resolved and unresolved; and
 - (ii) details of any disagreement remaining between the party consulted and the Proponent and how the Proponent has addressed the matters not resolved.

SCHEDULE 3 ENVIRONMENTAL PERFORMANCE CONDITIONS

IDENTIFICATION OF APPROVED LIMITS OF EXTRACTION

1. The Proponent shall, prior to carrying out quarrying operations on the site:
 - (a) engage a registered surveyor to mark out the boundaries of the approved limits of extraction within the Extraction Area; and
 - (b) submit a survey plan of the extraction boundaries, to the satisfaction of the **Planning** Secretary.
2. The Proponent **must** ensure that the extraction boundaries are clearly marked at all times while quarrying operations are being carried out, in a manner that allows the limits of extraction to be clearly identified.

NOISE

Operational Noise Criteria

3. The Proponent **must** ensure that the operational noise generated by the project does not exceed the criteria in Table 2.

Table 2: Operational noise criteria (dB(A) $L_{Aeq}(15 \text{ min})$)

Location	Criteria (day)
Residence on Lot 11 DP 1024564	43
A	40
B	37
G	38
All other residences	35

Notes:

- Receiver locations are shown in Appendix 2.
- Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy.
- Appendix 4 sets out the meteorological conditions under which these criteria apply, and the requirements for evaluating compliance with these criteria.

However, the noise criteria in Table 2 do not apply if the Proponent has an agreement with the relevant landowner to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of the agreement.

Road Traffic Noise Criteria

4. The Proponent **must** take all reasonable and feasible measures to ensure that the traffic noise generated by the project does not cause additional exceedances of the criteria in Table 3 at any residence on privately-owned land.

Table 3: Road traffic noise criteria (dB(A) $L_{Aeq}(\text{period})$)

Road	Criteria (day)
Pacific Highway	60
Local roads	55

Cumulative Noise Criteria

5. The Proponent **must** implement all reasonable and feasible measures to ensure that the noise generated by the project combined with the noise generated by adjacent quarrying operations does not cause any exceedances of the criteria in Table 4.

Table 4: Cumulative noise criteria (dB(A) $L_{Aeq}(\text{period})$)

Location	Criteria (day)
F	50
G	50
All other privately-owned residences, except the residence on Lot 11	55

Notes:

- Receiver locations are shown in Appendix 2.
- The structure used as a residence on Lot 11 is excluded from Table 4 because the other major contributor to cumulative noise totals is quarrying operations conducted on this Lot, under agreement with the Lot owner.
- Cumulative noise is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy.
- Appendix 4 sets out the meteorological conditions under which these criteria apply, and the requirements for evaluating compliance with these criteria.

Operating Conditions

6. The Proponent **must**:
- implement best management practice, to minimise the construction, operational and traffic noise of the project;
 - minimise the noise impacts of the project during meteorological conditions when the noise limits in this approval do not apply; and
 - regularly assess noise monitoring data and relocate, modify, and/or stop operations on site to ensure compliance with the relevant conditions of this approval;
 - apply and enforce a speed limit of 40 km/hour for all project-related vehicles on site;
 - ensure that project-related trucks slowing to use the intersection of Branch Lane and Andesite Road do not use engine or compression braking systems, to the satisfaction of the **Planning** Secretary.

Noise Management Plan

7. The Proponent **must** prepare a Noise Management Plan for the project to the satisfaction of the **Planning** Secretary. This plan must:
- be prepared by a suitably qualified expert whose appointment has been approved by the **Planning** Secretary;
 - be prepared in consultation with EPA, and submitted to the **Planning** Secretary for approval prior to the commencement of construction activities;
 - describe the measures that would be implemented to ensure compliance with the noise criteria and operating conditions in this approval;
 - describe the proposed noise management system in detail; and
 - include a monitoring program that:
 - uses attended and unattended monitoring to evaluate the compliance of the project against the noise criteria in this approval;
 - evaluates and reports on:
 - the effectiveness of the on-site noise management system; and
 - compliance against the noise operating conditions; and
 - defines what constitutes a noise incident and includes a protocol for identifying and notifying the Department and relevant stakeholders of any noise incidents.

The Proponent **must** implement the plan as approved by the **Planning** Secretary.

BLASTING

Blasting Criteria

8. The Proponent **must** ensure that blasting on the site does not cause exceedances of the criteria in Table 5.

Table 5: Blasting criteria

Location	Airblast overpressure (dB(Lin Peak))	Ground vibration (mm/s)	Allowable exceedance
Any residence on privately-owned land, or any public infrastructure	120	10	0%
	115	5	5% of the total number of blasts over a period of 12 months

However, these criteria do not apply if the Proponent has a written agreement with the relevant landowner or infrastructure provider/owner, and the Proponent has advised the Department in writing of the terms of this agreement.

Blasting Hours

9. The Proponent **must** ensure that blasting on site is only carried out during the hours in Table 6.

Table 6: Blasting hours

Day	Blasting hours
Monday – Friday	9.00 am to 4.00 pm
Saturdays, Sundays and Public Holidays	No blasting

Blasting Frequency

10. The Proponent **must** not carry out more than 2 blasts a week on the site, unless an additional blast is required following a blast misfire.

Note: A blast may involve a number of explosions within a short period, typically less than two minutes.

Operating Conditions

11. The Proponent **must**:
- implement best blast management practice to:
 - protect the safety of people and livestock in the surrounding area;
 - protect public or private infrastructure/property in the surrounding area from any damage; and
 - minimise the dust and fume emissions of any blast;
 - schedule blasts to avoid the blasting schedule of any nearby quarrying operation;
 - operate a suitable system to enable the public to get up-to-date information on the proposed blasting schedule on the site, and
 - not undertake blasting within 500 metres of:
 - any public road without the approval of the relevant road authority; or
 - any land outside the site not owned by the Proponent, unless:
 - the Proponent has a written agreement with the relevant landowner to allow blasting to be carried out closer to the land, and the Proponent has advised the Department in writing of the terms of this agreement, or
 - the Proponent has:
 - demonstrated to the satisfaction of the **Planning** Secretary that the blasting can be carried out closer to the land without compromising the safety of the people or livestock on the land, or damaging the buildings and/or structures on the land; and

- updated the Blast Management Plan to include the specific measures that would be implemented while blasting is being carried out within 500 metres of the land,
- to the satisfaction of the Planning Secretary.

Blast Management Plan

12. The Proponent **must** prepare a Blast Management Plan for the project to the satisfaction of the Planning Secretary. This plan must:
- be prepared by a suitably qualified expert whose appointment has been approved by the Planning Secretary;
 - be prepared in consultation with Council and EPA, and submitted to the Planning Secretary for approval prior to the commencement of construction activities;
 - describe the measures that would be implemented to ensure:
 - best management practice is being employed; and
 - compliance with the relevant conditions of this approval;
 - include a road closure protocol if blasting occurs within 500 metres of a public road;
 - include a specific blast fume management protocol, to demonstrate how emissions will be minimised including risk management strategies if blast fumes are generated; and
 - include a monitoring program for evaluating the performance of the project including:
 - compliance with the applicable criteria; and
 - minimising fume emissions from the site.

The Proponent must implement the plan as approved by the Planning Secretary.

AIR QUALITY

Air Quality Criteria

13. The Proponent **must** ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the project do not exceed the criteria in Tables 7 to 9 at any residence on privately-owned land.

Table 7: Long-term impact assessment criteria for particulate matter

Pollutant	Averaging period	^d Criterion
Total suspended particulates (TSP)	Annual	^a 90 µg/m ³
Particulate matter < 10 µm (PM ₁₀)	Annual	^a 30 µg/m ³

Table 8: Short-term impact assessment criteria for particulate matter

Pollutant	Averaging period	^d Criterion
Particulate matter < 10 µm (PM ₁₀)	24 hour	^a 50 µg/m ³

Table 9: Long-term Impact Assessment Criteria for Deposited Dust

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
^c Deposited dust	Annual	^b 2 g/m ² /month	^a 4 g/m ² /month

Notes to Tables 7-9:

- ^a Total impact (ie incremental increase in concentrations due to the project plus background concentrations due to all other sources);
- ^b Incremental impact (ie incremental increase in concentrations due to the project on its own);
- ^c Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.

- ^d Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed by the **Planning Secretary** in consultation with EPA.

Greenhouse Gas Emissions

14. The Proponent **must** implement all reasonable and feasible measures to minimise the release of greenhouse gas emissions from the site.

Operating Conditions

15. The Proponent **must**:
 - (a) implement best management practice to minimise dust emissions by the project;
 - (b) regularly assess air quality monitoring data and relocate, modify, and/or stop operations on site as may be required to ensure compliance with the air quality criteria in this approval;
 - (c) minimise the air quality impacts of the project during adverse meteorological conditions and extraordinary events (see note d under Tables 7-9); and
 - (d) minimise surface disturbance of the site, other than as permitted under this approval.

Air Quality Management Plan

16. The Proponent **must** prepare an Air Quality Management Plan for the project to the satisfaction of the **Planning Secretary**. This plan must:
 - (a) be prepared by a suitably qualified expert whose appointment has been approved by the **Planning Secretary**;
 - (b) be prepared in consultation with Council and EPA, and submitted for approval to the **Planning Secretary** prior to the commencement of construction activities;
 - (c) describe the measures that would be implemented to ensure:
 - compliance with the relevant air quality conditions of this approval;
 - best management practice is employed; and
 - the air quality impacts of the project are minimised during adverse meteorological conditions and extraordinary events;
 - (d) describe the proposed air quality management system; and (e) include a monitoring program that:
 - is capable of evaluating the performance of the project;
 - includes a protocol for determining any exceedances of the relevant conditions of approval;
 - effectively supports the air quality management system; and
 - evaluates and reports on the adequacy of the air quality management system.

The Proponent **must** implement the plan as approved by the **Planning Secretary**.

METEOROLOGICAL MONITORING

17. For the life of the project, the Proponent **must** ensure that there is a suitable meteorological station operating in the vicinity of the site that complies with the requirements in the *Approved Methods for Sampling of Air Pollutants in New South Wales* guideline.

SOIL & WATER

Note: The Proponent is required to obtain the necessary water licences for the project under the Water Act 1912 and/or the Water Management Act 2000.

Water Supply

18. The Proponent **must** ensure it has sufficient water during all stages of the project, and if necessary, adjust the scale of quarrying operations on site to match its available supply.

Surface Water Discharges

19. The Proponent **must** comply with the discharge limits in any EPL, or with Section 120 of the POEO Act.

Effluent Management

20. The Proponent **must**:
- (a) not irrigate, discharge or dispose of sewage or bathroom effluent from the site; and
 - (b) operate and maintain a suitable effluent storage facility, to the satisfaction of Council and EPA.

Water Management Plan

21. The Proponent **must** prepare a Water Management Plan for the project to the satisfaction of the **Planning** Secretary. This plan must:
- (a) be prepared in consultation with the EPA and NOW by suitably qualified and experienced person/s whose appointment has been approved by the **Planning** Secretary;
 - (b) be submitted to the **Planning** Secretary for approval prior to the commencement of construction activities;
 - (c) include:
 - (i) a Site Water Balance that includes details of:
 - sources and security of water supply, including contingency planning;
 - water use on site; and
 - measures that would be implemented to minimise use of clean water and maximise recycling of dirty water on the site;
 - (ii) a Surface Water Management Plan, that includes:
 - baseline data on surface water flows and quality in the watercourses that could be affected by the project;
 - a detailed description of the surface water management system on the site, including the design objectives and performance criteria for the:
 - clean water diversions;
 - erosion and sediment controls;
 - water storages (including Maximum Harvestable Rights requirements); and
 - control of water pollution from areas of the site that have been rehabilitated;
 - surface water impact assessment criteria, to be developed following analysis of baseline data, including trigger levels for investigating any potentially adverse surface water quality impacts;
 - a program to monitor:
 - any surface water discharges;
 - the effectiveness of the water management system;
 - surface water flows and quality in local watercourses; and
 - ecosystem health of local watercourses; and
 - an assessment of appropriate options to improve storage and retention times in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom);
 - (iii) a Groundwater Monitoring Program that includes:
 - baseline data of groundwater levels surrounding the site;
 - groundwater impact assessment criteria, to be developed following analysis of baseline data, including trigger levels for investigating any potentially adverse groundwater impacts; and
 - a program to monitor and/or validate the impacts of the project on groundwater resources; and
 - (iv) a Surface and Ground Water Response Plan that describes the measures and/or procedures that would be implemented to:
 - respond to any exceedances of the surface water impact assessment criteria and groundwater impact assessment criteria; and
 - mitigate and/or offset any adverse impacts on surface water and groundwater resources located within and adjacent to the site.

The Proponent **must** implement the plan as approved by the **Planning** Secretary.

TRANSPORT

Roadworks

22. The Proponent **must**, at its own cost, complete the following roadworks shown conceptually in Figure 2 of Appendix 1, prior to transporting quarry products from the site:
- (a) extending Blue Rock Close, with tar seal and appropriate pavement, road markings and advance warning signage, to the satisfaction of Council and RMS;
 - (b) realigning and upgrading the Blue Rock Close/Andersite Road intersection with appropriate road markings, pavement thickening and advance warning signage, to the satisfaction of Council;
 - (c) upgrading the Branch Lane/Andersite Road intersection with appropriate road markings and advance warning signage, to the satisfaction of Council;
 - (d) constructing the site access road on Lots 12 and 13 DP 1024564 with appropriate pavement and advance warning signage, to the satisfaction of Council; and (e) installing a wheel-wash facility on the site.

Monitoring of Product Transport

23. The Proponent **must**:
- (a) keep accurate records of:
 - the amount of quarry products transported from the site (per calendar month and year); and
 - the number of laden truck movements from the site (per hour, day, week, calendar month and year); and
 - (b) publish these records on its website quarterly.

Parking

24. The Proponent **must** provide sufficient parking on-site for all project-related traffic, in accordance with Council's parking codes, to the satisfaction of the **Planning** Secretary.

Operating Conditions

25. The Proponent **must** ensure that all project-related heavy vehicles:
- (a) enter and exit the site in a forward direction; and
 - (b) exit the site with loads covered.

Transport Management Plan

26. The Proponent **must** prepare a Transport Management Plan for the project to the satisfaction of the **Planning** Secretary. This plan must:
- (a) be prepared by a suitably qualified traffic consultant whose appointment has been approved by the **Planning** Secretary;
 - (b) be prepared in consultation with RMS and Council, and submitted to the **Planning** Secretary for approval prior to the commencement of construction activities;
 - (c) include a Driver Code of Conduct;
 - (d) describe the measures that would be implemented to ensure:
 - compliance with the relevant conditions of this approval;
 - that drivers of project-related heavy vehicles are aware of potential safety issues along the haulage routes; and
 - that drivers of project-related heavy vehicles comply with the Driver Code of Conduct;and
 - (e) include a program to monitor the effectiveness of these measures.

The Proponent must implement the plan as approved by the **Planning Secretary.**

LANDSCAPE

Tetratheca Juncea Translocation

27. The Proponent **must** develop a translocation program for *Tetratheca juncea* to the satisfaction of the **Planning** Secretary. This program must:
- (a) be prepared in consultation with OEH, by a suitably qualified and experienced ecologist whose appointment has been approved by the **Planning** Secretary;
 - (b) be submitted to the **Planning** Secretary for approval prior to the commencement of construction activities that involve clearing of or potential harm to *Tetratheca juncea*;
 - (c) include measures for the translocation of all *Tetratheca juncea* stems in the area of disturbance to nearby areas with similar physical and biological habitat features;
 - (d) include a monitoring program to study the *Tetratheca juncea* stems before and after translocation;
 - (e) include short and long-term goals and performance criteria to measure the effectiveness of the program; and
 - (f) provide for the transfer of information obtained as a result of implementing the program to OEH and the **Department**.

The Proponent must implement the program as approved by the **Planning** Secretary.

Biodiversity Offset Strategy

28. The Proponent **must**, prior to the commencement of vegetation clearing activities, finalise the Biodiversity Offset Strategy, as described in documents listed in condition 2 of Schedule 2, summarised in Table 10 and shown conceptually in Figure 1 of Appendix 4, in consultation with OEH and Council, and to the satisfaction of the **Planning** Secretary.

Table 10: Biodiversity Offset Strategy

Area	Offset Type	Minimum Size (ha)
Offset Area	Existing vegetation to be managed and enhanced	130.36 ha

Note: The Biodiversity Offset Strategy **must** direct that the land proposed as the Biodiversity Offset **must** be free of any dwelling-houses and associated sheds, bushfire asset protection zones and other related utilities or structures so as to preserve the integrity and function of that offset area. The Biodiversity Offset Strategy **must** also provide details of the revegetation of any parts of the offset area that are cleared of native vegetation or are in an otherwise substantially modified state, other than required management trails and boundary fencing buffer distances.

The Proponent must implement the strategy as approved by the **Planning** Secretary.

Long Term Security of Offsets

29. The Proponent **must**, within 12 months of the finalisation of the Biodiversity Offset Strategy, make suitable arrangements to provide appropriate long-term security for the offset area, in consultation with OEH and Council, and to the satisfaction of the **Planning** Secretary.

Note: In order of preference, mechanisms to provide appropriate long-term security to the land within the Biodiversity Offset Strategy include transfer to the National Park Estate, Biobanking Agreement, Voluntary Conservation Agreement, or restrictive covenant on land titles.

Rehabilitation Objectives

30. The Proponent **must** rehabilitate the site to the satisfaction of the **Planning** Secretary. This rehabilitation must:
- (a) be generally consistent with the rehabilitation strategy as described in the EA and shown conceptually in Figure 1 in Appendix 5; and
 - (b) comply with the objectives in Table 11.

Table 11: Rehabilitation Objectives

Feature	Objective
Site (as a whole)	Safe, stable & non-polluting.
Surface Infrastructure	To be decommissioned and removed, unless the Planning Secretary agrees otherwise.
Quarry Wall Benches	Landscaped and revegetated utilising native tree and understorey species, ensuring that the tree canopy is restored and integrated with the surrounding tree canopy.
Quarry Pit Floor	Landscaped and revegetated with wetland vegetation.
Other land affected by the project	Restore ecosystem function, including maintaining or establishing self-sustaining eco-systems comprised of: <ul style="list-style-type: none"> • native endemic species; and • a landform consistent with the surrounding environment.
Community	Ensure public safety. Minimise the adverse socio-economic effects associated with quarry closure.

Progressive Rehabilitation

31. The Proponent **must**:
- rehabilitate the site progressively, that is, as soon as reasonably practicable following disturbance;
 - take all reasonable and feasible measures to minimise the total area of the site exposed at any time; and
 - implement interim rehabilitation strategies where areas prone to dust generation cannot yet be permanently rehabilitated.

Landscape and Rehabilitation Management Plan

32. **Within 6 months of the date of approval of Modification 1, the** Proponent **must** prepare a Landscape and Rehabilitation Management Plan for the project to the satisfaction of the **Planning** Secretary. This Plan would relate to the area of the quarry and all perimeter lands. This plan must:
- be prepared by a suitably qualified expert whose appointment has been approved by the **Planning** Secretary;
 - be prepared in consultation with OEH and Council, and submitted to the **Planning** Secretary for approval prior to the commencement of construction activities;
 - describe how the implementation of the Tetratheca juncea Translocation Program would be integrated with the overall rehabilitation of the site;
 - describe the short, medium and long-term measures that would be implemented to:
 - manage remnant vegetation and habitat on the site; and
 - ensure compliance with the rehabilitation objectives and progressive rehabilitation obligations of this approval.
 - include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, including triggers for any remedial action;
 - include a detailed description of the measures that would be implemented over the next 3 years (to be updated for each 3 year period following initial preparation of the plan), including the procedures to be implemented for:
 - ensuring compliance with the rehabilitation objectives and progressive rehabilitation obligations of this approval;
 - enhancing the quality of remnant vegetation and fauna habitat;
 - restoring native endemic vegetation and fauna habitat within the rehabilitation area, including details of the target revegetation communities of the rehabilitated landform;
 - coordinating the relocation of native fauna to protected habitats associated with pre-clearing fauna surveys;
 - maximising the salvage of environmental resources within the approved disturbance area - including tree hollows, vegetative and soil resources - for beneficial reuse in the enhancement of the rehabilitation area;
 - collecting and propagating seed;

- ensuring minimal environmental consequences for threatened species, populations and habitats;
 - minimising the impacts on native fauna on site, including the details and implementation of appropriate pre-clearance surveys;
 - minimising the impacts on fauna movement between undisturbed areas of the site and nearby vegetation (including potential fauna crossings);
 - controlling weeds and feral pests;
 - controlling erosion;
 - controlling access and providing for management trails; and
 - bushfire management and implementation of ecologically appropriate bushfire intervals.
- g. include a program to monitor the effectiveness of these measures, and progress against the performance and completion criteria;
- h. identify the potential risks to successful implementation of the *Tetratheca juncea* Translocation Program and rehabilitation of the site, and include a description of the contingency measures that would be implemented to mitigate these risks;
- i. include details as to how the rehabilitated land would be permanently conserved and managed as part of the broader Biodiversity Offset Area approved in these conditions;
- j. include details of who would be responsible for monitoring, reviewing, and implementing the plan; and
- k. include details as to the timing of actions set-out in the plan

The Proponent must implement the plan as approved by the Planning Secretary.

Biodiversity Offset Area Management Plan

33. The Proponent must prepare a Biodiversity Offset Area Management Plan for the project to the satisfaction of the Planning Secretary. This Plan would relate to the area of the Biodiversity Offset Area required in these Conditions. This plan must:
- a. be prepared by a suitably qualified expert whose appointment has been approved by the Planning Secretary;
 - b. be prepared in consultation with OEH and Council, and submitted to the Planning Secretary within 12-months of the approval of the Biodiversity Offset Strategy required in these conditions;
 - c. describe how the implementation of the *Tetratheca juncea* Translocation Program would be integrated with the Biodiversity Offset Area management;
 - d. describe the short, medium and long-term measures that would be implemented to manage remnant vegetation and habitat on the Biodiversity Offset Area;
 - e. include detailed performance and completion criteria for evaluating the performance of the conservation, restoration and management of the Biodiversity Offset Area, including triggers for any remedial action;
 - f. providing for the transfer of environmental resources from the approved disturbance area - including tree hollows, vegetative and soil resources - for beneficial reuse in the enhancement of the Biodiversity Offset Area;
 - g. providing for the incorporation of the final rehabilitated landform into the Biodiversity Offset Area and its management;
 - h. include a detailed description of the measures that would be implemented over the next 3 years (to be updated for each 3 year period following initial preparation of the plan), including the procedures to be implemented for:
 - enhancing the quality of remnant vegetation and fauna habitat;
 - restoring native endemic vegetation and fauna habitat within the parts of the Biodiversity Offset Area that are cleared or modified, including details of the target revegetation communities of the restored landform;
 - coordinating the relocation of native fauna to protected habitats associated with pre-clearing fauna surveys;
 - collecting and propagating seed;
 - maximising the protection and restoration of threatened species, populations and habitats in the Biodiversity Offset Area;
 - maximising fauna movement between the Biodiversity Offset Area and adjacent habitats;

- controlling weeds and feral pests;
 - controlling erosion;
 - controlling access and providing for management trails; and
 - bushfire management and implementation of ecologically appropriate bushfire intervals.
- i. include a program to monitor the effectiveness of these measures, and progress against the performance and completion criteria;
 - j. identify the potential risks to successful implementation of the Biodiversity Offset program, and include a description of the contingency measures that would be implemented to mitigate these risks;
 - k. include details of who would be responsible for monitoring, reviewing, and implementing the plan;
 - l. include details of the indicative costs of management actions; and
 - m. include details as to the timing of actions set-out in the plan

The Proponent must implement the plan as approved by the Planning Secretary.

Conservation & Rehabilitation Bond

34. The Proponent must lodge a Conservation and Rehabilitation Bond with the Department within 6 months of the approval of the Landscape and Rehabilitation Management Plan, to ensure that the Biodiversity Offset Strategy and the rehabilitation of the site is implemented in accordance with the performance and completion criteria set out in the Landscape and Rehabilitation Management Plan. The sum of the bond must be determined by:
 - (a) calculating the cost of implementing the Biodiversity Offset Strategy over the next 3 years;
 - (b) calculating the cost of rehabilitating disturbed areas of the site, taking into account the likely surface disturbance over the next 3 years of quarrying operations; and
 - (c) employing a suitably qualified quantity surveyor or other expert to verify the calculated costs, to the satisfaction of the Planning Secretary.

Notes:

- If capital and other expenditure required by the Landscape and Rehabilitation Management Plan is largely complete, the Planning Secretary may waive the requirement for the lodgement of a bond in respect of the remaining expenditure.
- If the Biodiversity Offset Strategy and rehabilitation of the site area are completed to the satisfaction of the Planning Secretary, then the Planning Secretary will release the bond. If the Biodiversity Offset Strategy and rehabilitation of the site are not completed to the satisfaction of the Planning Secretary, then the Planning Secretary will call in all or part of the bond, and arrange for the completion of the relevant works.
- The component of the bond relating to the implementation of the Biodiversity Offset Strategy may be waived, if a separate arrangement is entered into between the Proponent and OEH which satisfactorily replaces that component, to the satisfaction of the Planning Secretary.

35. Within 3 months of each Independent Environmental Audit (see condition 9 of schedule 5), the Proponent must review, and if necessary revise, the sum of the Conservation and Rehabilitation Bond to the satisfaction of the Planning Secretary. This review must:
 - (a) consider the performance of the implementation of the Biodiversity Offset Strategy and rehabilitation of the site to date;
 - (b) consider the effects of inflation; and
 - (c) calculate the cost of implementing the Biodiversity Offset Strategy and rehabilitating the disturbed areas of the site (taking into account the likely surface disturbance over the next 3 years of quarrying operations); and

HERITAGE

Heritage Management Plan

36. The Proponent must prepare a Heritage Management Plan for the project to the satisfaction of the Planning Secretary. This plan must:
 - (a) be prepared by a suitably qualified expert whose appointment has been approved by the Planning Secretary;

- (b) be prepared in consultation with the local Aboriginal community and OEH, and submitted to the **Planning** Secretary for approval prior to the commencement of construction activities;
- (c) describe the measures that would be implemented to:
 - monitor initial surface disturbance on site for Aboriginal cultural heritage sites or objects;
 - manage the discovery of Aboriginal cultural heritage sites, objects or human remains on site; and
 - ensure ongoing consultation with Aboriginal stakeholders in the conservation and management of Aboriginal cultural heritage values on site.

The Proponent must implement the plan as approved by the **Planning** Secretary.

VISUAL

37. The Proponent **must**:
- (a) ensure that clearing vegetation from any visually prominent ridgeline is undertaken in a progressive manner, to provide for a maximum of 6 months of future quarrying operations; and
 - (b) mitigate the visual impact of the project through the progressive and early rehabilitation of the upper quarry benches in accordance with the objectives in Table 11, to the satisfaction of the **Planning** Secretary.

Advertising Signage

38. The Proponent **must** not erect or display any advertising structure or sign on the site without the written approval of the **Planning** Secretary.

Note: This condition does not apply to business identification, traffic management, and/or safety or environmental signs.

EMERGENCY AND HAZARDS MANAGEMENT

Dangerous Goods and Hazardous Materials

39. The Proponent **must** ensure that the storage, handling, and transport of dangerous goods and hazardous materials is conducted in accordance with the relevant *Australian Standards*, particularly AS1940 and AS1596, and the *Dangerous Goods Code*.

Safety

40. The Proponent **must** secure the site to ensure public safety at all times, to the satisfaction of the **Planning** Secretary.

Bushfire Management

41. The Proponent **must**:
- (a) ensure that the project is suitably equipped to respond to any fires on site; and
 - (b) assist the Rural Fire Service and emergency services as much as possible if there is a fire in the surrounding area.

WASTE

42. The Proponent **must**:
- (a) minimise the waste generated by the project; and
 - (b) ensure that the waste generated by the project is appropriately stored, handled, and disposed of,
- to the satisfaction of the **Planning** Secretary.

SCHEDULE 4 ADDITIONAL PROCEDURES

NOTIFICATION OF LANDOWNERS

1. As soon as practicable after obtaining monitoring results showing an:
 - (a) exceedance of any relevant criteria in Schedule 3, the Proponent **must** notify affected landowners in writing of the exceedance, and provide regular monitoring results to each affected landowner until the project is again complying with the relevant criteria; and
 - (b) an exceedance of the relevant air quality criteria in Schedule 3, the proponent **must** send a copy of the NSW Health fact sheet entitled “*Mine Dust and You*” (as may be updated from time to time) to the affected landowners and/or existing tenants of the land.

INDEPENDENT REVIEW

2. If an owner of privately-owned land considers the project to be exceeding the relevant criteria in schedule 3, then the landowner may ask the **Planning** Secretary in writing for an independent review of the impacts of the project on its land.

If the **Planning** Secretary is satisfied that an independent review is warranted, then within 2 months of the **Planning** Secretary's decision the Proponent **must**:

- (a) commission a suitably qualified, experienced and independent expert, whose appointment has been approved by the **Planning** Secretary, to:
 - consult with the landowner to determine its concerns;
 - conduct monitoring to determine whether the project is complying with the relevant criteria in Schedule 3; and
 - if the project is not complying with these criteria, then identify the measures that could be implemented to ensure compliance with the relevant criteria; and
 - (b) give the **Planning** Secretary and landowner a copy of the independent review.
3. If the independent review determines that the project is complying with the relevant criteria in Schedule 3, then the Proponent may discontinue the independent review with the approval of the **Planning** Secretary.

If the independent review determines that the project is not complying with the relevant criteria in Schedule 3, then the Proponent **must**:

- (a) implement all reasonable and feasible mitigation measures, in consultation with the landowner and appointed independent expert, and conduct further monitoring until the project complies with the relevant criteria; or
- (b) secure a written agreement with the landowner to allow exceedances of the relevant criteria, to the satisfaction of the **Planning** Secretary.

SCHEDULE 5 ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING

ENVIRONMENTAL MANAGEMENT

Environmental Management Strategy

1. The Proponent **must** prepare an Environmental Management Strategy for the project to the satisfaction of the **Planning** Secretary. This strategy must:
 - (a) be submitted to the **Planning** Secretary for approval prior to the commencement of construction activities;
 - (b) provide the strategic framework for environmental management of the project;
 - (c) identify the statutory approvals that apply to the project;
 - (d) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the project;
 - (e) describe the procedures that would be implemented to:
 - keep the local community and relevant agencies informed about the operation and environmental performance of the project;
 - receive, handle, respond to, and record complaints;
 - resolve any disputes that may arise during the course of the project;
 - respond to any non-compliance; and
 - respond to emergencies; and (f) include:
 - copies of any strategies, plans and programs approved under the conditions of this approval; and
 - a clear plan depicting all the monitoring required to be carried out under the conditions of this approval.

The Proponent must implement the strategy as approved by the **Planning** Secretary.

Adaptive Management

2. The Proponent **must** assess and manage project-related risks to ensure that there are no exceedances of the criteria and/or performance measures in schedule 3. Any exceedance of these criteria and/or performance measures constitutes a breach of this consent and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.

Where any exceedance of these criteria and/or performance measures has occurred, the Proponent **must**, at the earliest opportunity:

- (a) take all reasonable and feasible measures to ensure that the exceedance ceases and does not recur;
- (b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and
- (c) implement remediation measures as directed by the **Planning** Secretary; to the satisfaction of the **Planning** Secretary.

Management Plan Requirements

3. The Proponent **must** ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include:
 - (a) detailed baseline data;
 - (b) a description of:
 - the relevant statutory requirements (including any relevant approval, licence or lease conditions);
 - any relevant limits or performance measures/criteria; and
 - the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;
 - (c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;
 - (d) a program to monitor and report on the:

- impacts and environmental performance of the project; and
- effectiveness of any management measures (see (c) above);
- (e) a contingency plan to manage any unpredicted impacts and their consequences;
- (f) a program to investigate and implement ways to improve the environmental performance of the project over time;
- (g) a protocol for managing and reporting any:
 - incidents;
 - complaints;
 - non-compliances with statutory requirements; and
 - exceedances of the impact assessment criteria and/or performance criteria; and
- (h) a protocol for periodic review of the plan.

*Note: The **Planning** Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.*

Annual Review

4. By the end of March each year, the Proponent **must** review the environmental performance of the project to the satisfaction of the **Planning** Secretary. This review must:
 - (a) describe the development (including rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year;
 include a comprehensive review of the monitoring results and complaints records of the project over the previous calendar year, which includes a comparison of these results against:
 - the relevant statutory requirements, limits or performance measures/criteria;
 - the monitoring results of previous years; and
 - the relevant predictions in the EA;
 - (b) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
 - (c) identify any trends in the monitoring data over the life of the project;
 - (d) identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and
 - (e) describe the measures that would be implemented over the current calendar year to improve the environmental performance of the project.

Revision of Strategies, Plans and Programs

5. Within 3 months of:
 - (a) the submission of an annual review under Condition 4 above;
 - (b) the submission of an incident report under Condition 7 below;
 - (c) the submission of an audit report under Condition 9 below; or
 - (d) any modification to the conditions of this approval, (unless the conditions require otherwise),
 the Proponent **must** review the strategies, plans, and programs required under this approval, to the satisfaction of the **Planning** Secretary. Where this review leads to revisions in any such document, then within 4 weeks of the review the revised document must be submitted for the approval of the **Planning** Secretary.

Note: The purpose of this condition is to ensure that strategies, plans and programs are regularly updated to incorporate any measures recommended to improve environmental performance of the project.

Community Consultative Committee

6. The Proponent **must** establish and operate a Community Consultative Committee (CCC) for the project. The CCC must:
 - (a) be established and operated in general accordance with the *Community Consultative Committees Guidelines for State Significant Projects* (Department of Planning and Environment, 2016); and
 - (b) be established prior to the commencement of construction activities, to the satisfaction of the **Planning** Secretary.

Notes:

- *The CCC is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Proponent complies with this approval.*
- *In accordance with the guideline, the Committee should comprise an independent chair and appropriate representation from the Proponent, Council, recognised environmental groups and the local community.*

REPORTING

Incident Notification

7. The Proponent must immediately notify the Department and any other relevant agencies immediately after it becomes aware of an incident. The notification must be in writing to compliance@planning.nsw.gov.au and identify the Project (including the project application number and name) and set out the location and nature of the incident.

Non-compliance Notification

- 7A. Within seven days of becoming aware of a non-compliance, The Proponent must notify the Department of the non-compliance. The notification must be in writing to compliance@planning.nsw.gov.au and identify the Project (including the project application number and name), set out the condition of this approval that the Project is non-compliant with, the way in which it does not comply and the reasons for the non-compliance (if known) and what actions have been, or will be, undertaken to address the non-compliance.

Note: *A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.*

Regular Reporting

8. The Proponent **must** regularly report on the environmental performance of the project on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this approval.

INDEPENDENT ENVIRONMENTAL AUDIT

9. Within 12 months of the commencement of development on the site, and every 3 years thereafter, unless the **Planning** Secretary directs otherwise, the Proponent **must** commission and pay the full cost of an Independent Environmental Audit of the project. This audit must:
 - (a) be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the **Planning** Secretary;
 - (b) include consultation with the relevant agencies;
 - (c) assess the environmental performance of the project and whether it is complying with the relevant requirements in this approval and any relevant EPL and/or Water Licence (including any assessment, plan or program required under these approvals);
 - (d) review the adequacy of any approved strategy, plan or program required under these approvals; and
 - (e) recommend measures or actions to improve the environmental performance of the project, and/or any assessment, plan or program required under these approvals.

Note: *This audit team must be led by a suitably qualified auditor and include experts in any fields specified by the **Planning** Secretary.*

10. Within three months of commencing an Independent Environmental Audit, or within another timeframe agreed by the Planning Secretary, the Proponent must submit a copy of the audit report to the Planning Secretary, and any other NSW agency that requests it, together with its response to any recommendations contained in the audit report, and a timetable for the implementation of the recommendations. The recommendations must be implemented to the satisfaction of the Planning Secretary.

Note: *The audit team must be led by a suitably qualified auditor and include experts in any fields specified by the Planning Secretary.*

ACCESS TO INFORMATION

11. The Proponent **must**:
- (a) make the following information publicly available on its website:
 - the EA;
 - any statutory approvals for the project;
 - approved strategies, plans and/ programs;
 - a summary of the monitoring results of the project, which have been reported in accordance with the various plans and programs approved under the conditions of this approval;
 - a complaints register, updated quarterly;
 - minutes of CCC meetings;
 - annual reviews;
 - any independent environmental audit, and the Proponent's response to the recommendations in any audit; and
 - any other matter required by the **Planning** Secretary; and
 - (b) **keep this information up-to-date, to the satisfaction of the **Planning** Secretary.**

APPENDIX 1 PROJECT LAYOUT

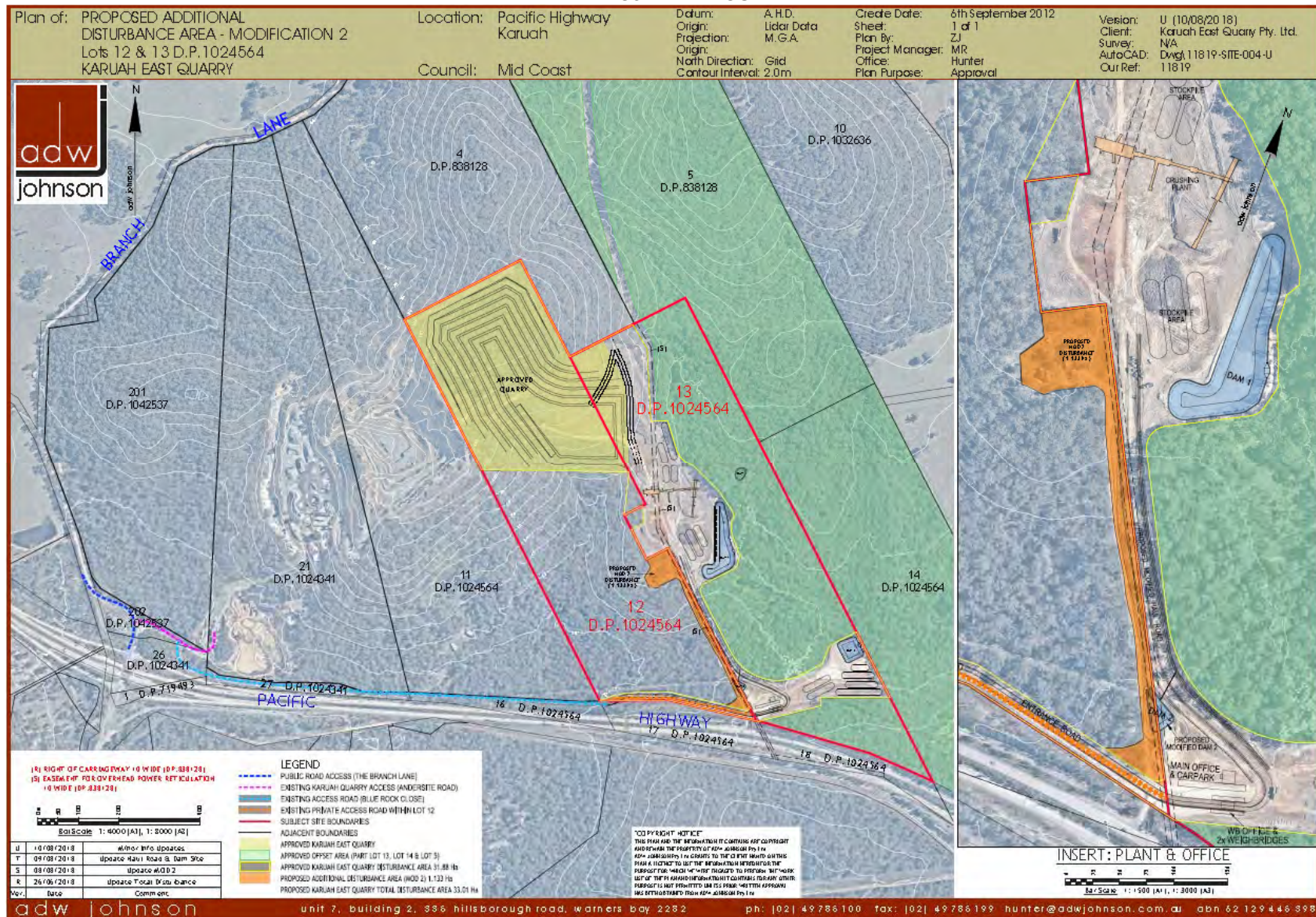


Figure 1: Project Layout

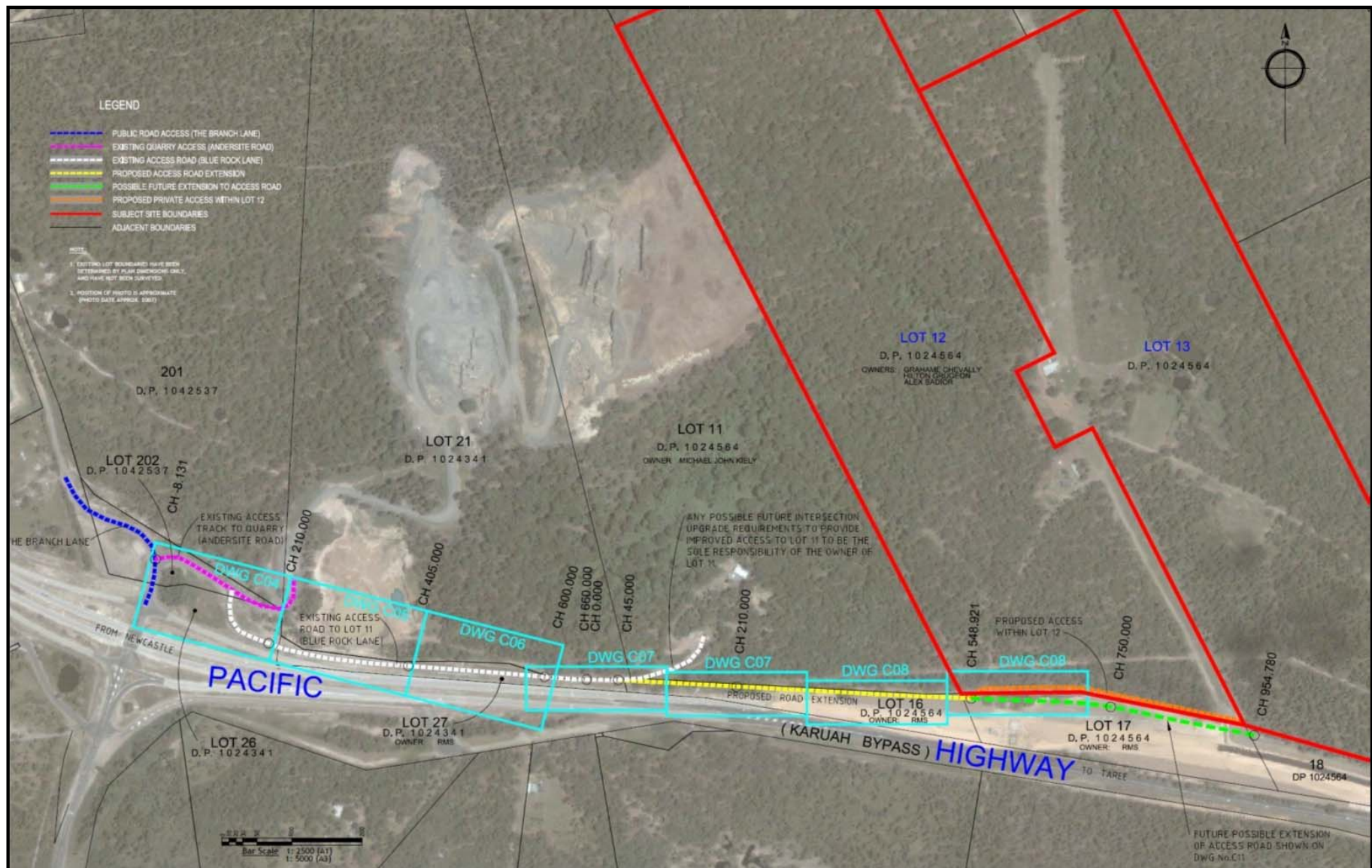


Figure 2: Proposed roadworks

**APPENDIX 2
NOISE RECEIVER LOCATIONS**



Figure 1: Closest residences

APPENDIX 3 NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

1. The noise criteria in Tables 2 and 4 are to apply under all meteorological conditions except the following:
 - (a) during periods of rain or hail; or
 - (b) wind speeds greater than 3 m/s measured at 10 m above ground level.

Determination of Meteorological Conditions

2. Except for wind speed at microphone height, the data to be used for determining meteorological conditions **must** be that recorded by the meteorological station in the vicinity of the site.

Compliance Monitoring

3. Attended monitoring is to be used to evaluate compliance with the relevant conditions of this approval.
4. Unless otherwise agreed with the **Planning** Secretary, this monitoring is to be carried out in accordance with the relevant requirements for reviewing performance set out in the *NSW Industrial Noise Policy* (as amended from time to time), in particular the requirements relating to:
 - (a) monitoring locations for the collection of representative noise data;
 - (b) meteorological conditions during which collection of noise data is not appropriate;
 - (c) equipment used to collect noise data, and conformity with Australian Standards relevant to such equipment; and
 - (d) modifications to noise data collected, including for the exclusion of extraneous noise and/or penalties for modifying factors apart from adjustments for duration.

APPENDIX 4 CONCEPTUAL BIODIVERSITY OFFSET AREA



Figure 1: Conceptual Biodiversity Offset Area

APPENDIX 5 REHABILITATION STRATEGY

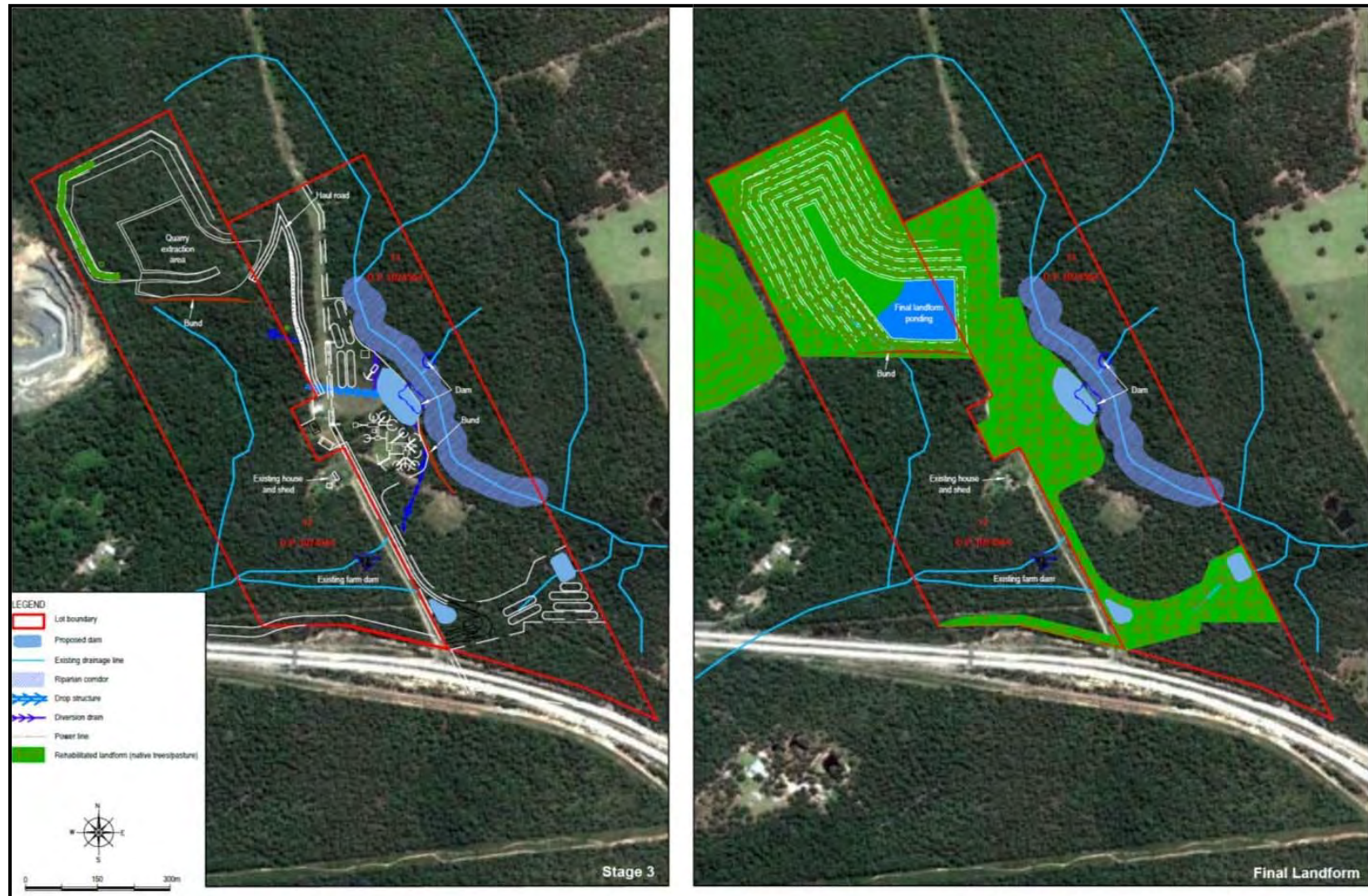


Figure 1: Conceptual Rehabilitated Landform

APPENDIX 6 STATEMENT OF COMMITMENTS

STATEMENT OF COMMITMENTS

The following section outlines the proponent's commitment to implement construction and operational strategies relating to environmental management and mitigation measures. This section details how the proposal and its environmental safeguards will be implemented and managed in an integrated and feasible manner.

1.0 PLANS, DOCUMENTS AND APPROVALS

The proposed development will be completed in accordance with the submitted plans and descriptions of the proposed development provided in the Environmental Assessment Report (31 January 2013) and the Preferred Project Report (30 July 2013).

Any changes to the proposed development will require further approval of the relevant authorities.

The proposed development will be carried out in accordance with all approvals granted by relevant authorities.

2.0 SUMMARY OF MANAGEMENT PLANS

The following management plans will be prepared prior to commencement of construction works:

- Construction Environmental Management Plan (CEMP);
- Environmental Management Plan (EMP). The EMP will ensure that the commitments made in the EA Report and Preferred Project Report and the requirements under subsequent approval and license conditions are fully implemented. The EMP will confirm who is responsible and when the commitments associated with the mitigation and monitoring strategies should be implemented/undertaken;
- Annual Environmental Management Report (AEMR);
- Pre- clearing survey;
- Vegetation Management / Monitoring Plan;
- Conservation Management Plan;
- Soil Management Plan;
- Groundwater Monitoring Plan;
- Surface Water Management Plan (including erosion and sediment control and monitoring);
- Noise Monitoring Plan;
- Blasting Management Plan;
- Air Quality Monitoring Plan;
- Construction Traffic Management Plan;
- Environmental Management Strategy;
- Quarry Closure and Rehabilitation Plan; and
- Waste Management Plan.

3.0 SOIL AND WATER

3.1 Soil Management

Soil Management

The following will be undertaken:

- Topsoil will be stripped in accordance with the recommended stripping depth for each soil type, together with area of land and calculated volume which are provided in the table below;

Table 1 - Recommended Stripping Depths

Soil Type	Project Soil Name	Soil Layer	Recommended Stripping Depth (m)	Area (ha)	Volume (m³)
1	Brown Chromosols	Topsoil	0.30	8.63	25,890
		Subsoil	0.90	8.63	77,670
2	Red Dermosols	Topsoil	0.10	4.55	4,550
		Subsoil	1.10	4.55	50,050
3	Leptic Tenosols	Topsoil	0.0	16.4	0
		Subsoil	0.0	16.4	0
Total Volume					158,160

Total Volume (10% handling loss allowance)	142,344
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- Topsoil disturbance resulting from the excavation of the open cut pit will not be stripped. Areas to be disturbed within the infrastructure boundary will be stripped and stockpiled for re-use in rehabilitation for the area from where it was stripped;
- Only the sandy clay loam topsoil of Soil Type 1 will be used as the final surface topdressing in rehabilitation;
- Rehabilitation involving topsoil respreading will occur on the entire infrastructure area. The open cut footprint will be rehabilitated through direct tree planting and more specific rehabilitation measures; and
- Topsoil will be respread on final landforms at a minimum of 15cm, and an intermediate layer will be established at a minimum of 30cm.

Where topsoil stripping and transportation is required, the following topsoil handling techniques will be implemented to prevent excessive soil deterioration, note this also applies to subsoil stripping:

- Strip material to the depths stated in the table above, subject to further investigation as required;
- Topsoil will be maintained in a slightly moist condition during stripping. Material will not be stripped in either an excessively dry or wet condition;
- Place stripped material directly onto reshaped overburden and spread immediately to avoid the requirement for stockpiling;
- Clay material will be applied first to create an intermediate layer. The loam topsoil will then be spread to overlie this layer;
- The surface of soil stockpiles will be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming;
- Maintain a maximum stockpile height of 3m;
- If long-term stockpiling is planned (i.e. greater than 12 months), stockpiles will be seeded and fertilised as soon as possible; and
- Prior to re-spreading stockpiled topsoil onto reshaped overburden an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and/or "scalping" of weed species prior to topsoil spreading.

An inventory of available soil will be maintained to ensure adequate topsoil materials are available for planned rehabilitation activities.

The respread topsoil surface will be scarified prior to, or during seeding, to reduce run-off and increase infiltration.

3.2 Groundwater Management

- Prior to commencement of works, further investigation of groundwater conditions will be conducted in consultation with the NSW Office of Water;
- Benches and the pit floor will be graded to promote drainage toward the entrance to the pit;
- Minor seepage and ponding water from excessive rainfall will be managed by conventional drainage measures within the quarry such as periodic pumping out to the surrounding drainage controls. Water will be retained on site for quarry operations and for environmental mitigation;
- Only emergency vehicles repairs will be carried out onsite and any major vehicle repairs/maintenance will occur offsite;
- Refuelling will be undertaken in a designated non-permeable (compacted clay or concrete) area;
- Runoff water from the Project site will be collected and monitored for environmental mitigation to prevent chemicals and hydrocarbon pollutants such as petroleum, diesel, and oil seeping into the groundwater system;
- Fuel storage facilities will be installed in accordance with relevant statutory requirements. Handling and storage of fuel and oil within the project site will be in accordance with Australian Standards, AS 1940-2004 (Storage and Handling of Flammable and Combustible Liquids) and NSW Work Cover 2005 Code of Practice for Storage and Handling of Dangerous Goods to reduce the risk of any spills or environmental release. Above ground storage in a bunded facility will be used;
- Material Safety Data Sheets (MSDS) will be kept in the site safety system for all chemicals used on site. The MSDS will contain information on the environmental impacts of the use of certain chemicals and include detail on emergency response, clean up and disposal. Handling and storage of all chemicals within the project site will be in accordance with Dangerous Goods Act 1975 (NSW), and Australian standards, including AS 1940-2004 (Storage and Handling of Flammable and Combustible Liquids); and
- Quarry rehabilitation will use spoil, and clean fill fit for purpose and in accord with relevant statutory requirements.

Contingency, Monitoring and Reporting for Groundwater Management

Contingency Plans

Emergency Response Procedures will be developed and implemented for the proposed Karuah East quarry.

Contingency plans will be developed to address actions that are required where unforeseen events occur. Contingency plans will consider the following:

- Groundwater levels: If groundwater level monitoring indicates abrupt changes, additional investigations will be carried out to implement necessary measures; and

- Groundwater quality: In the event that the groundwater quality monitoring indicates a deteriorating change of groundwater quality in relation to the proposed quarrying operations, the appropriate authority will be contacted to discuss the implementation of necessary measures.

Monitoring Plan

Monitoring of groundwater levels and groundwater quality will be conducted prior to the start of quarry operations. The existing monitoring bores at BH205, BH207, BH208 and BH303 will be used for monitoring groundwater of the quarry area.

New monitoring bores will be installed if any existing monitoring bores are destroyed during the quarry operations, or are subject to general failure. Surface runoff water will also be monitored.

Groundwater Levels

Groundwater levels will be monitored on a quarterly basis to identify any adverse impacts arising from the operation of the quarry in the future, and to identify long-term groundwater level trends.

Groundwater Quality

Groundwater samples will be collected for laboratory analysis on a 6-monthly basis. The groundwater quality results will be laboratory analysed for the parameters below and compared to background water quality results. The groundwater sampling will be carried out by an experienced groundwater professional or environmental scientist in accordance with Australian sampling standards.

The basic analyte and parameter suite applies to all samples. The additional extended analytic suite should apply annually together with the basic suite.

Basic Analytes and Parameters – 6 monthly (every sample):

- pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS); Alkalinity;
- Total nitrogen, total phosphorus;
- Major ions, calcium, magnesium, sodium, potassium, chloride, sulphate, carbonate, bicarbonate;
- Total Petroleum Hydrocarbon (TPH); and
- BTEX (benzene, toluene, ethyl benzene, xylene).

Additional Analysis – 12 monthly (every second sample only):

- Nutrient suite: total nitrogen, nitrate, total Kjeldahl nitrogen, total phosphorus, phosphate;
- Metals (arsenic, cadmium, chromium, copper, lead, zinc, nickel, manganese, mercury, total iron, filterable iron);
- Polycyclic Aromatic Hydrocarbon (PAH); and
- Organophosphorus pesticides, phenoxy acid herbicides.

Reporting

The recording date, time and parameters of monitoring data will be collected and tabulated. All original laboratory reports will be maintained on file. Monitoring records will be kept until the closure stage of the quarry for inspection on request by government agencies.

3.3 Surface Water – Proposed Water Management System

The following surface water management measures will be implemented:

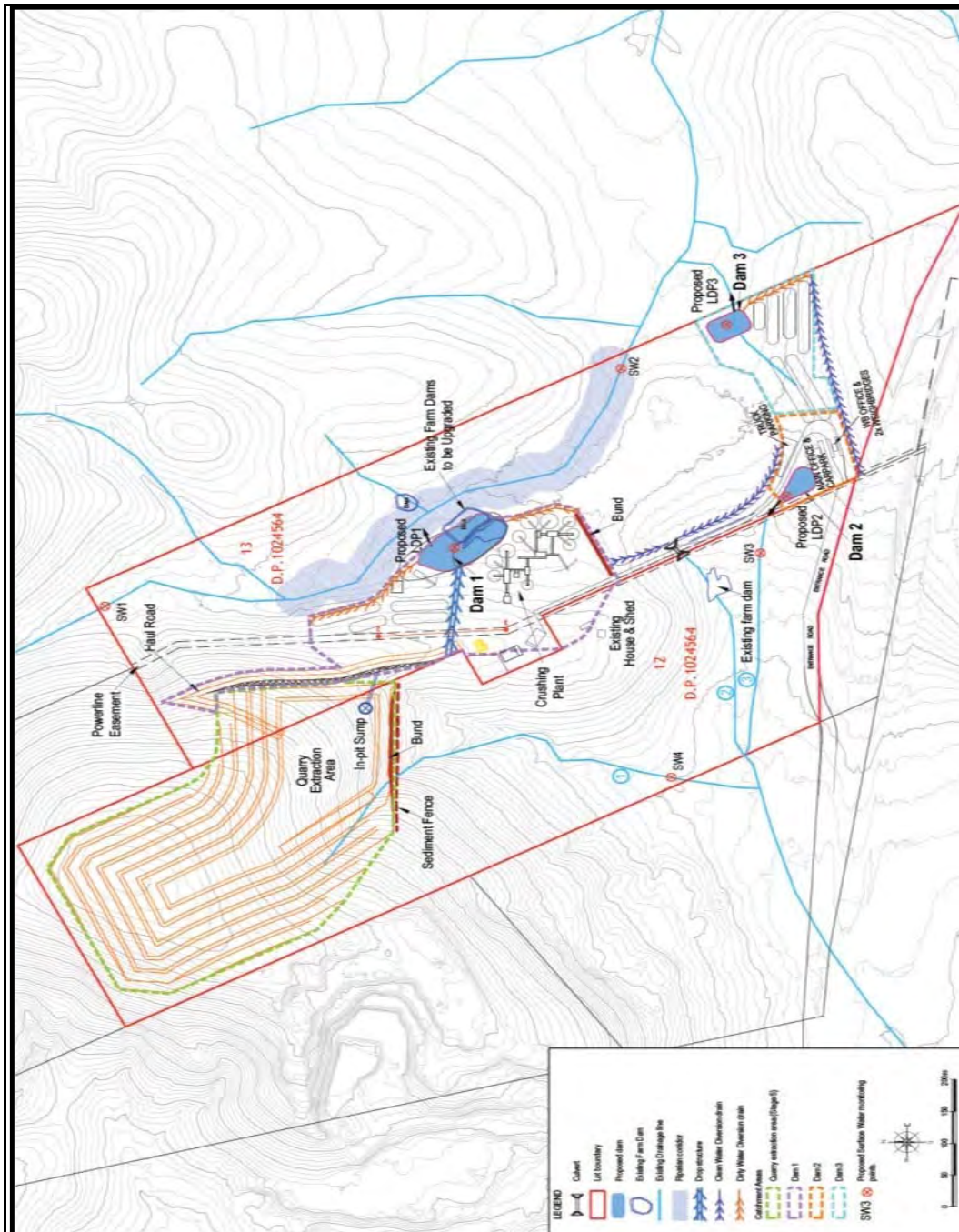


Figure 1: Surface Water Management Plan.

Quarry Extraction Area

- Runoff generated within the active quarry extraction area will be directed into an in-pit sump where it will be contained and pumped out as required so as not to impede quarrying activity;
- A bund and sediment fence will be maintained along the southern boundary of the quarry, to minimise the risk of sediment being washed downstream of the quarry;
- Construction of the quarry floor will be managed in such a way so as to direct all runoff to the in-pit sump. The location of this sump will change as quarrying progresses, however it will generally be located in the south east corner of the quarry;
- Water collected in the in-pit sump will be pumped out as required into a rock lined table drain adjacent to the main haul road. The water will flow down this drain to the main dirty water dam, Dam 1, via a rock lined drop structure; and
- Progressive rehabilitation of all formed surfaces, such as quarry benches and long-term soil stockpiles, will occur wherever possible to reduce the amount of total suspended solids (TSS) in runoff from disturbed areas.

Dam 1 Catchment (crushing plant and product stockpiles)

- An existing farm dam will be upgraded and used as a sediment dam (Dam 1);
- The crushing plant area will be graded such that runoff from this area will flow into Dam 1;
- Water for haul road and some stockpile dust suppression, as well as for the crushing plant will be sourced from Dam 1; and
- A diversion bund will be constructed along the eastern boundary of this catchment area, to direct runoff from the area into Dam 1.

Dam 2 Catchment (product stockpiles and office infrastructure area)

- A second sediment dam, Dam 2, will be constructed adjacent to the main haul road to capture runoff from this area. Water collected in Dam 2 will be re-used for dust suppression on the product stockpiles.

Dam 3 Catchment (product stockpiles)

- A third sediment dam, Dam 3, will be constructed in the north-east corner of the southern stockpile area. Water collected in dam 3 will be re-used for dust suppression on the adjacent product stockpiles.

During Construction

Sediment laden runoff from disturbed areas during construction will be managed by implementing the following erosion and sedimentation control principles:

- Conducting best practice land clearing procedures for all proposed disturbance areas;
- Minimising the disturbance footprint;
- Coordinating construction sequences to minimise exposure of disturbed soils to the elements;
- Separate/diversion of upslope 'clean' water catchment runoff prior to land disturbance;
- Ensuring sediment-laden runoff is treated via designated sediment control devices;
- Appropriate storage of topsoil stockpiles in areas away from roadways and other drainage lines;
- Revegetation of disturbed areas as soon as possible following the completion of construction activities; and
- Implementing an effective maintenance period.

Surface Water Management – Final Landform

- Dams 1, 2 & 3 will remain in place for post-mining landuse. Consultation will be undertaken with relevant government agencies in relation to licensing conditions at that time; and
- If deemed necessary by the relevant government agency, the dams will be removed.

Dam Design

Each dam will be constructed to the following capacity in accordance with 'Blue Book' requirements:

Table 2 – Summary of Proposed Dams

Dam	Sediment Zone (ML)	Settling Zone (ML)	Additional water storage capacity (ML)	Total Capacity (ML)
Dam 1	3.4	5.4	3.6	12.4
Dam 2	0.4	0.9	0	1.3
Dam 3	0.6	1.7	0	2.3

Management and Maintenance of Dams

- In the event that water is required to be discharged offsite, the water will be tested prior to discharge to ensure appropriate discharge criteria are met, such as Total Suspended Solids (TSS) below a concentration of 50mg/L. Where this is not the case, water will be treated, for example through the use of chemical flocculation, to achieve a suitable water quality; and
- An inspection of the sediment dams will be undertaken as part of the routine site environmental inspection program or following significant rainfall. Various information, such as the general condition of the dam, evidence of overflow, condition of downstream catchments, water colour, evidence of eroding surfaces and approximate retained capacity, will be recorded.

Mitigation Measures for Drainage Lines

- A sediment fence will be installed along the downstream side of the entire southern face of the quarry as a sediment control measure to minimise the transport of any sediment into the remaining section of the first order drainage line to the south of the extraction area;

This drainage line will be reinstated as close as possible to its original path following completion of extraction activities at the quarry as part of the final rehabilitation of the site;

- A Site Water Management Plan (SWMP) for Karuah East will be prepared and include details on the drainage line rehabilitation works. Works within the restored drainage lines will be generally undertaken in accordance with Section 5.3.3 of the Blue Book (Volume 1) and the 'Guidelines for Controlled Activities – In-Stream Works' (DWE, 2008) for watercourse rehabilitation and riparian zone rehabilitation. Key design elements of channel establishment works will include:
 - Implement temporary erosion controls to provide for the short-term stabilisation of the channel;
 - Design and construct the stream channel so that it will be stable for the longterm and minimizes the potential for the migration of any erosion upstream or downstream;
 - The drainage line will be re-instated as a compound channel with a main channel conveying the small to medium flows, and a floodplain used to convey the high overbank flows;
 - The main channel forming part of the re-instated central drainage line will be generally trapezoidal in shape with 3:1 (H:V) bank batters;
 - Natural meanders will be used instead of straight lines to reflect natural stream characteristics;
 - Where there are high erosive forces (such as high flow velocity or steep grades) the channel bed will be rock lined where required and constructed in accordance with the 'Blue Book', including the placement of appropriately sized rocks above a filter layer of suitable geotextile; and
 - Soil will be packed in between rocks to allow sedges and grasses to be established within the channel to provide for long-term channel stability.

Following earthworks and channel establishment, a riparian corridor will be established with a minimum width of 10 m, measured horizontally and at right angles to the flow from the top of both banks on the streams. Key design elements of the riparian corridor establishment will include:

- Implement temporary erosion controls to provide for the short-term stabilisation of the riparian corridor;
- Restore a vegetated riparian corridor along the stream channel (10 m from top of bank);
- Establish a diverse range of locally occurring vegetation species;
- Establish a full range of vegetation types, including trees, shrubs and grass covers;
- No exotics species are to be introduced; and
- Maintain the rehabilitated riparian corridor for two years after initial rehabilitation.

Licensed Discharge Point / Licensing Requirements

- A Licensed Discharge Point (LDP) will be installed is required at the outlets of Dam 1, Dam 2 and Dam 3. An application to the NSW OEH for the establishment of the LDP's will be made; and
- The controlled release of water will preferentially be made from Dam 1 and Dam 3. The water management system will be set up to allow for water to be pumped from Dam 2 to Dam 1 as required for release.

Site Water Balance

- The proposed dams will be built to at least the specified sizes (Table 2 above), and made larger where practical in consultation with NOW;
- That controlled discharge of treated (e.g. flocculated) water be undertaken when total site storage levels are above 4.3ML, which would provide the capacity to contain more rainfall events and reduce wet weather discharges (this assumes the dams are built to the capacities presented in Table 2 above); and
- All water usage will be monitored across the site to enable an update of the water balance using actual metered water usage data after 12 months of operation.

Site Water Management Plan

A Site Water Management Plan (SWMP) will be prepared following project approval in accordance with regulatory requirements and conditions of consent. The SWMP will be developed in accordance with the *Blue Book* (Volume 1 and Volume 2E).

The SWMP will incorporate the following:

- On-site soil and water management principles and objectives, including the following:
 - o Containment of dirty water runoff from the active quarry area by directing this water into in-pit sumps;
 - o Directing sediment-laden runoff from disturbance areas and rehabilitated areas into designated sediment control dams;
 - o Installing temporary erosion and sediment control devices as required (i.e. sediment fences sand bag weirs) to minimise the discharge of sediment laden water from newly disturbed areas;

- Diverting clean water runoff unaffected by the operations away from disturbed areas and offsite, where possible;
- Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments; and
- Implementing an effective revegetation and maintenance program for the site.
- Identification of sources of sedimentation and erosion.
- Soil Best Management Practices (BMPs) to be implemented on-site, including:
 - quarry planning considerations (such as minimising disturbance); o topsoil/subsoil handling and stockpiling procedures; and o topsoil/subsoil respreading procedures.
- Water BMPs to be implemented on-site, including; o clean water diversions;
 - dirty water capture and treatment;
 - additional sediment protection measures to be employed during the life of the Project; and o maintenance of sediment control structures.
- Drainage line rehabilitation.
- Water monitoring procedures.
- Documentation and reporting procedures.

Surface Water Monitoring Program

A Surface Water Monitoring Program will be implemented to monitor both the surface water quality upstream and downstream of the site, and the effectiveness of the Site Water Management Plan, including:

- The results of Surface water monitoring undertaken during quarrying operations at Karuah East will be compared against the baseline data collected as part of the Surface Water Assessment;
- A baseline ecological health condition assessment of Yalimbah Creek will be undertaken prior to commencement of operations, and monitoring of Yalimbah Creek will continue as part of the annual ecological monitoring of offset areas;
- The following parameters (see Table 3 below) will be measured at each monitoring location via collection of a grab sample. The recorded values for the parameters measured will be assessed as a minimum against baseline water quality results as well as the ANZECC trigger values presented below, and plotted to identify any trends over time. The OEH will be notified in the event of increasing levels of any parameter; and
- The range of analytes measured will be reviewed following the first 12 months of monitoring and a diagnostic set of analytes adopted for ongoing monitoring.

Table 3 – Surface Water Monitoring Parameters

Parameter	Unit	ANZECC Guidelines¹
pH (Field)	--	6.5 – 8.5
Conductivity (Field)	uS/cm	125 – 2200
Conductivity (Lab)	uS/cm	125 – 2200
Total Dissolved Solids	mg/L	-
Parameter	Unit	ANZECC Guidelines¹
Total Phosphorus	mg/L	0.025
Ammonia	mg/L	0.02
Nitrogen (Nitrate)	mg/L	0.350
Total Hardness (as CaCO ₃)	mg/L	--
Oil & Grease	mg/L	--
Arsenic	mg/L	0.024
Cadmium	mg/L	0.0002
Calcium	mg/L	--
Chromium	mg/L	0.001
Copper	mg/L	0.0014
Lead	mg/L	0.0034
Magnesium	mg/L	--
Manganese	mg/L	1.9

Nickel	mg/L	0.011
Potassium	mg/L	--
Sodium	mg/L	--
Vanadium	Mg/L	--
Zinc	mg/L	0.0312

¹ Key default trigger values presented in ANZECC 2000 for slightly disturbed upland rivers in NSW. Heavy metals based on hard water (120-179 mgCaCO₃/L)

Surface water monitoring locations will be as follows:

- Dam 1;
- Dam 2;
- Dam 3;
- SW 1 & SW 2 - Existing second order drainage line (within Lot 13 flowing along the eastern boundary of the Study Area); both upstream and downstream of the quarry;
- SW 3 - Existing drainage line downstream of Dam 2; and
- SW 4 - Existing drainage line downstream of the quarry extraction area.

The table below identifies the monitoring point locations, the type of monitoring point, and the frequency of sampling.

Table 4 - Proposed Surface Water Monitoring Locations

Location	Type of Monitoring Point	Description of Location	Frequency
Dam 1	Water Quality	Proposed dam located in crushing plant area	Monthly, and within 24 hours of any discharge. Also prior to any controlled (i.e. planned) discharge.
Dam 2	Water Quality	Proposed dam located in western section of stockpile area	Monthly, and within 24 hours of any discharge. Also prior to any controlled (i.e. planned) discharge.
Dam 3	Water Quality	Proposed dam located in eastern section of stockpile area	Monthly and within 24 hours of any discharge. Also prior to any controlled (ie. planned) discharge.
SW1	Water Quality	Existing second order drainage line upstream of site	Monthly (if creek flowing)
SW2	Water Quality	Existing second order drainage line downstream of site	Monthly (if creek flowing) and within 24 hours of any discharge.

SW3	Water Quality	Downstream of Dam 2	Monthly (if creek flowing) and within 24 hours of any discharge.
SW4	Water Quality	Downstream of quarry extraction area.	Monthly (if creek flowing).
Water management (erosion and sediment)	Erosion and Sediment Control	All noted erosion and sediment control structures.	Monthly and after significant rainfall events.

Reporting of Monitoring Data

- Karuah East Quarry Pty Ltd will collate surface water analysis data and maintain an up to date record of analysis both in hard copy (laboratory reports) and electronic (results) format. These results will be interpreted as they are received in order to ensure appropriate operational guidance on maintaining water quality within desired parameters;
- The results of water quality analysis will be reported in the Annual Environmental Management Report (AEMR); and
- In the event that an exceedance in surface water quality criteria is identified, the exceedance will need to be reported to the relevant agencies in accordance with the requirements of the EPL.

4. BIODIVERSITY & CONSERVATION OFFSET

4.1 Flora and Fauna

The following will be implemented by the proponent:

Vegetation Clearing Management

Site Survey and Exclusion Fencing

The extraction area/forest interface will be delineated to protect retained bushland areas on Lot 12 and 13. To achieve this, the quarry footprint boundary will be surveyed and pegged by a Registered Surveyor prior to the conduct of clearing operations. Plastic mesh fencing or star pickets and flagging tape will be installed along the extraction boundary for use as exclusion fencing. The fencing will function as a clearly marked 'exclusion' boundary for the machinery operations.

Permanent chain wire metal exclusion fencing will be installed around the entire perimeter of the quarry footprint (except at the designated aerial fauna crossings) prior to the commencement of quarry operations.

Clearing Protocol

The following protocol will be undertaken as part of the clearing activity on the subject site:

- All contractors conducting clearing, earth works or quarrying activities within the subject site will be informed of the restrictions to the clearing of vegetation outside the 'exclusion fencing'. A construction protocol will be prepared requiring all earthworks, machinery and personnel be strictly controlled and be restricted to the extraction footprint. No storage of materials, vehicle parking or other disturbance will be undertaken outside the exclusion fencing. Contractors will be supplied with the construction protocol regarding the clearing restrictions through a work site induction program;
- Trees will be felled away from the refined bushland on the subject site back into the extraction areas; and
- Domestic fauna (ie. dogs) will be prohibited from entering the subject site with Contractors.

Fauna Management

Pre-Clearing Surveys

Where possible, vegetation clearing activity will be timed so as to avoid the following breeding periods for hollow dependant fauna:

- October – February (microbats); and
- June – August (large forest owls and microbats in torpor).

If restricting the clearing to these limited times is not found to be practical, then ecological pre-clearing surveys will be undertaken within two weeks prior to the commencement of the clearing.

If required, components of the pre-clearing surveys will include:

Threatened Fauna Searches

Within one week prior to commencement of vegetation clearing, searches for signs of Threatened species occurring within the quarry footprint will be undertaken. These searches would include but not be limited to;

- Searches for nests of threatened raptors; and
- Searches for whitewash or other signs of roosting or nesting Powerful and Masked Owls.

If a threatened raptor or owl nest site is recorded within the subject site during the surveys, clearing activity will not take place in the vicinity of the nest (within 50 metres) until the nest is vacated by the affected species (including fledglings). Recorded nest sites would be subject to a monitoring program to ensure that no clearing activity is undertaken until the nest sites are vacated.

Small Mammal Trapping

Elliott trapping will be undertaken within one week prior to commencement of vegetation clearing over a 4 night period, targeting the Brush-tailed Phascogale (*Phascogale tapoatafe*) and Squirrel Glider (*Petaurus norfolcensis*). A total of 4 trap lines (equating to 160 arboreal Elliott traps and 400 terrestrial Elliott trap nights) will be established across the subject site (2 lines/stratification unit).

Stag Watching and Anabat Survey

A combined Stag Watching and Anabat survey would be conducted within the subject site over a 4 night period in an attempt to identify potential Microchiropteran bat roost trees. Should further investigations reveal the presence of a maternity colony, no clearing would be undertaken until after the completion of the breeding period (mid October – mid February inclusive).

Reporting

A report detailing the methods and results of the pre-clearing surveys will be prepared and submitted to OEH immediately prior to the commencement of the clearing operations.

Ecological Clearing Supervision

The removal of all identified hollow bearing trees will be undertaken with the presence of a qualified and suitably experienced fauna ecologist.

A tree felling protocol will be developed to minimise harm to hollow obligates during the clearing of trees for the proposal. The tree felling protocol will be developed by a suitably qualified and licenced ecologist with previous experience supervising felling trees. The tree felling protocol will comprise pre-felling identification and mapping of hollow bearing trees, inspections of trees on the day of clearing, procedures for the safe removal of fauna species from trees prior to and post felling, a relocation/release procedure and a methodology for salvaging (and relocating) tree hollows where practicable.

The relevance of the marked hollow bearing trees and requirements for ecological clearing supervision and hollow resource recovery will be communicated to the clearing Contractor as part of a site induction program.

Nest Box Program

One nest box will be installed for each hollow to be lost as a result of the proposal. Softwood pine (plywood) nest boxes will be used and will be specifically designed for Threatened hollow obligates. Nest boxes will have swivel mounts and be fitted with screw lids to prevent damage from brushtail possums.

Nest boxes will be placed in retained habitats in the study area onto host trees that do not already support hollows at a minimum height of 3 metres (aboveground) in an orientation other than west and north-west to minimise exposure to the afternoon sun.

Nest boxes will be erected prior to the commencement of clearing operations and will be subject to 2 yearly maintenance for the life of the quarry.

Feral bees found to colonise the nest boxes will be eradicated by a specialist pest contractor.

Nest box installation will be supervised by a suitably experienced fauna ecologist.

Aerial Fauna Crossings

Two (2) dedicated aerial fauna crossings will be installed.

- The western aerial fauna crossing will to be located at the existing quarry haul road approximately 250 metres north east from the existing quarry site office; and
- The eastern aerial fauna crossing is proposed on Lot 13 along the north-south running access road.

The canopy bridges will comprise rope netting suspended across the entire width of the haul roads connected to two (2) poles placed on opposite side of the roads. The western canopy bridge would be approximately 40-45m in length and 50cm wide whilst the eastern canopy bridge would be approximately 55 metres in length and 50cm in width.

The netting of both canopy bridges would comprise 14mm diameter marine grade 'silver rope' in a flat lattice-work configuration (ie. analogous to a rope ladder laid horizontally).

The height of the poles and canopy crossing above the road surface would be between 6 – 12 metres, depending on the road profile.

Single strands of rope will extend from the timber poles into the canopy of adjacent trees to facilitate access by arboreal mammals.

The final design of the canopy rope bridges would be chosen as part of detailed design following project approval.

A twelve month monitoring program will be undertaken using a motion detecting camera system mounted on each pole at each of the two (2) aerial crossings.

Salvage and Relocation of Terrestrial Habitat Structures

Large fallen logs will be salvaged during the clearing operations and relocated into retained forested habitats on Lots 12 and 13.

Threatened Plant Populations

Salvage and Reintroduction

A salvage program for *Tetratheca juncea* will be implemented. The salvage program will compromise the excavation of clumps (along with rhizomes and surrounding root balls) proposed for removal and their reintroduction into prepared 'beds' within suitable habitats nearby.

Application for a Section 91 licence from OEH for the salvage program will be made and will be subject to a detailed Salvage Plan to be prepared by the Proponent (and endorsed by OEH and Department of Planning) prior to commencement of the works.

Monitoring

Threatened plant sub-populations of *Tetratheca juncea*, *Grevillea parviflora* subsp. *parviflora* and *Asperula asthenes* situated within retained bushland habitats on Lots 12-14 will be monitored annually by a suitably qualified and experienced botanist for the life of the quarry operation.

A Monitoring Plan will be prepared prior to the commencement of clearing activity to detail survey design, data collection and reporting. Adaptive management will be employed for the life of the quarry to respond to population issues that are identified, including weed control.

4.2 Biodiversity Offset Strategy

The proposed offset site is identified as Part Lot 13 DP 1024564, Lot 14 DP 1024546 and Lot 5 DP 838128 (provided that an option to purchase Lot 5 has been secured by the proponent). In the event that Lot 5 DP 838128 is unable to be secured by the proponent, the proponent will purchase an alternate offset site, which, combined with Lots 13 and 14, will provide a total biodiversity offset area of not less than 129.32 ha. The alternate offset site will be required to be agreed to by NSW OEH and be to the satisfaction of the DirectorGeneral.

The following will be undertaken by the proponent in relation to the proposed offset site identified as Part Lot 13 DP 1024564, Lot 14 DP 1024546 and Lot 5 DP 838128:

- Seasonal flora and fauna survey of the offset site will be undertaken in accordance with relevant OEH guidelines. In particular, seasonal survey for *tetratheca juncea* and *grevillea parviflora* ssp *parviflora* will be undertaken and reported to the NSW OEH;
- Prior to establishment of the proposed quarry, the proponent will purchase Lot 5 DP 838128 (provided than an option to purchase has been secured). In the event that Lot 5 DP 838128 is unable to be secured by the proponent, as noted above, the proponent will purchase an alternate offset site (to be agreed to by NSW OEH and be to the satisfaction of the Director-General).
- Upon approval of the project, in consultation with the NSW OEH, the proponent will secure the offset lands via a Conservation Agreement under Part 4, Division 12 of the National Parks and Wildlife Act 1974;
- A Conservation Management Plan will be developed. The plan will:
 - Confirm required on ground works such as weed control, fencing, signage and pest control;

- Confirm the timing / schedule of the abovementioned works; and
- Specify restrictions to the existing two (2) residences of Lot 5 and Lot 14 (if purchase of Lot 5 is secured by the proponent). If an alternate offset site is provided instead of Lot 5 (as noted above) any restrictions on this land will be specified in the Conservation Management Plan.
- Monitoring of the offset land will be undertaken annually. Results of the monitoring will be used to provide input into the priority areas for the following year(s) of ground maintenance works.

5.0 NOISE, BLASTING AND VIBRATION

The following will be undertaken:

- Four (4) metre noise barriers will be included around stockpile and stacker locations to reduce noise emissions from mobile plant items in these areas;
- Noise compliance monitoring will be undertaken in accordance with conditions of consent by a suitably qualified acoustic expert. The monitoring will consider the performance of the quarry in relation to the project specific noise, vibration and blast criteria established in the SLR Noise and Blasting Impact Assessment (dated 2 November 2012);
- The proponent will not fire blasts at the existing quarry and the proposed Karuah East quarry at the same time;
- The proponent will implement a blasting program where nearby receivers are notified in advance of a blast;
- The following control measures for vibration will be undertaken:
 - Reducing the maximum instantaneous charge (MIC) by using delays, reduced hole diameter and/or deck loading;
 - Changing the burden and spacing by altering the drill pattern and/or delay layout or altering the hole inclination;
 - Use the minimum practicable sub drilling which gives satisfactory toe conditions; and - Investigate alternative rock breaking techniques.
- The following control measures for air blasting will be undertaken:
 - Reducing the maximum instantaneous charge (MIC) by using delays, reduced hole diameter and/or deck loading;
 - Ensure stemming depth and type is adequate;
 - Eliminate exposed detonating cord and secondary blasting;
 - Restrict blasting events to favourable weather conditions;
 - Orient quarry faces away from potentially sensitive receivers;
 - Use a hole spacing and burden which will ensure that the explosive force is just sufficient to break the ore to the required size; and
 - The proponent will take particular care where the face is already broken and consider deck loading where appropriate to avoid broken ground or cavities in the face.

6.0 TRANSPORT

Karuah East Quarry Pty Ltd will undertake the following road works as part of the proposed development:

- Upgrade and extend Blue Rock Lane;
- Realign Andesite Drive and Blue Rock Lane intersection; and
- Adjust road marking at Branch Lane and Andesite Road intersection.

The works will be undertaken in accordance with the upgrade plans prepared by GCA numbered C00-C27. Road construction and drainage works will comply with Great Lakes Council and NSW RMS standards.

7.0 AIR QUALITY & GREENHOUSE GAS EMISSION

7.1 Air Quality

The following will be undertaken:

- Air quality monitoring will be undertaken in accordance with conditions of consent by a suitably qualified acoustic expert. The monitoring will consider the performance of the quarry in relation to the criteria outlined in the SLR Air Quality Impact Assessment (dated July 2013); Haul Roads from the site to the Pacific Highway will be sealed;
- Watering of any unsealed roads – Level 1 Watering at 2L/m²/hour;
- The crusher will be enclosed; and
- Stockpiles will be subject to both water spraying and wind breaks will be installed.

7.2 Greenhouse Gas

The following practices will be adopted to assist in the reduction of Greenhouse Gas emissions from operations at the project site:

Relating to diesel / petroleum consumption:

- Emissions from construction / transport vehicles and on site machinery will comply with the relevant Australian Standards;
- All vehicles and machinery will be regularly maintained to ensure proper and efficient working order and therefore minimise emissions;
- Optimum vehicle / equipment tire pressures will be maintained;
- Vehicle idling time will be reduced where possible;
- The finished site topography will ensure that no excessive engine use is required; and
- Optimisation of incline / decline of roads within the construction area on the project site will be considered to reduce transport distances for vehicles entering / exiting the project site.

Relating to electricity consumption:

- Use of efficient construction equipment technology;
- Use of efficient crushing and processing plant technology; and
- Continued monitoring of site electricity usage and review of techniques to reduce usage (if possible).
-

8.0 HERITAGE

The following will be adopted by the proponent.

8.1 Aboriginal Archaeology

- If Aboriginal site/s are identified in the study area during works, then all activity in the area will cease, the area cordoned off and contact made with the Office of Environment and Heritage Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed; and
- In the event that skeletal remains are uncovered, work will cease immediately in the vicinity and the site fenced. The proponent will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, contact will be made with the OEH Enviroline 131 555 and relevant Aboriginal stakeholders in order to determine an action plan for the management of the skeletal remains prior to works re-commencing on site.

8.2 European Heritage

- If, during the course of development works, significant European cultural heritage material is uncovered, work will cease in that area immediately. The OEH will be notified and works only recommenced when an appropriate and approved management strategy has been instigated.

9.0 VISUAL

The following will be undertaken:

- Trees will be planted as soon as practical on the initial benches on the western face of the quarry; and
- The proposed infrastructure area will be painted in an appropriate colour to blend in with the natural surroundings.

10.0 ENVIRONMENTAL MANAGEMENT STRATEGY

The Environmental Management Strategy dated August 2011 developed by GSS Environmental for the Karuah East Quarry will be adopted & implemented in full by Karuah East Pty Ltd.

11.0 QUARRY CLOSURE & REHABILITATION

The Quarry Closure & Rehabilitation Plan dated November 2012 prepared by GSS Environmental for the Karuah East Quarry will be adopted and implemented in full by the proponent for the Karuah East Hard Rock Quarry (**Appendix H** of the EA Report dated 31 January 2013) will be adopted & implemented in full by Karuah East Pty Ltd.

11.1 Rehabilitation Management Plan

Until such time that extraction has ceased, rehabilitation will occur around the perimeter of the pit only along the benches and will not involve the pit floor. As the extraction progresses through the resource, 15m wide benches will be left every 15m of depth to provide a horizontal platform on which native flora species will be established.

The revegetation program will re-establish native tree / shrub / ground cover and will stabilise reshaped and benched areas. Benches will be deep ripped to actively promote infiltration of water which will enhance soil moisture requirements for direct tree seeding and minimise surface runoff to underlying benches and the pit floor dirty water control system.

On completion of quarry operations, the pit floor will be re-shaped and revegetated with wetland plant species to form a free draining wetland environment.

Topsoil Management

Topsoil stripping within the disturbed area will be undertaken when the soil is in a slightly moist condition to reducing damage to soil structure. Stripped material will be placed directly onto the disturbed areas and spread immediately if excavation sequences, equipment scheduling and weather conditions permit.

A maximum stockpile height of 3m will be maintained to preserve viability and reduce soil deterioration.

Stockpiles will be protected with sediment fencing and planted with a sterile cover crop (annual species) to ensure stabilisation. Surface drainage in the vicinity of the stockpiles will be configured so as to direct any runoff around the stockpile.

Where the stockpile is not wholly contained within the “closed loop” water management system, temporary sediment control measures such as sand bags and silt fences will be used to prevent sediment from leaving the disturbed areas.

Topsoil will be re-spread in the reverse sequence to its removal, so that the organic layer, containing any seed or vegetation, is returned to the surface. Topsoil will be spread to a minimum depth of 50mm on 3:1 or steeper slopes and to a minimum depth of 150mm on flatter slopes.

Re-spread topsoil will be levelled to achieve an even surface, avoiding a compacted or an over-smooth finish.

Surface Preparation

Thorough site preparation will be undertaken to ensure rapid establishment and growth of seedlings. All areas proposed for seeding will be deep ripped to an approximate depth of 400 – 500mm.

Where ripping on slopes is required, the ripping will be undertaken around the contour of the land at right angles to water flow.

Direct Seeding

A mixture of native trees and shrubs endemic to the area will be sown onto the majority of the reshaped and benched pit areas following topdressing and site preparation.

The seed will be sourced from reputable seed supply agents. Native seed for revegetation of the quarry will be appropriately pre-treated in order to break dormancy restrictions.

The native tree and shrub seed mix will be sown at a total combined rate of approximately 6.3 kg/ha. Seed will be broadcast evenly onto top-dressed areas. Seeding will be conducted in late spring, summer and early autumn.

Exotic pasture species (warm season perennial, cool season perennial, year long green perennial and annual) will be sown where the risk of erosion is less and on the more protected aspects of landforms.

All legumes will be inoculated and lime pelleted prior to seeding. Oats and/or ryecorn/millet (depending on season) will be utilised as the cover crop species.

Revegetation activities will generally be undertaken in spring and autumn; however opportunistic revegetation will be undertaken if areas become available for sowing in summer or winter. After surface soil amelioration and tillage is completed for any given area, revegetation will commence as soon as practicable. The proposed method of sowing will be via conventional spreading using agricultural broadcasting equipment, or by hand if the terrain is difficult and machinery use is not possible.

Slope stabilising techniques such as hydro seeding and straw mulching will be undertaken on slopes exceeding 180 for enhancement of pasture germination.

Fencing and Weed Control

Fencing (or a similar barrier) will be erected and maintained to exclude and prohibit the movement of persons and vehicles into areas that have been rehabilitated. The fencing will be routinely checked and repaired where necessary. Signs will be placed in prominent locations to indicate areas that are undergoing rehabilitation. Weed control will be undertaken on an “as required” basis should cyclical weed invasion events occur.

Rehabilitation Maintenance

All erosion and sediment control measures will be maintained in a functioning condition until individual areas have been deemed “successfully” rehabilitated. Structural soil conservation works will be inspected after high intensity rainfall so that de-silting and prompt repairs and/or replacement of damaged works can be initiated as required.

Rehabilitation Monitoring

Regular monitoring of the revegetated areas will be undertaken during the initial vegetation establishment period and beyond. The table below presents the monitoring program, including the specific aspects and elements to be monitored and frequencies for those various aspects.

Monitoring will be conducted periodically by independent, suitably qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas. Annual reviews will be conducted of monitoring data to assess trends and monitoring program effectiveness. The outcome of these reviews will be included in each Annual Environmental Management Report (AEMR).

In addition to the rehabilitated areas, at least two reference sites will be monitored to allow a comparison of the development and success of the rehabilitation against a control. Reference sites indicate the condition of surrounding un-disturbed areas.

Table 5 - Proposed Rehabilitation Monitoring Program

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
Ecosystem Establishment		
General Description	<ul style="list-style-type: none"> Describe the vegetation in general terms, e.g. mixed eucalypt woodland with grass understorey and scattered shrubs, dense Acacia scrub, etc. 	12 months after establishment and then every 2 years
2m x 2m quadrants	<ul style="list-style-type: none"> Count the number of plants of all species, excluding grass. Measure live vegetation cover for understorey and grasses (separately) using a line intercept 	12 months after establishment and then every 2 years

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
	method. <input type="checkbox"/> Record details of ground cover (litter, logs, rocks etc).	

20m x 10m plots	<ul style="list-style-type: none"> Count, by species, all trees >1.6m tall. Tag and measure DBH of trees >1.6m tall, to a maximum of 10 for any one species. Record canopy cover over the whole 20m centreline when trees are tall enough. Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack. Where health problems are noted record the percentage of unhealthy trees. Record any new plant species not present in the smaller plots, including any problem and declared noxious weeds. Take five surface soil samples (e.g. at approx. 5m intervals along the centreline) and bulk these for analyses of: PH, EC, chloride and sulfate; exchangeable Ca/Mg/K/Na; cation exchange capacity; particle size analysis and R1 dispersion index; 15 bar and field capacity moisture content; organic carbon; total and nitrate nitrogen; total and extractable phosphorus; Cu, Mn and Zn. 	12 months after establishment and then every 2 years
50m transect	<ul style="list-style-type: none"> Along the 50m erosion monitoring transect, record the location, number and dimension of all gullies >30cm wide and/or 30cm deep. Erosion pins may be established in plots located in newer rehabilitation to record sheet erosion if present. 	12 months after establishment and then every 2 years
Rehabilitation in general	<ul style="list-style-type: none"> When traversing between monitoring plots, note the presence of species of interest not previously recorded (e.g. key functional or structural species, protected species, noxious weeds), as well as obvious problems including any extensive bare areas (e.g. those greater than 0.1ha). Observation such as this can provide useful, broad scale information on rehabilitation success and problems. 	12 months after establishment and then every 2 years

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
Photographic record	<input type="checkbox"/> For each 20m x 10m plot, a photograph should be taken at each end of the plot, along the centreline looking in.	12 months after establishment and then every 2 years

Habitat	<ul style="list-style-type: none"> • General observations relating to the availability and variety of food sources (e.g. flowering/ fruiting trees, presence of invertebrates etc). • Availability and variety of shelter (e.g. depth of leaf litter, presence of logs, hollows etc). • Presence/absence of free water in the rehabilitation areas. 	12 months after establishment and then every 2 years
Fauna	<ul style="list-style-type: none"> • General observations of vertebrate species (including species of conservation significance). • Detailed fauna surveys including presence and approximate abundance and distribution of vertebrate species (focusing on species of conservation significance). 	After rehabilitation is three years old undertake monitoring in every 2 years after establishment in both Autumn and Spring
Weeds and pests	<ul style="list-style-type: none"> • Species identity. • Approximate numbers/level of infestation. • Observation of impact on rehabilitation (if any). 	Quarterly during the first two years and biannually after that. Inspections should be opportunistic after significant rainfall events.
Geotechnical Stability		
	<ul style="list-style-type: none"> • Assessment of the stability of batters and also looking at surface settlements (sink holes). In particular where these features could impact on the performance of any surface water management system. • Surface integrity of landform cover/capping (measurement of extent of integrity failure). • Presence/ absence of landform slumping. 	Annually
Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
Surface and Groundwater		

	<ul style="list-style-type: none"> • Groundwater quality and depth • Efficiency of landform surface water drainage systems (integrity of banks and drains). • Water quality including pH, EC and total suspended solids of water in water storages, and pits, sedimentation dams. 	<p>Quarterly or following rainfall events. Monitoring of receiving waters during a rainfall event which results in runoff.</p>
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11.2 Final Void Management s

Void Water Quality

Water will only be permitted to accumulate in the void if it maintains a quality that does not compromise its intended final use or surrounding groundwater systems. The following aspects will be considered with respect to managing final void water quality:

- Concentration of elements resulting from the quarrying of material;
- Control of surface flow into the void; and ☐ Rainfall and evaporation.

Post closure a water monitoring program will remain in place to monitor any changes to chemistry within the void.

Void Slope Stability

The surrounding final slopes will be left in a condition where the risk of slope failure is minimised. This may require the benches to be battered back from the vertical to enable a stable overall slope angle.

The following will be considered when assessing the geotechnical stability of highwalls:

- Long term final void water levels;
- Height and inclination of slope and number and spacing of intermediate benches;
- Shear strength of the highwall soils and rocks;
- Density and orientation of fractures, faults, bedding planes, and any other discontinuities, and the strength along them; and
- The effects of the external factors, such as surface runoff.

Prior to closure, investigations will be undertaken to confirm the criteria above.

Control of Surface Inflow

Drainage will be directed away from the highwall face through the construction of interceptor channels around the perimeter of the highwall and spoon drains will be utilised on the upslope side of all benches.

The catchment area of the final void will be minimised by the installation of diversion drains.

Safety

The following will be considered at the time of closure to ensure that the void is left in a safe manner.

- All high will to be left geotechnically stable;
- A barrier at a safe distance from the perimeter of the void to prevent human access will be constructed. The highwall areas will be secured by the construction of a trench and a safety berm, as well as a security fence along the entire length of the remaining high wall;
- Suitable signs, clearly stating the risk to public safety and prohibiting public access will be erected at 50m intervals outside the safety fence;
- Surface runoff from land surrounding the void will be diverted from entering the void; and
- Shrub and/or tree planting along the outside edge of the bund wall will be implemented where practicable to lessen the visual impact of the wall, and will be in accordance with the agreed post mining rehabilitation criteria and land use.

Monitoring and Management

After decommissioning works have been undertaken, whether progressive or final, a monitoring program will be designed to demonstrate that the completion criteria have been met and that the site is not resulting in any off-site effects.

Closure Liability

In accordance with the Department of Trade and Investment Regional Infrastructure and Services ESG1 – Rehabilitation Cost Estimate Guidelines, the closure liability for the Karuah East Quarry is **\$468,134**.

12.0 WASTE MANAGEMENT

All waste or recyclable material will be handled as follows:

During Construction

Material Type

Excavation Material & Green Waste - Will be stockpiled on site in accordance with the quarry rehabilitation plan.

Bricks – Any remaining bricks will be removed from the site by a suitably qualified contractor and transported to a local crushing and recycling company.

Concrete - Any remaining concrete will be removed from the site by a suitably qualified contractor and transported to a crushing and recycling company.

Timber – Any excess timber will be removed from the site by a suitably qualified contractor and transported to a landscaping supply company for chipping and composting.

Plasterboard – Any excess plasterboard will be removed from the site by a suitably qualified contractor and taken to landscape supply company.

Metals – Any excess metal will be removed from the site by a suitably qualified contractor and transported to a metal recycling facility.

Other – Any other materials not noted above will be removed from the site by a suitably qualified contractor and transported to an appropriate facility.

During Operation

Quarry Activity

Excavation Material & Green Waste - Will be stockpiled on site in accordance with the quarry rehabilitation plan.

Bricks – Any remaining bricks will be removed from the site by a suitably qualified contractor and transported to a local crushing and recycling company.

Concrete - Any remaining concrete will be removed from the site by a suitably qualified contractor and transported to a crushing and recycling company.

Timber – Any excess timber will be removed from the site by a suitably qualified contractor and transported to a landscaping supply company for chipping and composting.

Metals – Any excess metal will be removed from the site by a suitably qualified contractor and transported to a metal recycling facility.

Other – Any other materials not noted above will be removed from the site by a suitably qualified contractor and transported to an appropriate facility.

General Waste & Recyclables from Staff within the Plant Area

Recyclables

Paper, cardboard, glass, aluminium & plastic

Temporary recycle bins will be provided within staff areas of the plant. Management will ensure that bins are regularly collected and transported to an appropriate recycling facility.

Non Recyclables

Food scraps and other waste

Temporary waste bins will be provided within staff areas of the plant. Management will ensure that bins are regularly collected and transported to an appropriate recycling facility.

Quarry Closure

Waste and recyclable material associated with the quarry closure and decommissioning will be undertaken in accordance with the Quarry Closure and Rehabilitation Plan. This will include:

Site Services

All services including power, water, data and telephone on the site will be isolated, disconnected and terminated to make them safe. All underground services will be made safe and left buried in the ground. Overhead power lines (where they are not used by others) will be removed and the materials (i.e. poles and wire) recovered for potential re-sale or recycling as applicable.

Infrastructure and Buildings

- All sumps will be de-watered and de-silted prior to the commencement of demolition. In addition all items of equipment will be de-oiled, degassed, depressurised and isolated and any hazardous materials (HAZMATs) removed from the site;
- All infrastructure, including the office buildings, workshops, parking areas, crushing plant, wash plant and product storage areas will be demolished and removed from the site. Where possible assets may be reused or sold to other operations. Otherwise they will be removed from the site by a suitably qualified contractor and transported to an appropriate recycling facility;
- The remaining items will be demolished, removed and transported from the site as required. All recoverable scrap steel will be sold and recycled, with the remaining non-recyclable wastes being taken to a licenced landfill. Prior to disposal, all wastes will be assessed and classified in accordance with *Waste Classification Guidelines (DECC, 2008)*; and
- All concrete footings and pads will be broken up to at least 1.5m below the surface. The waste concrete will be crushed to produce an aggregate that can either be used on the site or sold for some other beneficial use.

Roadways, Car Parks and Hardstand

The roadways, car parks, and hardstand areas around the processing and administration areas will be ripped up. All areas will be reshaped, deep ripped, topsoiled and seeded in accordance with the rehabilitation plan.

Fuel Farm and Lubricant Storage Area

Leading up to closure, a preliminary sampling and analysis programme (Phase 1) will be implemented to determine whether a more detailed assessment (Phase 2 – detailed investigation of contamination involving drilling, etc) should be conducted.

13.0 HAZARDOUS MATERIALS / DANGEROUS GOODS

All fuel storage and storage of any required chemicals will be within the specified bunded area of the infrastructure plant. Material Safety Data Sheets will be recorded in the site safety system for all chemicals used on site. This will contain information on the environmental impacts for the use of certain chemicals and include detail on emergency response, clean up and disposal should a highly unlikely event of a spill occur.

14.0 UTILITIES

The proposed development will comply with the requirements of the relevant utility authorities and evidence of the necessary approvals will be provided to the NSW DoPI prior to construction works.

15.0 OUTDOOR LIGHTING

All outdoor lighting associated with the proposed development will be designed to comply with the requirements of AS 4282, Control of Obtrusive Effects of Outdoor Lighting.



Australian Government
Department of the Environment

Approval

Karuah East Quarry, Pacific Highway, 3 km from Karuah, NSW (EPBC 2014/7282)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

Person to whom the approval is granted Karuah East Quarry Pty Ltd

Proponent's ACN 141 505 035

Proposed action To develop a hard rock (andesite) quarry and associated infrastructure in the Lower North Coast, Pacific Highway, 3 km north of Karuah, NSW

Approval decision

Controlling Provision	Decision
Listed threatened species and communities (sections 18 & 18A)	Approved

Conditions of approval

This approval is subject to the conditions specified below.

Expiry date of approval

This approval has effect until 30 March 2045.

Decision-maker

name and position Tim Wyndham
Acting Assistant Secretary
South-Eastern Australia Environment Assessments Branch

signature

Date of decision

20.3.15

Conditions attached to the approval

Proposed project area

1. The person taking the action must not impact on any **Black-eyed Susan** or **Trailing Woodruff** outside the **project area** identified at **Appendix A**.
2. The person taking the action must not impact on any habitat for the **Koala** outside the **project area** identified at **Appendix B**.

Mitigation

3. Prior to the **commencement of construction**, the person taking the action must install fencing around the perimeter of the **project area** and identify signed **no-go areas**. Fencing and **no-go areas** must be maintained for the life of the action.
4. Prior to the **commencement of construction** and for the life of the action, all on-site personnel must be inducted on environmental sensitivities in the area, including the risk of **Koala** vehicle strike. Induction material is to be prepared by a **suitably qualified ecologist**.
5. Should injury to Koalas occur, advice from a **wildlife expert** must be sought and action taken in accordance with that advice. Records of any Koala injury within the **project area** must be documented and maintained.
6. Within 48 hours before the clearing of vegetation, pre-clearance surveys must be undertaken by a **suitably qualified ecologist** to ensure the absence of the **Koala** in the **project area**. If any **Koalas** are found to be present, **salvage and translocation** must be undertaken by a **suitably qualified ecologist**.

Offsets

7. The person taking the action must comply with the offset conditions set out in the **NSW Project Approval**.
8. Prior to the **commencement of construction**, to compensate for the impact to the **Trailing Woodruff** and habitat for the **Koala**, the person taking the action must secure suitable offset sites consistent with the **Karuah East Quarry EPBC Act Assessment Report**. In the case that offsets for the **Trailing Woodruff** or habitat for the **Koala** consistent with those set out in the **Karuah East Quarry EPBC Act Assessment Report** cannot be secured, alternative offset sites must be secured, consistent with the **EPBC Act Offsets Policy**.

9. Prior to the **commencement of construction**, the person taking the action must provide the **Minister** with a Biodiversity Area Offset Management Plan for approval. The Biodiversity Area Offset Management Plan must be consistent with the **NSW Project Approval** and include:
- a) **survey information** identifying the number of **Trailing Woodruff** present across all proposed offset sites; and
 - b) details on the management and monitoring of the **Trailing Woodruff**, and corrective actions and **contingency plans** to be implemented where the re-establishment of the **Trailing Woodruff** fails to meet targets specified in the **Karuah East Quarry EPBC Act Assessment Report**.

The approved Biodiversity Area Offset Management Plan must be implemented.

Administrative

10. Within 30 days after the **commencement of construction**, the person taking the action must advise the **Department** in writing of the actual date of **commencement of construction**.
11. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the management plan, and make it available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the **Department's** website. The results of audits may also be publicised through the general media.
12. Within three months of every 12 month anniversary of the **commencement of construction**, the person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval over the previous 12 months, including implementation of any management plan, as specified in the conditions. Documentary evidence providing proof of the date of publication must be provided to the Department at the same time as the compliance report is published. The compliance reports must remain on the website for 12 months from the date of publishing. Potential or actual contraventions of the conditions of the approval must be reported to the **Department** in writing within 2 business days of the person taking the action becoming aware of the potential or actual contravention. All contraventions must also be included in the compliance reports.
13. Upon the direction of the **Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor must be approved by the **Minister** prior to the commencement of the audit. Audit criteria must be agreed to by the **Minister** and the audit report must address the criteria to the satisfaction of the **Minister**.
14. If the person taking the action wishes to carry out any activity otherwise than in accordance with the management plan as specified in the conditions, the person taking the action must submit to the Department for the **Minister's** written approval a revised version of that management plan. The varied activity shall not commence until the **Minister** has approved the varied management plan in writing. If the **Minister** approves the revised management plan, that management plan must be implemented in place of the management plan originally.

15. If the **Minister** believes that it is necessary or convenient for the better protection of listed threatened species and ecological communities to do so, the **Minister** may request that the person taking the action make specified revisions to the management plan specified in the conditions and submit the revised management plan for the **Minister's** written approval. The person taking the action must comply with any such request. The revised approved management plan must be implemented. Unless the **Minister** has approved the revised management plan then the person taking the action must continue to implement the management plan originally approved, as specified in the conditions.
16. If, at any time after 5 years from the date of this approval, the person taking the action has not **substantially commenced** the action, then the person taking the action must not **substantially commence** the action without the written agreement of the **Minister**.
17. Unless otherwise agreed to in writing by the **Minister**, the person taking the action must publish all management plans referred to in these conditions of approval on their website. Each management plan must be published on the website within 1 month of being approved. The person taking the action must notify the **Department** within 5 business days of publishing the management plan on their website and the management plan must remain on the website for the period this approval has effect.

Definitions:

Black-eyed Susan is the EPBC listed threatened species *Tetratheca juncea*.

Commencement of construction is the date that preparatory works are first undertaken, including but not limited to clearing of vegetation, the erection of any onsite temporary structures and the use of heavy duty equipment for the purpose of breaking the ground for infrastructure or earthworks. This does not include investigative activities such as accessing the site for surveying or planning purposes.

Contingency plans include compensatory measures such as additional direct offsets which would be required to meet the EPBC Act Offsets Policy.

Department means the Australian Government Department administering the *Environment Protection and Biodiversity Conservation Act 1999*.

EPBC Act Offsets Policy means the Australian Government policy document titled: *EPBC Act environmental offsets policy Department of the Environment, 2013 Policy guiding the use of offsets under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

Karuah East Quarry EPBC Act Assessment Report means the report prepared by Eco Logical Australia, October 2014.

Koala is the EPBC listed threatened species *Phascolarctos cinereus*.

Minister means the Australian Government Minister administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the Minister.

No-go areas means areas adjacent to the **project area** containing habitat for EPBC listed threatened species, to be excluded from construction, vehicles, personnel and equipment.

NSW Project Approval means Project Approval number 09_0175, granted under section 75J of the *Environmental Planning and Assessment Act 1979* by the Minister for Planning to Karuah East Quarry Pty Ltd and dated 17 June 2014.

Project area means the Karuah East Hard Rock Quarry identified by the red line at Appendix A and Appendix B.

Salvage and translocation means the relocation of animals or plants from an area adversely affected by development to an area reserved or protected from ongoing impacts.

Substantially commence/d means the installation of any permanent infrastructure associated with the action excluding signage and fences.

Suitably qualified ecologist means an ecologist with relevant tertiary qualifications and at least 2 years of experience in koala surveying and salvage and translocation.

Survey information is data gathered by a **suitably qualified ecologist**.

Trailing Woodruff is the EPBC listed threatened species *Asperula asthenes*.

Wildlife expert means a practicing expert (such as a veterinarian) with qualifications in caring for injured wildlife and access to adequate equipment to provide appropriate care.

Appendix A – locations of the Black-eyed Susan and Trailing Woodruff in the **project area** and surrounding properties.

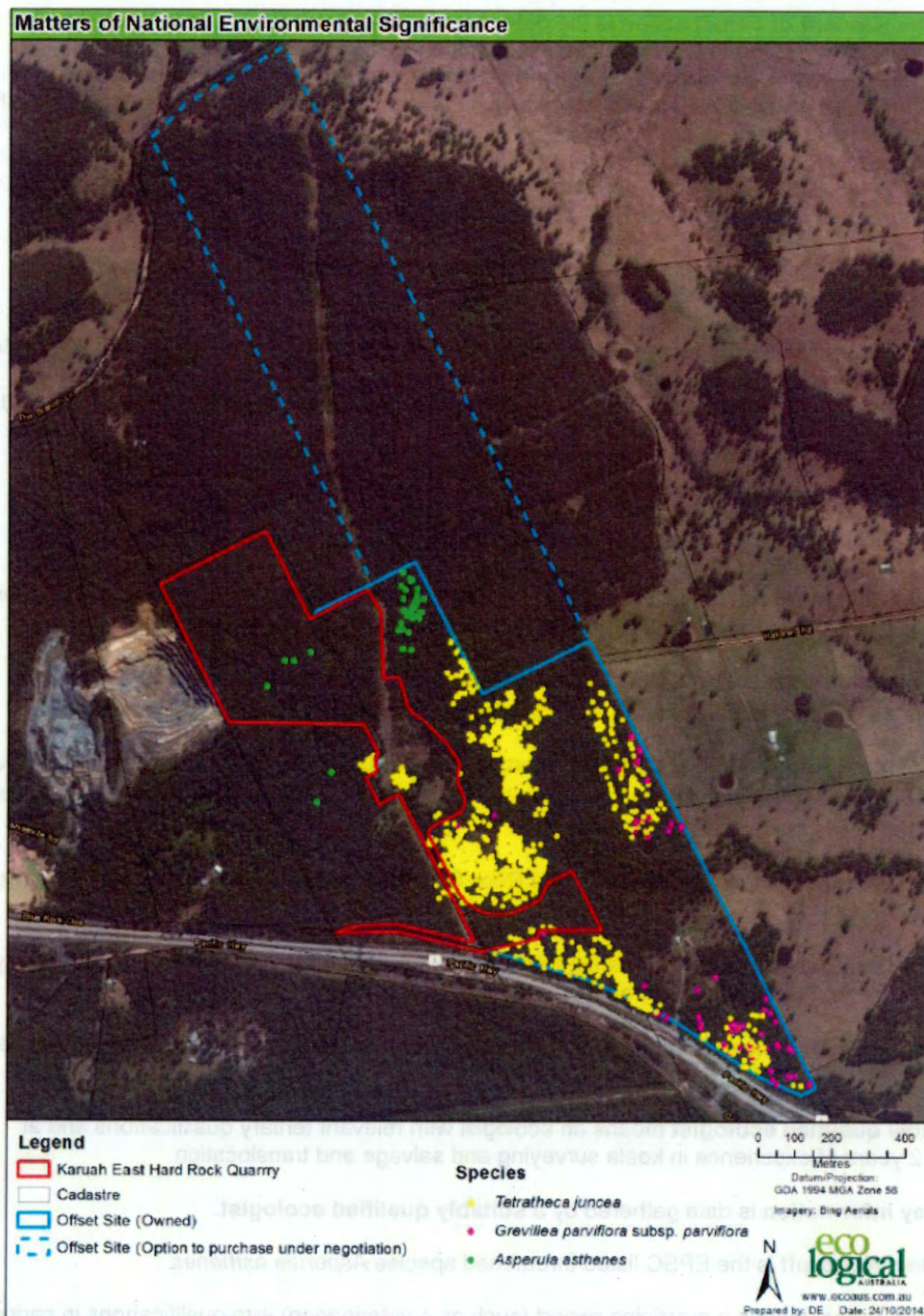


Figure 11 Threatened species recorded within the offset site

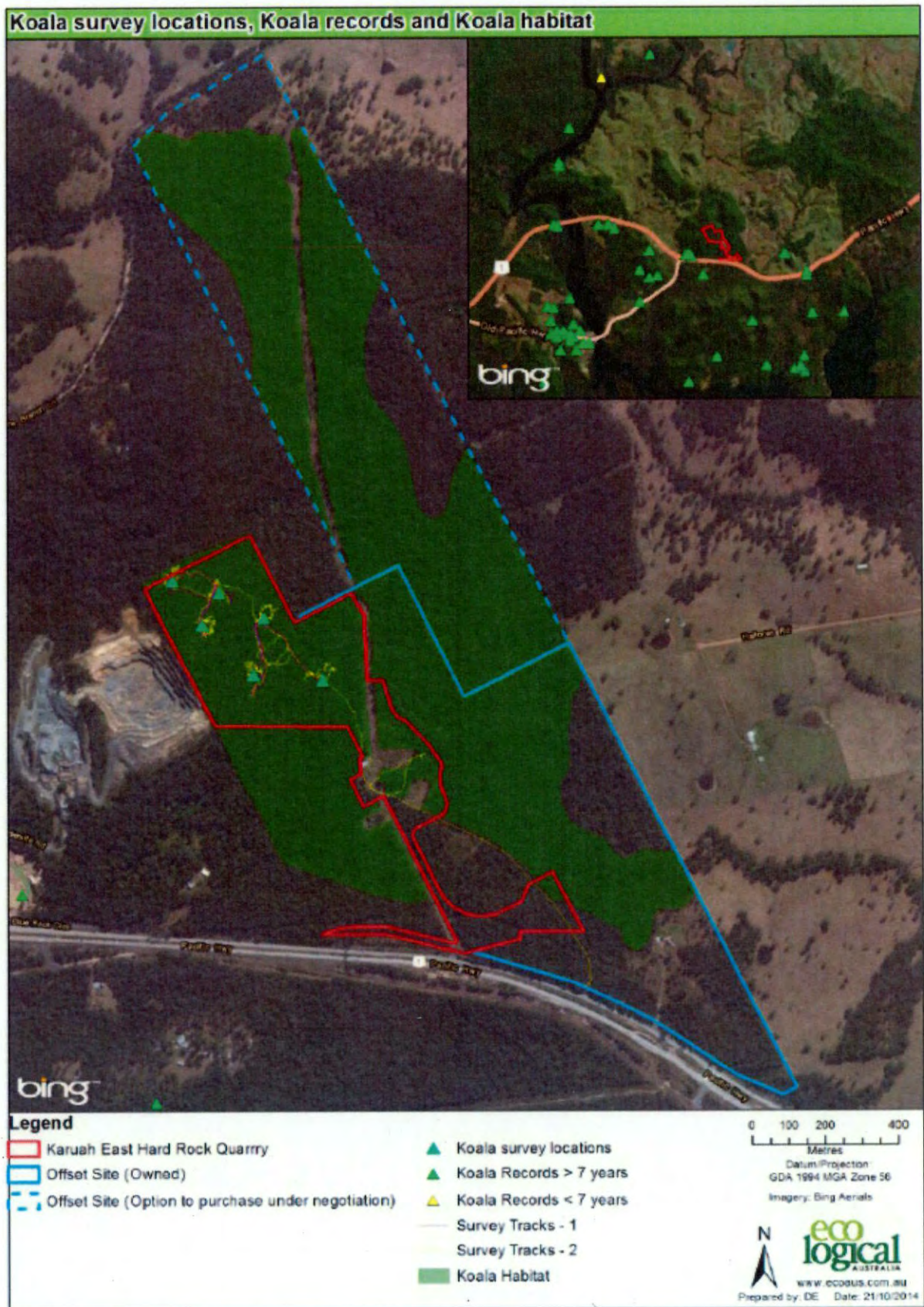


Figure 9 Koala habitat within both the quarry impact area and the adjacent offset areas

APPENDIX 2 – Environment Protection Licence

Environment Protection Licence



Licence - 20611

Licence Details	
Number:	20611
Anniversary Date:	26-August

Licensee
KARUAH EAST QUARRY PTY LIMITED
PO BOX 3284
THORNTON NSW 2322

Premises
KARUAH EAST QUARRY
PACIFIC HIGHWAY
KARUAH NSW 2324

Scheduled Activity
Crushing, grinding or separating
Extractive activities

Fee Based Activity	Scale
Crushing, grinding or separating	> 500000-2000000 T annual processing capacity
Land-based extractive activity	> 500000-2000000 T annual capacity to extract, process or store

Region
North - Hunter
Ground Floor, NSW Govt Offices, 117 Bull Street
NEWCASTLE WEST NSW 2302
Phone: (02) 4908 6800
Fax: (02) 4908 6810
PO Box 488G NEWCASTLE
NSW 2300

Environment Protection Licence

Licence - 20611



INFORMATION ABOUT THIS LICENCE	4
Dictionary	4
Responsibilities of licensee	4
Variation of licence conditions	4
Duration of licence	4
Licence review	4
Fees and annual return to be sent to the EPA	4
Transfer of licence	5
Public register and access to monitoring data	5
1 ADMINISTRATIVE CONDITIONS	6
A1 What the licence authorises and regulates	6
A2 Premises or plant to which this licence applies	6
A3 Information supplied to the EPA	6
2 DISCHARGES TO AIR AND WATER AND APPLICATIONS TO LAND	7
P1 Location of monitoring/discharge points and areas	7
3 LIMIT CONDITIONS	9
L1 Pollution of waters	9
L2 Concentration limits	9
L3 Waste	9
L4 Noise limits	9
L5 Blasting	11
L6 Hours of operation	11
L7 Potentially offensive odour	12
4 OPERATING CONDITIONS	12
O1 Activities must be carried out in a competent manner	12
O2 Maintenance of plant and equipment	12
O3 Dust	12
O4 Emergency response	13
O5 Processes and management	13
O6 Waste management	14
O7 Other operating conditions	14
5 MONITORING AND RECORDING CONDITIONS	14
M1 Monitoring records	14
M2 Requirement to monitor concentration of pollutants discharged	15

Environment Protection Licence



Licence - 20611

M3	Testing methods - concentration limits -----	16
M4	Weather monitoring -----	16
M5	Recording of pollution complaints -----	17
M6	Telephone complaints line -----	17
M7	Blasting -----	18
M8	Noise monitoring -----	18
6	REPORTING CONDITIONS -----	18
R1	Annual return documents -----	18
R2	Notification of environmental harm -----	19
R3	Written report -----	19
R4	Other reporting conditions -----	20
7	GENERAL CONDITIONS -----	21
G1	Copy of licence kept at the premises or plant -----	21
DICTIONARY	-----	22
	General Dictionary -----	22

Environment Protection Licence

Licence - 20611



Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act);
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

Environment Protection Licence



Licence - 20611

The EPA publication “A Guide to Licensing” contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

KARUAH EAST QUARRY PTY LIMITED
PO BOX 3284
THORNTON NSW 2322

subject to the conditions which follow.

Environment Protection Licence



Licence - 20611

1 Administrative Conditions

A1 What the licence authorises and regulates

- A1.1 This licence authorises the carrying out of the scheduled development work listed below at the premises listed in A2:
Works necessary to commence quarry operations (eg stormwater controls, development of roads).
- A1.2 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Crushing, grinding or separating	Crushing, grinding or separating	> 500000 - 2000000 T annual processing capacity
Extractive activities	Land-based extractive activity	> 500000 - 2000000 T annual capacity to extract, process or store

- A1.3 Notwithstanding the condition above, the scale of the land-based extractive activity and / or scale of crushing, grinding and separating authorised under this licence must not exceed 1.5 million tonnes of quarry products per annum, being the amount equivalent to the extraction limit approved by the project approval MP09_0175 granted under the *Environmental Planning and Assessment Act 1979* for the premises specified in A2.

A2 Premises or plant to which this licence applies

- A2.1 The licence applies to the following premises:

Premises Details
KARUAH EAST QUARRY
PACIFIC HIGHWAY
KARUAH
NSW 2324
LOT 26 DP 1024341, LOT 27 DP 1024341, LOT 12 DP 1024564, LOT 13 DP 1024564, LOT 16 DP 1024564, LOT 17 DP 1024564, LOT 202 DP 1042537

A3 Information supplied to the EPA

- A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

Environment Protection Licence

Licence - 20611



In this condition the reference to "the licence application" includes a reference to:

- a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
- b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

- P1.1 The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point.

<i>Air</i>			
EPA identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
4	Air emissions monitoring		Adjacent to Residence C at 5760 Pacific Highway, Karuah, referred to as DDG1 on Figure 2 "Sensitive Receivers & Air Quality Monitoring Locations" in draft Karuah East Quarry Project Air Quality Plan", July 2015. Located within EPA document DOC15/281558.
5	Air emissions monitoring		Adjacent to Residence B at 5770 Pacific Hwy, Karuah, referred to as DDG2 on Figure 2 titled "Sensitive Receivers & Air Quality Monitoring Locations" in draft Karuah East Quarry Project Air Quality Plan", July 2015. Located within EPA document DOC15/281558
6	Air emissions monitoring		Located Lot 24 DP 1024341 Pacific Karuah, referred to as DDG3 on Figure 2 titled "Sensitive Receivers and Air Quality Monitoring Locations" in draft Karuah East Quarry Project Air Quality Plan", July 2015. Located within EPA document DOC15/281558.
7	Air emissions monitoring		Located at 21 Halloran Road, North Arm Cove, referred to as DDG4 on Figure 2 titled "Sensitive Receivers and Air Quality Monitoring Locations" in draft Karuah East Quarry Project Air Quality Plan", July 2015. Located within EPA document DOC15/281558.
8	Air emission monitoring		Located on Lot21 DP1024341 Pacific Hwy, Karuah, referred to as DDG5 on Fig 2 "Karuah East Quarry - Sensitive Receivers & Air Quality Monitoring Locations" attached to licence variation application received 16/12/16. Located within EPA document DOC16/58114

Environment Protection Licence

Licence - 20611



9	Air emission monitoring	Residence B located at Lot 3 DP 785172, Karuah, referred to as "B" HVAS on Fig 2 "Karuah East Quarry - Sensitive Receivers & Air Quality Monitoring Locations" in licence variation application received 16/12/16. Located within EPA document DOC16/581149
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P1.2 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

P1.3 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Discharge to waters	Discharge to waters	The discharge point from Dam 1 as shown on the plan titled "Proposed Surface Water Management Plan - Figure 3", which is filed as part of EPA document DOC15/253402.
2	Discharge to waters	Discharge to waters	The discharge point from Dam 2 as shown on the plan titled "Proposed Surface Water Management Plan - Figure 3", which is filed as part of EPA document DOC15/253402.
3	Discharge to waters	Discharge to waters	The discharge from Dam 3 as shown on the plan titled "Proposed Surface Water Management Plan - Figure 3", which is filed as part of EPA document DOC15/253402.

P1.4 The following points referred to in the table below are identified in this licence for the purposes of weather and/or noise monitoring and/or setting limits for the emission of noise from the premises.

Noise

EPA identification no.	Type of monitoring point	Location description
11	Air blast overpressure & ground vibration peak particle velocity monitoring	Blast Monitor located adjacent to Residence B as identified in 'Figure 1 - Appendix 2 - Noise Receiver Locations' located in EPA document DOC15/253402.

3 Limit Conditions

Environment Protection Licence



Licence - 20611

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Concentration limits

L2.1 For each monitoring/discharge point or utilisation area specified in the table\ below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\.

L2.4 Water and/or Land Concentration Limits

POINT 1,2,3

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	milligrams per litre				5 and/or none visibl
pH	pH				6.5 - 8.5
Total suspended solids	milligrams per litre				40

L3 Waste

L3.1 The licensee must not cause, permit or allow any waste generated outside the premises to be received at the premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the premises to be disposed of at the premises, except as expressly permitted by the licence.

L3.2 This condition only applies to the storage, treatment, processing, reprocessing or disposal of waste at the premises if those activities require an environment protection licence.

L4 Noise limits

Environment Protection Licence

Licence - 20611



- L4.1 Noise generated at the premises must not exceed the noise limits in the table below. The locations referred to in the table below are indicated in Table 3 and Figure 10 of the document entitled Environmental Assessment Report - Proposed Karuah East Quarry (ADW Johnson Pty Limited 2013) which has been filed on EPA file LIC08/1088-03.

Location	Noise Limit dB(A)
	Day LAeq (15 minute)
Residence A on Lot 100 DP 785172	40
Residence B on Lot 3 DP 785172	37
Residence G on Lot 1 DP 1032636	38
Any other residence or sensitive receiver not subject to a private negotiated agreement	35
Any approved residence on Lot 11 DP 1024564	43

- L4.2 For the purpose of the table above, Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and Public Holidays.

- L4.3 The noise limits set out in this licence apply under all meteorological conditions except for the following:
- Wind speed greater than 3 metres/second at 10 metres above ground level; or
 - Stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or
 - Stability category G temperature inversion conditions.

L4.4 Determining Compliance

To determine compliance:

- with the Leq(15 minute) noise limits in the Noise Limits table, the noise measurement equipment must be located:
 - approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or
 - within 30 metres of a dwelling façade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or, where applicable
 - within approximately 50 metres of the boundary of a National Park or a Nature Reserve.
- with the LA1(1 minute) noise limits in the Noise Limits table, the noise measurement equipment must be located within 1 metre of a dwelling façade.
- with the noise limits in the Noise Limits table, the noise measurement equipment must be located:
 - at the most affected point at a location where there is no dwelling at the location; or
 - at the most affected point within an area at a location prescribed by part (a) or part (b) of this condition.

Note: A non-compliance of the Noise Limits table will still occur where noise generated from the premises in excess of the appropriate limit is measured:

- at a location other than an area prescribed in part (a) and part (b); and/or
- at a point other than the most affected point at a location.

- L4.5 For the purposes of determining the noise generated at the premises the modification factors in Section 4 of the NSW Industrial Noise Policy must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

Environment Protection Licence

Licence - 20611



L5 Blasting

- L5.1 Blasting in or on the premises must only be carried out between 0900 hours and 1600 hours, Monday to Friday. No blasting is permitted Saturdays, Sundays or public holidays. Blasting outside of the hours specified in this condition can only take place with the written approval of the EPA.
- L5.2 Blasting is not permitted simultaneously with adjacent quarry(s).
- L5.3 The airblast overpressure level from blasting operations in or on the premises must not exceed: 115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period at monitoring point 11 detailed in Condition P1.4.
- L5.4 The airblast overpressure level from blasting operations in or on the premises must not exceed: 120 dB (Lin Peak) at any time at monitoring point 11 detailed in Condition P1.4.
- L5.5 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed 5 mm/second for more than 5% of the total number of blasts during each reporting period at monitoring point 11 detailed in Condition P1.4.
- L5.6 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed 10 mm/second at any time at monitoring point 11 detailed in Condition P1.4.
- L5.7 Error margins associated with any monitoring equipment used to measure airblast overpressure or peak particle velocity are not to be taken into account in determining whether or not the limit has been exceeded.
- L5.8 The airblast overpressure and ground vibration levels in the conditions above do not apply at noise sensitive locations that are owned by the licensee or subject to a private agreement, relating to airblast overpressure and ground vibration levels, between the licensee and land owner.
- L5.9 Offensive blast fume must not be emitted from the premises.

Definition:

Offensive blast fume means post-blast gases from the detonation of explosives at the premises that by reason of their nature, duration, character or quality, or the time at which they are emitted, or any other circumstances:

- 1. are harmful to (or likely to be harmful to) a person that is outside the premises from which it is emitted, or*
- 2. interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted.*

L6 Hours of operation

- L6.1 All construction work at the premises must be conducted between 7am to 6pm Monday to Friday and between 8am to 1pm Saturdays and at no time on Sundays and public holidays. This condition does not apply in the event of a direction from police or other relevant authority for safety or emergency reasons.

Environment Protection Licence

Licence - 20611



Note: 'safety or emergency reasons' refers to emergency works which may need to be undertaken to avoid loss of life, property loss and/or prevent environmental harm.

- L6.2 Construction may occur outside these hours provided the noise (LAeq 15min) from these activities does not exceed 35 dBA at any privately owned residence.
- L6.3 All quarrying operations, including extraction, processing and loadings / transport must be conducted between 7am to 6pm Monday to Friday and 7am to 1pm Saturdays and at no time on Sundays and public holidays.

Maintenance activities may occur 24 hours per day, 7 days per week, provided these activities are inaudible at any privately owned residence.

L7 Potentially offensive odour

- L7.1 No condition of this licence identifies a potentially offensive odour for the purposes of Section 129 of the Protection of the Environment Operations Act 1997.

Note: Section 129 of the Protection of the Environment Operations Act 1997, provides that the licensee must not cause or permit the emission of any offensive odour from the premises but provides a defence if the emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

- O1.1 Licensed activities must be carried out in a competent manner.
This includes:
 - a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
 - b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

- O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
 - a) must be maintained in a proper and efficient condition; and
 - b) must be operated in a proper and efficient manner.

O3 Dust

- O3.1 All areas in or on the premises must be maintained in a condition that prevents or minimises the emission of dust to the air.

Environment Protection Licence

Licence - 20611



- O3.2 Any activity carried out in or on the premises must be carried out by such practical means as to prevent dust or minimise the emission of dust to the air.
- O3.3 Any plant operated in or on the premises must be operated by such practical means to prevent or minimise dust or other air pollutants.
- O3.4 All trafficable areas and vehicle manoeuvring areas in or on the premises must be maintained, at all times, in a condition that will minimise the emission of dust to the air, or emission from the premises of wind-blown or traffic generated dust.
- O3.5 The licensee must ensure it has sufficient water during all stages of the quarry, and if necessary adjust the scale of quarrying operations on the premises to match its available supply.
- O3.6 Trucks entering and leaving the premises that are carrying loads of dust generating materials must have their loads covered at all times, except during loading and unloading.

O4 Emergency response

- O4.1 The licensee must maintain, and implement as necessary, a current Pollution Incident Response Management Plan (PIRMP) for the premises. The licensee must keep the incident response plan on the premises at all times. The incident response plan must document systems and procedures to deal with all types of incidents (e.g. spills, explosions or fire) that may occur at the premises or that may be associated with activities that occur at the premises and which are likely to cause harm to the environment.

The PIRMP must be tested at least annually or following a pollution incident.

The licensee must develop the Pollution Incident Response Management Plan in accordance with the requirements in Part 5.7A of the Protection of the Environment Operations (POEO) Act 1997 and POEO regulations.

O5 Processes and management

- O5.1 All tanks and storage areas for drums containing material that has potential to cause environmental harm must be bunded or have an alternative spill containment system in-place.

The bunding and/or spill containment systems must be properly designed, engineered, and constructed to be suitable for the material types and quantities stored therein in accordance with all appropriate standards, including Australian Standards (AS)1940 and AS1596.

- O5.2 Bunds must:
 - a) have walls and floors constructed of impervious materials;
 - b) be of sufficient capacity to contain 110% of the volume of the tank (or 110% volume of the largest tank where a group of tanks are installed);
 - c) have floors graded to a collection sump; and
 - d) not have a drain valve incorporated in the bund structure,

or be constructed and operated in a manner that achieves the same environmental outcome.

Environment Protection Licence

Licence - 20611



- O5.3 All refuelling must be undertaken in a dedicated refuelling area. The refuelling area must be a hardstand and suitably bunded in accordance with EPA bunding guidance.
- O5.4 The licensee must, before undertaking any earthmoving or vegetation removal works, implement erosion and sediment control measures to prevent pollution of waters in accordance with Soils and Construction: Managing Urban Stormwater 2004 (Landcom, 2004).
- O5.5 Stormwater from all areas of the premises which has the potential to mobilise sediments and other material must be controlled and diverted through the appropriate erosion and sediment control and/or pollution control measures/structures, so as not to cause, permit or allow water pollution to occur.
- O5.6 The in-pit sump must be sized at all times to prevent a discharge to waters in the event of pump failure.

O6 Waste management

- O6.1 The licensee must not irrigate, discharge or dispose of sewage effluent, on the premises.
- O6.2 The licensee must operate and maintain a wastewater collection and storage tank/s to enable the pump out and offsite disposal of any sewage effluent.
- O6.3 The licensee must ensure that sewage effluent collected at the premises is pumped out and disposed of in a lawful manner.

O7 Other operating conditions

Noise and Blast Management

- O7.1 All acoustic bunds necessary to achieve compliance with the noise limits specified in this licence must be constructed prior to the commencement of quarrying activities and be maintained throughout the operational life of the premises to the height and location described in the Noise Management Plan.

Bitumin Pre-coat Plant

- O7.2 The licensee must not have a bitumin pre-coat plant on the site. Project Approval MP09_0175 did not assess or approve such a plant.

5 Monitoring and Recording Conditions

M1 Monitoring records

- M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.
- M1.2 All records required to be kept by this licence must be:

Environment Protection Licence

Licence - 20611



- a) in a legible form, or in a form that can readily be reduced to a legible form;
- b) kept for at least 4 years after the monitoring or event to which they relate took place; and
- c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:

- a) the date(s) on which the sample was taken;
- b) the time(s) at which the sample was collected;
- c) the point at which the sample was taken; and
- d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Air Monitoring Requirements

POINT 4,5,6,7,8

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	grams per square metre per month	Monthly	AM-19

POINT 9

Pollutant	Units of measure	Frequency	Sampling Method
PM10	micrograms per cubic metre	Every 6 days	AM-18
Total suspended particles	micrograms per cubic metre	Every 6 days	AM-15

M2.3 Water and/ or Land Monitoring Requirements

POINT 1,2,3

Pollutant	Units of measure	Frequency	Sampling Method
Oil and Grease	milligrams per litre	Special Frequency 1	Visual Inspection
pH	pH	Special Frequency 1	Grab sample
Total suspended solids	milligrams per litre	Special Frequency 1	Grab sample
Turbidity	nephelometric turbidity units	Special Frequency 1	Grab sample

Environment Protection Licence

Licence - 20611



Note: For the purposes of the table above 'Special Frequency 1' means:

- (a) within 12 hours prior to any controlled discharge; and
- (b) daily during a controlled discharge; or
- (c) daily during any uncontrolled discharge.

M3 Testing methods - concentration limits

M3.1 Monitoring for the concentration of a pollutant emitted to the air required to be conducted by this licence must be done in accordance with:

- a) any methodology which is required by or under the Act to be used for the testing of the concentration of the pollutant; or
- b) if no such requirement is imposed by or under the Act, any methodology which a condition of this licence requires to be used for that testing; or
- c) if no such requirement is imposed by or under the Act or by a condition of this licence, any methodology approved in writing by the EPA for the purposes of that testing prior to the testing taking place.

Note: The *Protection of the Environment Operations (Clean Air) Regulation 2010* requires testing for certain purposes to be conducted in accordance with test methods contained in the publication "Approved Methods for the Sampling and Analysis of Air Pollutants in NSW".

M3.2 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

M4 Weather monitoring

M4.1 Prior to the commencement of operation of the development, the Proponent must establish a permanent meteorological station complying with the Approved Methods for Sampling and Analysis and the Australian Standard AS2923 - 1987, at the facility. The meteorological station must monitor the following parameters:

Parameter	Units of measure	Averaging period	Frequency	Sampling Method
Rainfall	mm/hr	1 hour	Continuous	AM-4
Sigma Theta @ 10m	degrees	1 hour	Continuous	AM-2
Siting	-	-	-	AM-1
Temperature @ 10m	Kelvin	1 hour	Continuous	AM-4
Temperature @ 2m	Kelvin	1 hour	Continuous	Am-4
Total Solar Radiation @ 10m	W/m2	1 hour	Continuous	AM-4

Environment Protection Licence

Licence - 20611



Wind direction @ 10m	degrees	1 hour	Continuous	AM-2
Wind speed @ 10m	m/s	1 hour	Continuous	AM-2

Note: Sampling methods as identified in the table above refer to those outlined in NSW EPA, 2001, Approved Methods for the Sampling and Analysis of Air Pollutants in NSW.

- M4.2 The location of the site chosen for the station and details of equipment, measurement and maintenance / service procedures and schedules to be installed and maintained must be submitted to the EPA and approved in writing by the EPA before any sampling or analysis is carried out.
- M4.3 The meteorological monitoring station must be calibrated at least once every 12 months. The EPA is to be provided with data on request in a Microsoft Office software compatible format.

M5 Recording of pollution complaints

- M5.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.
- M5.2 The record must include details of the following:
- the date and time of the complaint;
 - the method by which the complaint was made;
 - any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
 - the nature of the complaint;
 - the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
 - if no action was taken by the licensee, the reasons why no action was taken.
- M5.3 The record of a complaint must be kept for at least 4 years after the complaint was made.
- M5.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M6 Telephone complaints line

- M6.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.
- M6.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.
- M6.3 The preceding two conditions do not apply until 1 month after the date of the issue of this licence.

Environment Protection Licence

Licence - 20611



M7 Blasting

M7.1 To determine compliance with Blast Limit conditions of this licence:

- Airblast overpressure and ground vibration levels must be measured and electronically recorded for monitoring point 11 for the parameters specified in Column 1 of the table below; and
- The licensee must use the units of measure, sampling method, and sample at the frequency specified opposite in the other columns.

Parameter	Units of Measure	Frequency	Sampling Method
Airblast Overpressure	Decibels (Linear Peak)	All blasts	Australian Standard AS 2187.2-2006
Ground Vibration Peak Particle Velocity	millimetres/second	All blasts	Australian Standard AS 2187.2-2006

M8 Noise monitoring

M8.1 To assess compliance with the noise limits for this premises attended noise monitoring must be undertaken in accordance with all noise conditions and:

- at each one of the locations listed in the noise limits table of this licence;
- occur annually each reporting period at the time of year generally associated with maximum noise transmission (ie generally winter conditions);
- occur during each day period as defined in the NSW Industrial Noise Policy.

Note: the frequency of this noise monitoring may be varied at the discretion of the EPA.

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:

- a Statement of Compliance,
- a Monitoring and Complaints Summary,
- a Statement of Compliance - Licence Conditions,
- a Statement of Compliance - Load based Fee,
- a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan,
- a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
- a Statement of Compliance - Environmental Management Systems and Practices.

At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

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- R1.3 Where this licence is transferred from the licensee to a new licensee:
- a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
 - b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

- R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
- a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
 - b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.
- R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect *EPA* or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').
- R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.
- R1.7 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
- a) the licence holder; or
 - b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R2 Notification of environmental harm

- R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.
- R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R3 Written report

- R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
- a) where this licence applies to premises, an event has occurred at the premises; or
 - b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
- and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written

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Licence - 20611



report of the event.

- R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.
- R3.3 The request may require a report which includes any or all of the following information:
- a) the cause, time and duration of the event;
 - b) the type, volume and concentration of every pollutant discharged as a result of the event;
 - c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
 - d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
 - e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
 - f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
 - g) any other relevant matters.
- R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

R4 Other reporting conditions

Reporting blasting limit exceedance

- R4.1 The licensee must report any exceedance of the licence blasting limits to the regional office of the EPA as soon as practicable after the exceedance becomes known to the licensee or to one of the licensee's employees or agents.

Annual Blast Monitoring Report

- R4.2 The licensee must supply a Blast Monitoring Report with the EPA licence Annual Return, which must include the following information relating to each blast carried out within the premises during the respective reporting period:
- a) the date and time of the blast;
 - b) the location of the blast on the premises;
 - c) the blast monitoring results at each blast monitoring station;
 - d) an explanation for any missing blast monitoring results.

Noise Monitoring Report

- R4.3 A noise compliance assessment report must be submitted to the EPA within 30 days of the completion of the annual monitoring. The assessment must be prepared by a suitably qualified and experienced acoustical consultant and include:
- a) an assessment of compliance with noise limits presented in this licence; and
 - b) an outline of any management actions taken within the monitoring period to address any exceedances

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Licence - 20611



of the limits contained in this licence.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

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Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the <i>Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales</i> .
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the <i>Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales</i> .
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

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flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 months. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the <i>Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales</i> .

Environment Protection Licence



Licence - 20611

TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non - putrescible), special waste or hazardous waste

Mr Peter Jamieson

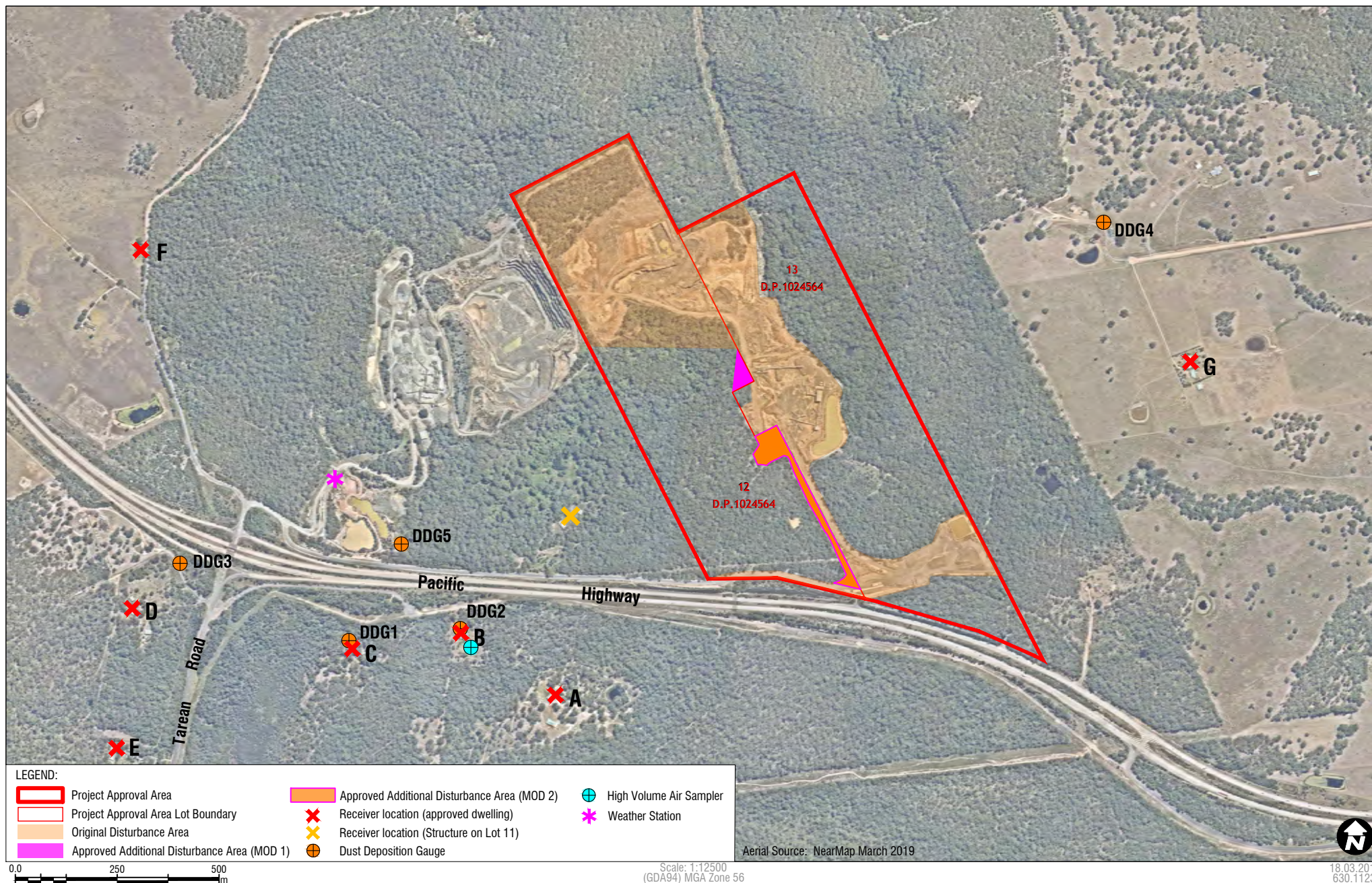
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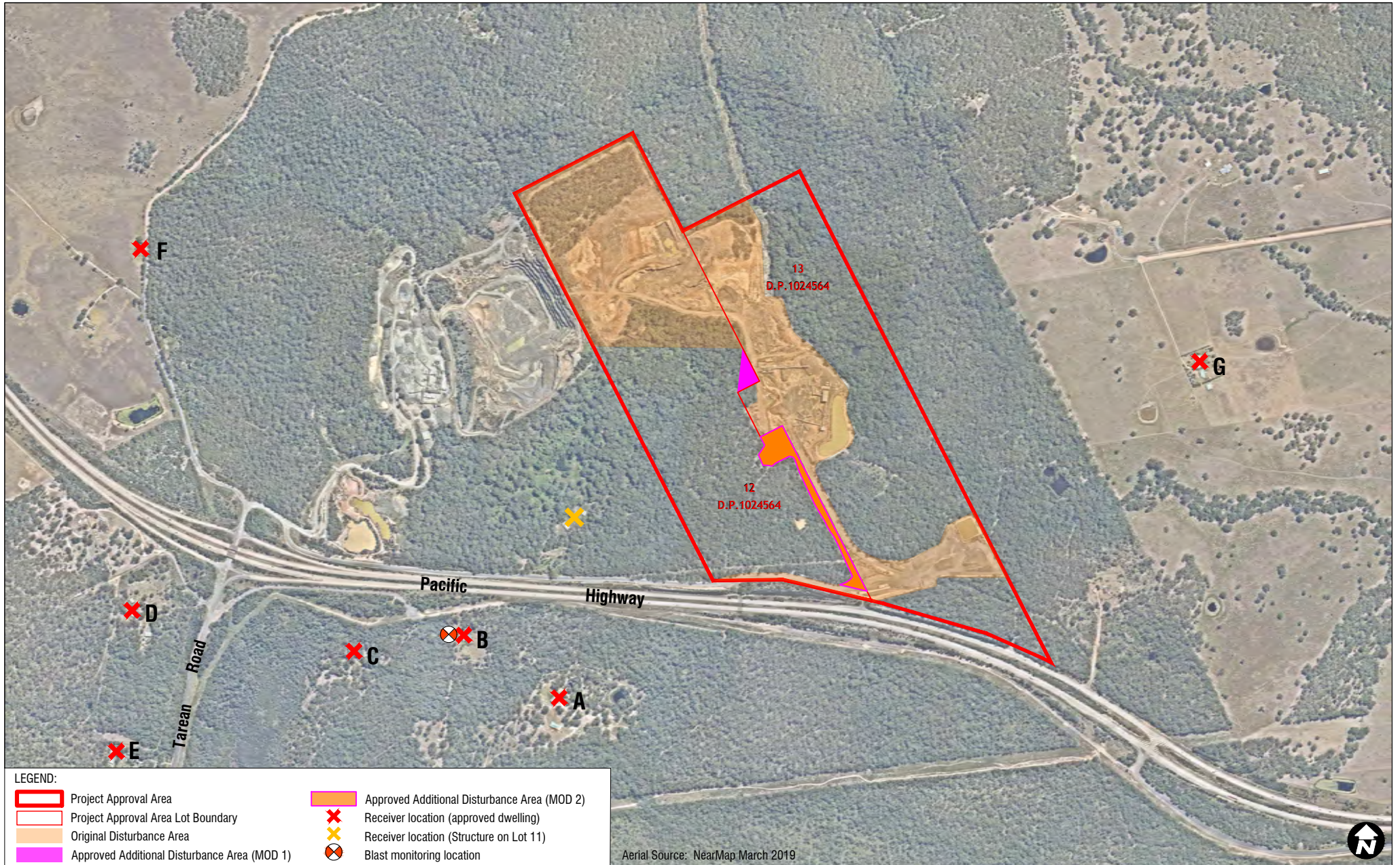
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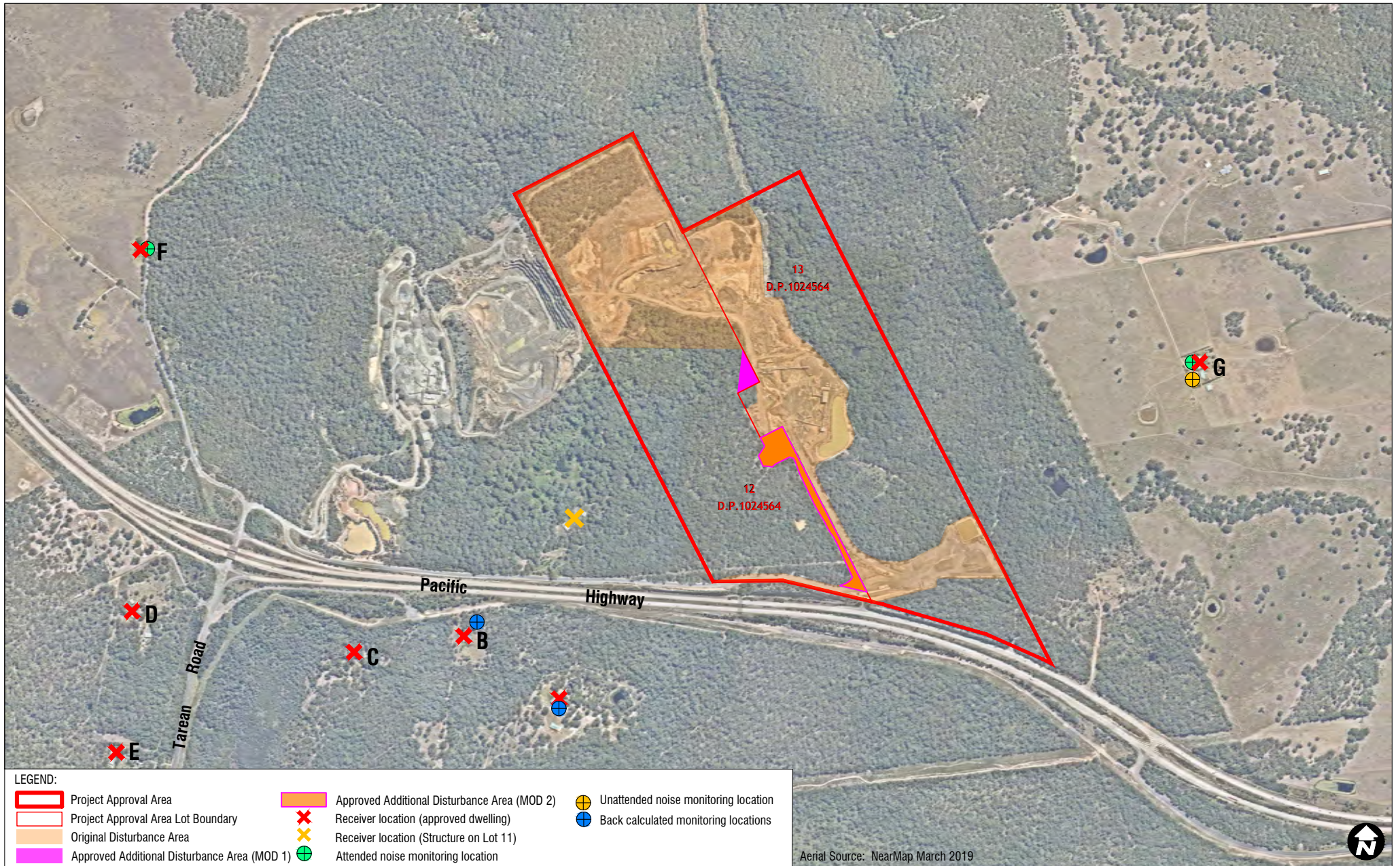
Date of this edition: 26-August-2015

End Notes		
2	Licence varied by notice	1533596 issued on 21-Sep-2015
3	Licence varied by notice	1547416 issued on 06-Dec-2016

APPENDIX 3 – Key Figures/Plans







LEGEND:

- | | | |
|--|--|--------------------------------------|
| Project Approval Area | Approved Additional Disturbance Area (MOD 2) | Unattended noise monitoring location |
| Project Approval Area Lot Boundary | Receiver location (approved dwelling) | Back calculated monitoring locations |
| Original Disturbance Area | Receiver location (Structure on Lot 11) | |
| Approved Additional Disturbance Area (MOD 1) | Attended noise monitoring location | |

Scale: 1:12500
(GDA94) MGA Zone 56

Aerial Source: NearMap March 2019

18.03.2019
630.11235

APPENDIX 4– Noise Monitoring Reports



global environmental solutions

Operational Compliance Monitoring

Karuah East Quarry

Quarter 1

February 2018

Report Number 630.12317-R02

31 May 2018

Karuah East Quarry Pty Ltd

PO Box 23

KARUAH NSW 2324

Version: -v1.0

Operational Compliance Monitoring

Karuah East Quarry

Quarter 1

February 2018

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This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Karuah East Quarry Pty Ltd. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.12317-R02--v1.0	31 May 2018	Jordan Murray	Robert Hall	Robert Hall

Table of Contents

1	INTRODUCTION	5
2	SENSITIVE RECEPTORS	5
3	OPERATIONAL COMPLIANCE CRITERIA	7
3.1	General Methodology	7
3.2	Operator Attended Noise Compliance Monitoring	7
3.3	Unattended Continuous Noise Monitoring	7
4	OPERATOR-ATTENDED NOISE MONITORING RESULTS	8
4.1	Results of Operator-attended Noise Monitoring	8
4.2	Operator-attended Noise Monitoring Summary	8
5	UNATTENDED CONTINUOUS NOISE MONITORING	9
6	CONCLUSION	10
1	INTRODUCTION	5
2	SENSITIVE RECEPTORS	5
3	OPERATIONAL COMPLIANCE CRITERIA	7
3.1	General Methodology	7
3.2	Operator Attended Noise Compliance Monitoring	7
3.3	Unattended Continuous Noise Monitoring	7
4	OPERATOR-ATTENDED NOISE MONITORING RESULTS	8
4.1	Results of Operator-attended Noise Monitoring	8
4.2	Operator-attended Noise Monitoring Summary	8
5	UNATTENDED CONTINUOUS NOISE MONITORING	9
6	CONCLUSION	10

TABLES

Table 1	Sensitive Receptor Locations Used in this Assessment	5
Table 2	Operational Noise Criteria (dBA LAeq(15minute))	7
Table 3	Ambient Noise Monitoring Locations	7
Table 4	Noise Logger and Noise Monitoring Location	8
Table 5	Operator Attended Noise Survey Results	8
Table 6	Compliance Noise Assessment – Operations	9
Table 7	Unattended Continuous Monitoring Ambient Noise Levels	9

Table of Contents

FIGURES

Figure 1	Sensitive Receptor Locations – Project Site	6
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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Karuah East Quarry Pty Ltd to conduct operational noise compliance monitoring for the Karuah East Quarry located on Lots 12 and 13 DP 1024564, off the Pacific Highway, approximately 3 km north of Karuah, New South Wales (NSW) (the Project Site).

The objectives of the operational noise compliance monitoring were as follows:

- Conduct operator-attended noise surveys at two locations (F and G) surrounding the Project Site and quantify all sources of noise including measured and/or estimated contribution and maximum level of individual sources.
- Conduct unattended noise monitoring at Location G to supplement the operator-attended noise measurements.
- Assess noise emissions of the Project Site with respect to the operational noise goals for the Project Site.

The operational noise compliance monitoring has been prepared with reference to Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in accordance with the Karuah East Quarry Noise Management Plan (NMP) 630.11235-R1 *Karuah East Quarry Project Noise Management Plan* dated October 2015.

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 SENSITIVE RECEPTORS

The Karuah East Quarry NMP identified the closest sensitive receptors to the Development Site. These locations are listed in **Table 1** and shown in **Figure 1**.

Table 1 Sensitive Receptor Locations Used in this Assessment

Receiver ID	Details
Existing Approved Dwellings	
A	Lot 100 DP 785172
B	Lot 3 DP 785172
C	Lot 2 DP 785172
D	Lot 22 DP 1024341
E	Lot 250 DP 1092111
F	Lot 50 DP 1036893
G	Lot 1 DP 1032636
Other Structures	
Lot 11 ¹	Lot 11 DP1024564

Note 1 - No currently approved residential dwelling exists on Lot 11.

Figure 1 Sensitive Receptor Locations – Project Site



Karuah East Quarry - Sensitive Receivers and Monitoring Locations
FIGURE 1

3 OPERATIONAL COMPLIANCE CRITERIA

In accordance with the Noise Management Plan, **Table 2** presents the adopted operational noise goals for the Project Site.

Table 2 Operational Noise Criteria (dBA LAeq(15minute))

Location	Criteria (day)
Residence on Lot 11 DP 1024564 ¹	43
A	40
B	37
G	38
All other residences	35

1. No currently approved residential dwelling exists on Lot 11 and therefore it is considered that the noise limits do not currently apply at this location.

3.1 General Methodology

Operator-attended compliance noise surveys were conducted to characterise and quantify the noise emissions from the Project Site. In accordance with the NMP, operator attended noise monitoring was undertaken at two locations, Location F and Location G and unattended noise monitoring undertaken at Location G (refer to **Figure 1**).

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672 2004 "*Electroacoustics – Sound Level Meters*" (parts 1 and 2) and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ± 0.5 dBA.

3.2 Operator Attended Noise Compliance Monitoring

Operator-attended noise measurements were conducted during the daytime period on Wednesday 14 February 2018 at the noise monitoring locations F and G. Details of the monitoring locations are provided in **Table 3** and shown in **Figure 1**.

Table 3 Ambient Noise Monitoring Locations

Sound level meter Type/ Serial No.	Location	Location (m, UTM)	
		Easting	Northing
B&K Type 2250L / 3004636	Location F – Eastern Boundary of property	405644	6389785
	Location G – North western boundary of property ¹	408055	6389753

Note 1: Noise monitoring conducted at the property gate.

Each operator-attended noise survey was 15 minutes in duration.

3.3 Unattended Continuous Noise Monitoring

An environmental noise logger was deployed at monitoring Location G in accordance with the NMP (refer to **Figure 1**). Noise monitoring was undertaken from Wednesday 14 February 2018 to Wednesday 21 February 2018, inclusive. Details of the noise loggers used for the unattended continuous noise monitoring are given in **Table 4**.

The environmental noise loggers were programmed to record statistical noise level indices continuously in 15 minute intervals.

Table 4 Noise Logger and Noise Monitoring Location

Location	Noise Logger/Serial Number	Date of Logging
G	ARL EL-316 16-306-039	14/2/2018-21/2/2018

4 OPERATOR-ATTENDED NOISE MONITORING RESULTS

4.1 Results of Operator-attended Noise Monitoring

The results of the operator attended noise measurements are given in **Table 5**. Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds, and any other industrial operations. The table provides the following information:

- Monitoring location.
- Date, start time, Wind velocity (m/s) and Temperature (°C) at the measurement location; and
- Typical maximum (L_{Amax}) and contributed noise levels.

Quarry contributions listed in the tables are from Karuah East Quarry and are stated only when a contribution could be quantified.

Table 5 Operator Attended Noise Survey Results

Date/Start Time Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels L _{Amax} – dBA
	L _{Amax}	LA1	LA10	LA90	LAeq	
Location F Period: Day Date: 14/2/2018 Time: 10:23 Wind: 2 m/s WSW Temperature: 29°C	84	66	53	47	56	Local road traffic 56 - 84 Pacific Highway 41 – 52 Insects 39 – 44 Karuah East Project Inaudible
Location G Period: Day Date: 14/2/2017 Time: 09:56 Wind: 2 m/s WSW Temperature: 29°C	56	52	50	45	48	Aeroplane 43 -45 Birds/insects 32 - 47 Karuah East Project Audible Crushing plant 39 – 46 General drone 37 – 45 Estimated LAeq(15minute) Contribution 43 dBA

4.2 Operator-attended Noise Monitoring Summary

Noise generated by traffic on the Pacific Highway and Branch Lane dominated ambient noise levels at noise monitoring Location F, Karuah East Quarry was inaudible. Noise generated by Karuah East Quarry was dominant at Location G however other ambient noise from birds, insects and aeroplanes contributed to the overall noise levels.

The results of the operational compliance assessment are given in **Table 6**.

Table 6 Compliance Noise Assessment – Operations

Location	Estimated Karuah LAeq(15minute) Contribution	Consent Conditions LAeq(15minute)	Compliance
	Day	Day	Day
F	Inaudible	35	Yes
G	43	38	No

Results presented in **Table 6** indicate that compliance with the relevant consent conditions was not achieved at Location G which was determined to be in exceedance by 5 dBA. Meteorological conditions at the time of operator attended noise measurements likely exacerbated Karuah East Quarry noise impacts at Location G. Meteorological data from the Karuah Quarry onsite weather station has shown stable light winds of approximately 2 m/s at 10 m above ground level travelling in a SW direction towards the monitoring location. Compliance was achieved at Location F.

5 UNATTENDED CONTINUOUS NOISE MONITORING

The unattended ambient noise logger data from monitoring Location G is presented graphically on a daily basis and attached as **Appendix B**. A summary of the results of the unattended continuous noise monitoring is given in **Table 7**. The ambient noise level data quantifies the overall noise level at a given location independent of its source or character.

Precautions can be taken to minimise influences from extraneous noise sources (eg optimum placement of the loggers away from creeks, trees, houses, etc), however, not all these sources or their effects can be eliminated. This is particularly the case during the warmer times of year when noise from insects, frogs, birds and other animals can become quite prevalent.

Weather data was obtained from the Bureau of Meteorology automatic weather station located at Williamtown Airport approximately 22 km south west of the monitoring locations. Unattended noise data corresponding with periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18km/hr) were discarded in accordance with INP data exclusion methodology.

Table 7 Unattended Continuous Monitoring Ambient Noise Levels

INP Period	LA1	LA10	LA90	LAeq
Location G				
Daytime	49	43	34	44
Evening	47	43	35	42
Night	48	46	36	48

Given the results of operator attended noise monitoring Karuah East Quarry contributes to overall noise levels at the Location G noise logger during the daytime operational period. However it is noted that other noise sources such as road noise from the Pacific Highway, local road traffic and other noise sources such as birdsong, insects and livestock also contribute to overall noise levels at this location.

6 CONCLUSION

SLR Consulting Australia Pty Ltd (SLR) has undertaken operational noise compliance monitoring for the Karuah East Project in accordance with the NMP.

Operator-attended noise compliance measurements were conducted during the daytime period on Wednesday 14 February 2018 at monitoring locations F and G. Unattended noise monitoring was conducted at Location G from Wednesday 14 February 2018 to Wednesday 21 February 2018 inclusive.

Karuah East Quarry was deemed to be in exceedance of the noise criteria at Location G during the 15-minute operator-attended noise survey, however results from continuous unattended noise monitoring indicate that compliance was indicated during other periods throughout the week. The exceedance is considered to be due to prevailing wind conditions carrying sound towards the monitoring location. Compliance was achieved at Location F.

Acoustic Terminology

1 Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that in common usage 'noise' is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	Loud
80	Kerbside of busy street	
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB Linear or dBZ.

3 Sound Power Level

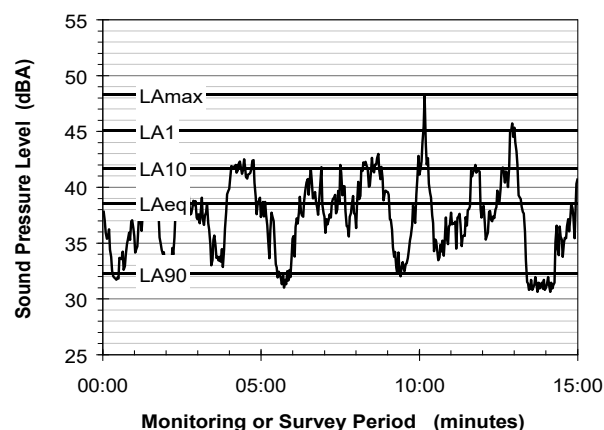
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or Lw, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

- LA1 The noise level exceeded for 1% of the 15 minute interval.
- LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- LAeq The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the 'repeatable minimum' LA90 noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or 'average' levels representative of the other descriptors (LAeq, LA10, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than 'broad band' noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

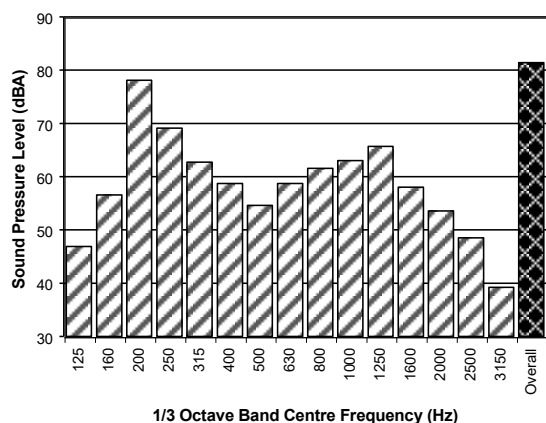
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

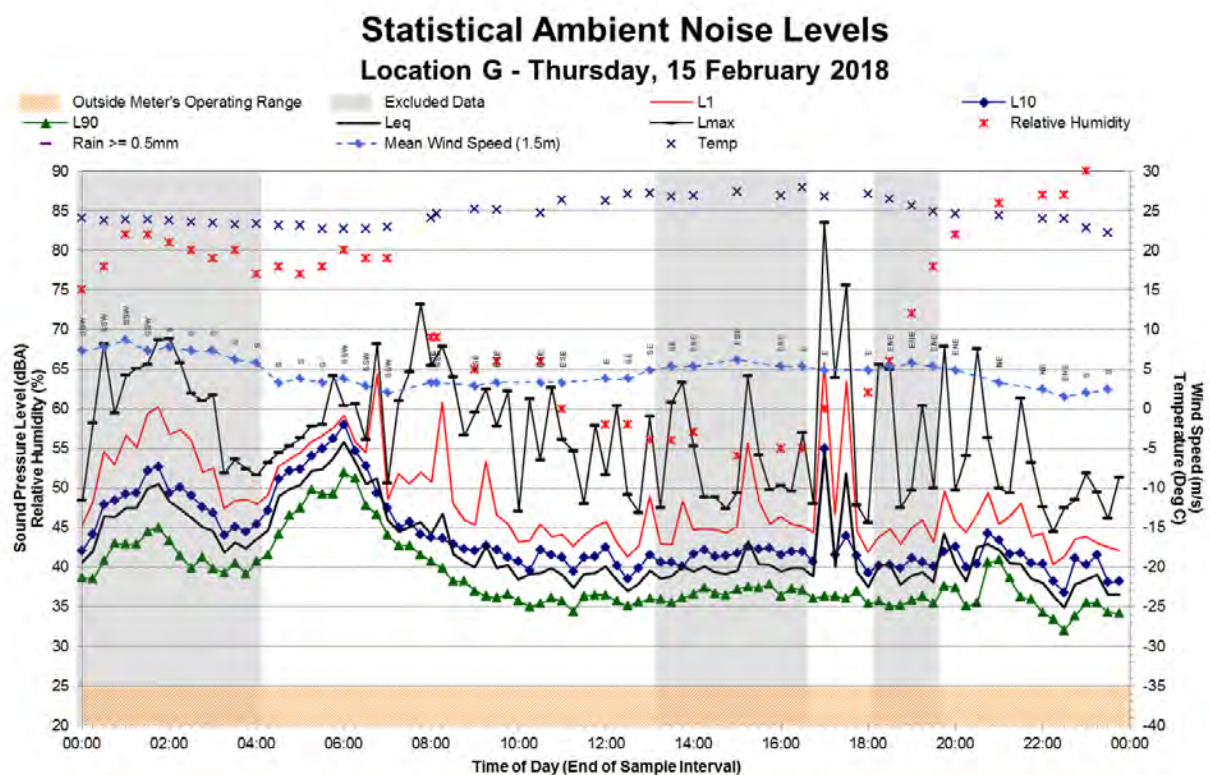
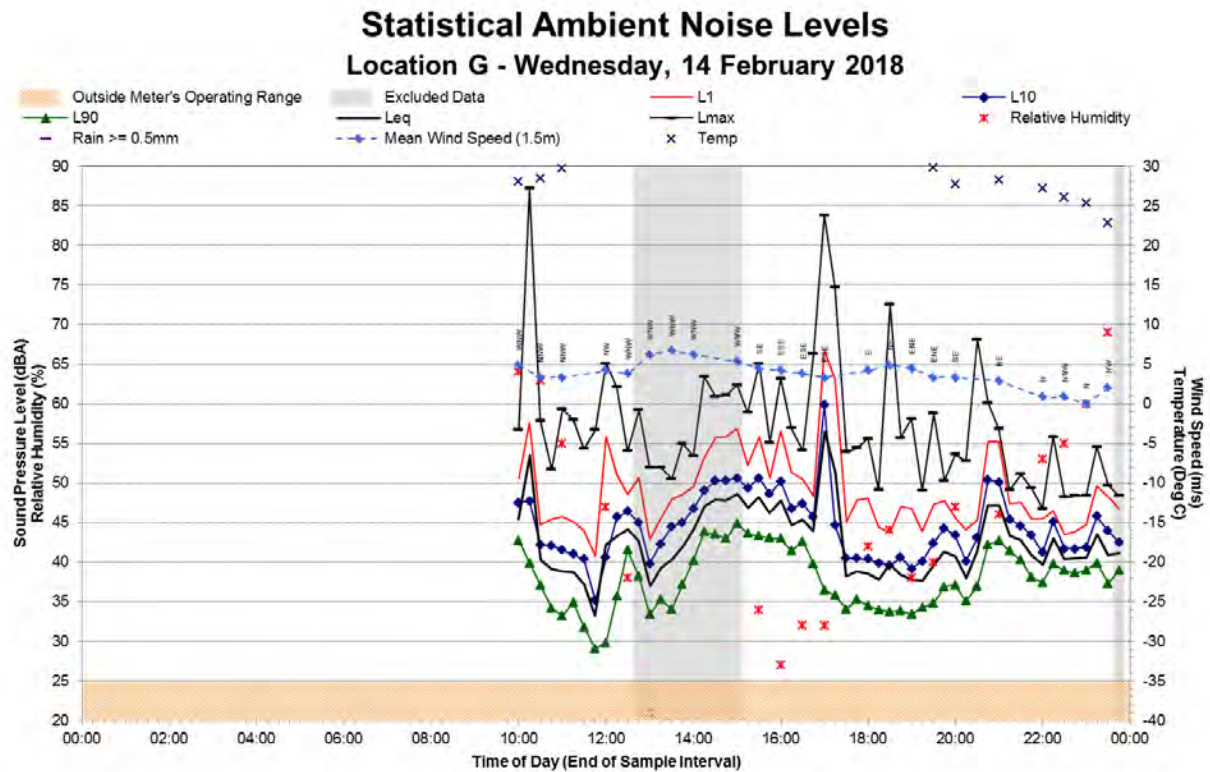
Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



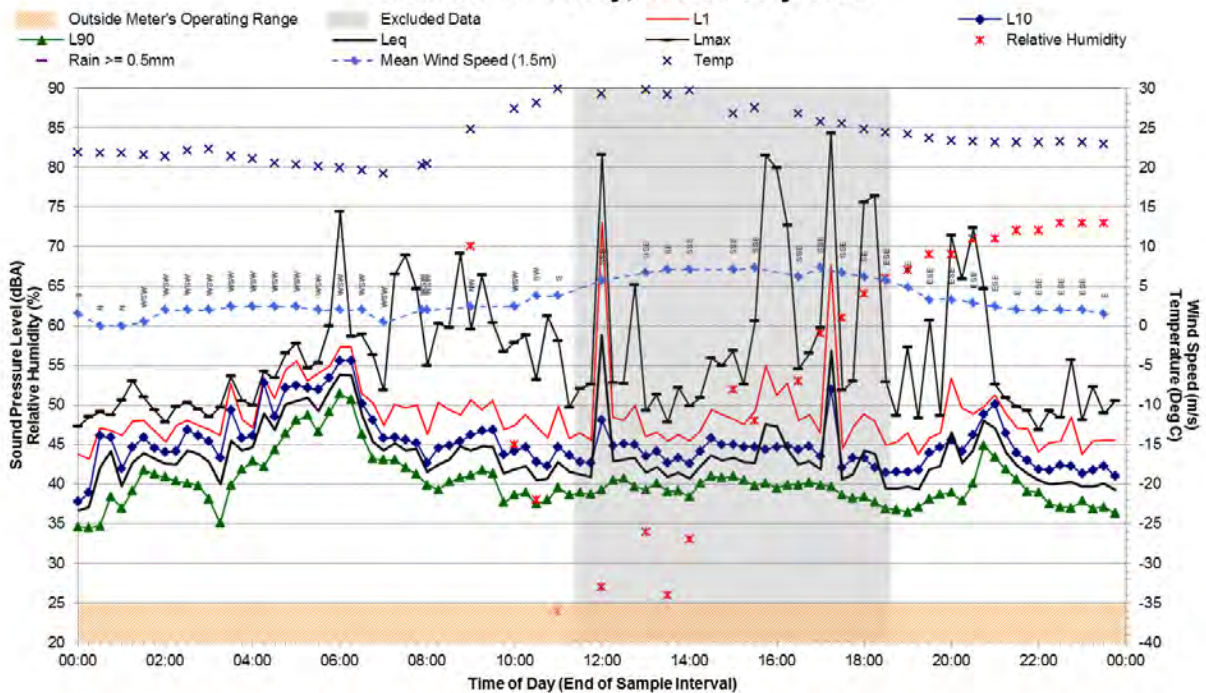
Location G Continuous Statistical Ambient Noise Monitoring Results



Location G Continuous Statistical Ambient Noise Monitoring Results

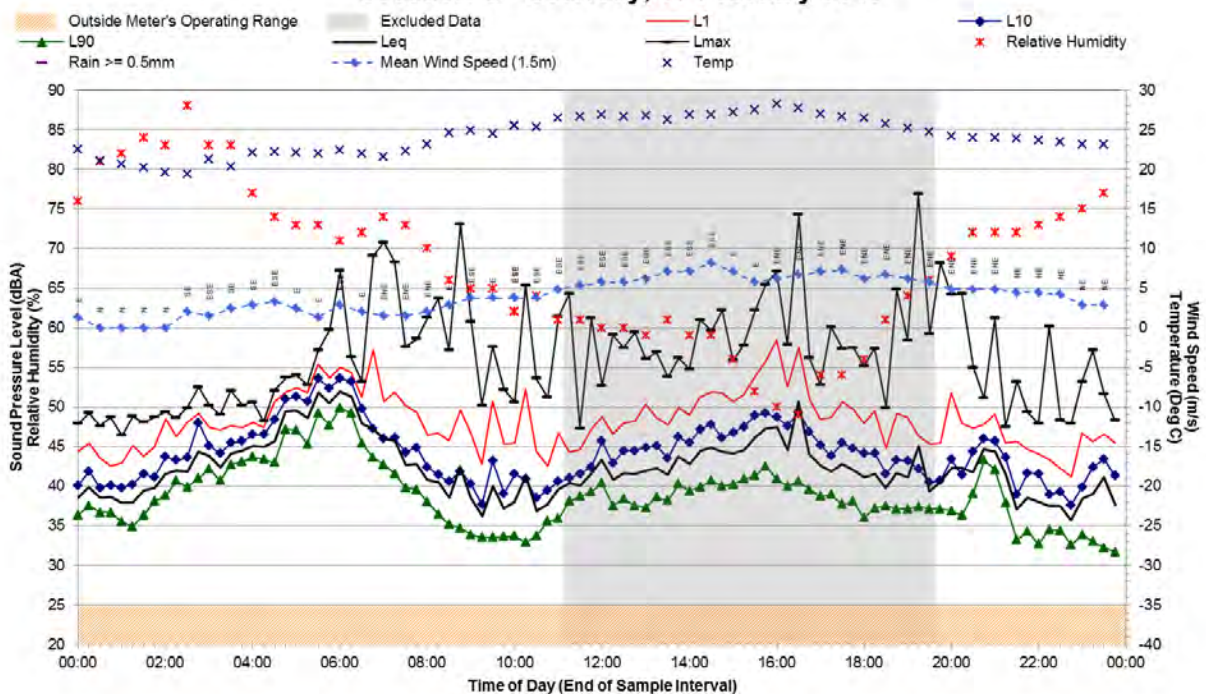
Statistical Ambient Noise Levels

Location G - Friday, 16 February 2018



Statistical Ambient Noise Levels

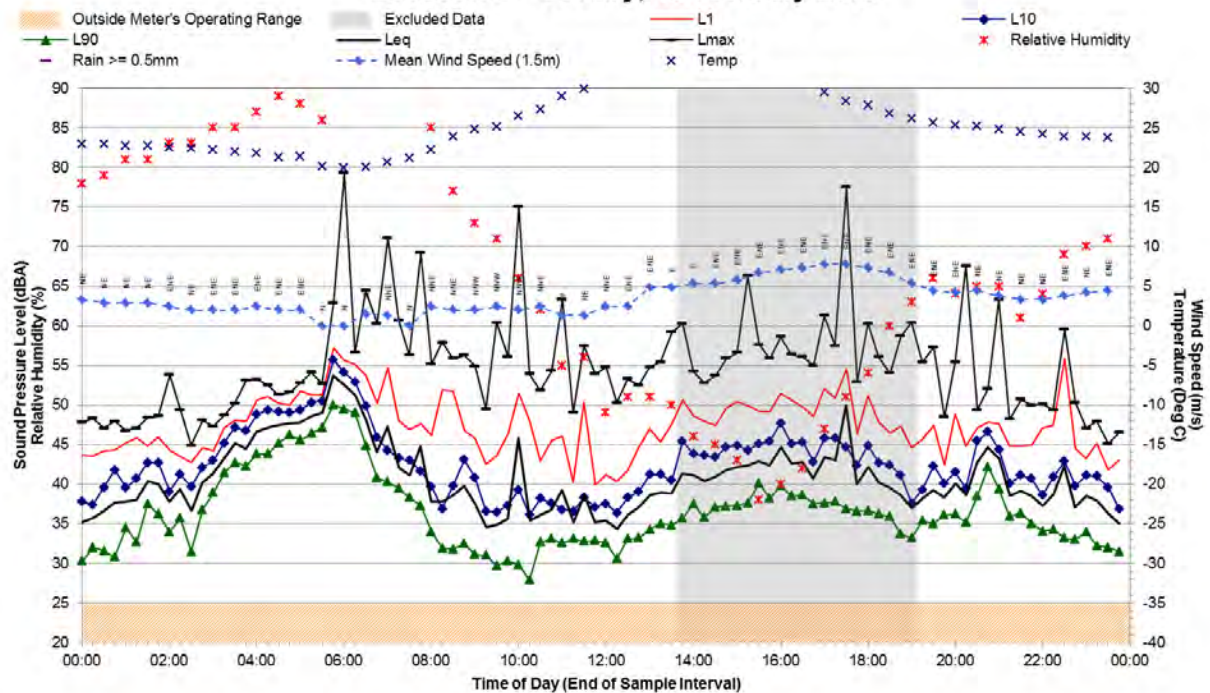
Location G - Saturday, 17 February 2018



Location G Continuous Statistical Ambient Noise Monitoring Results

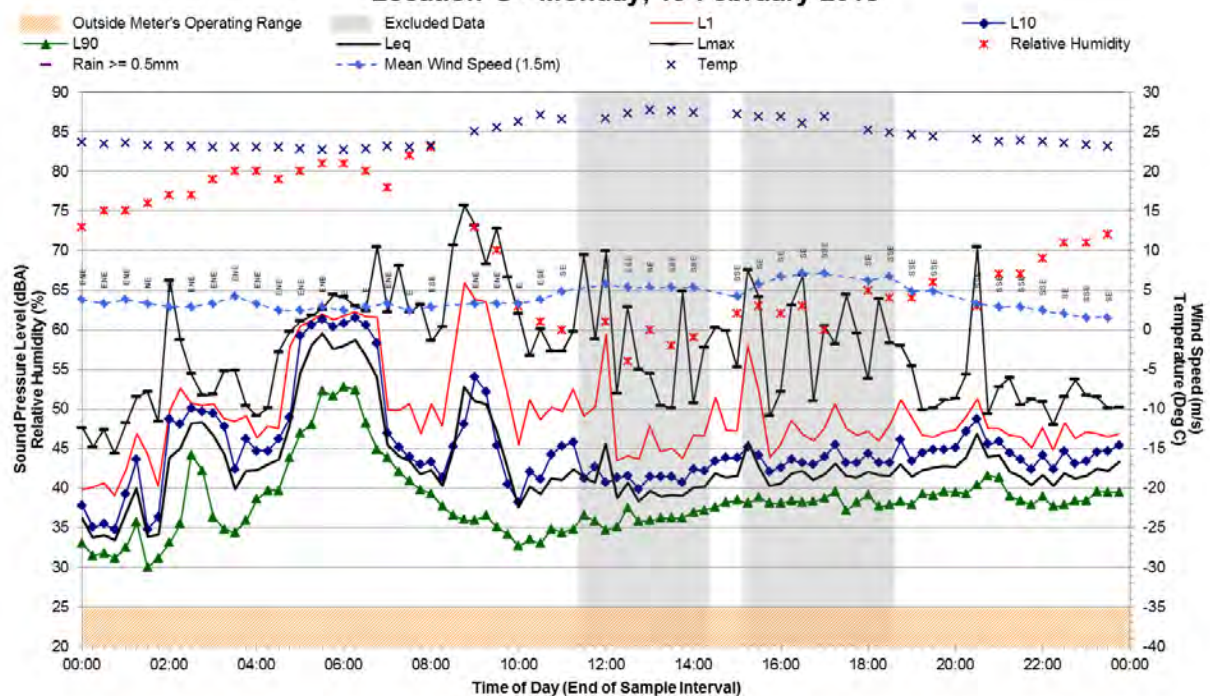
Statistical Ambient Noise Levels

Location G - Sunday, 18 February 2018



Statistical Ambient Noise Levels

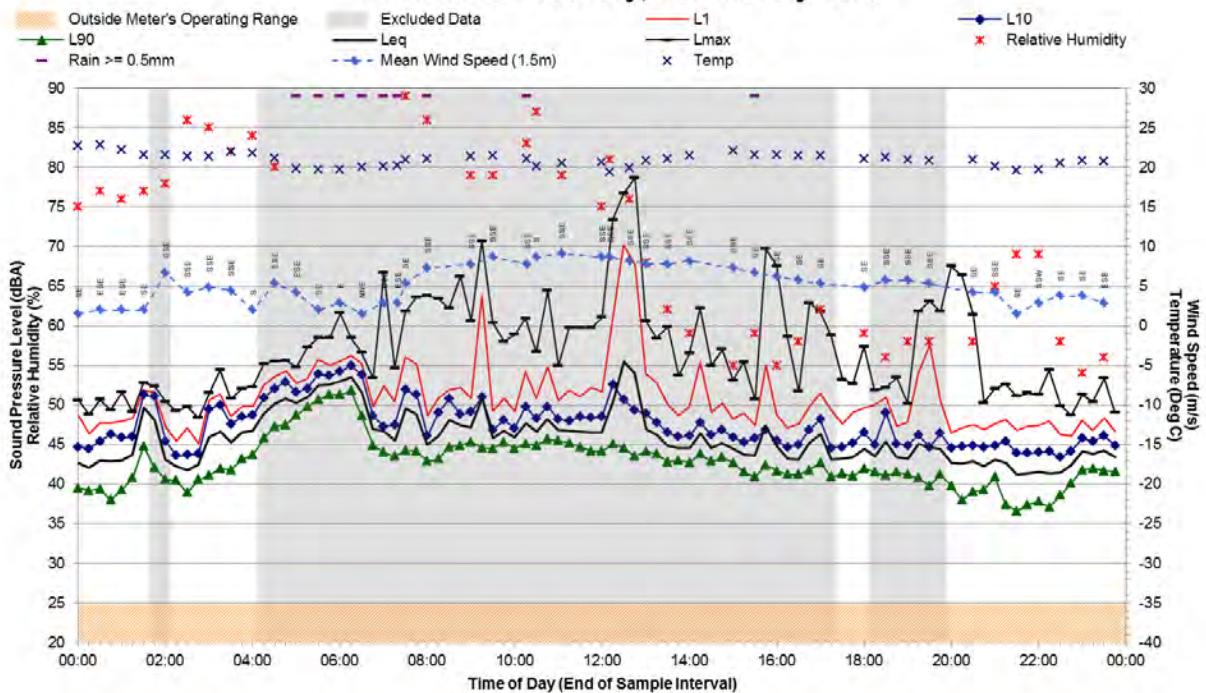
Location G - Monday, 19 February 2018



Location G Continuous Statistical Ambient Noise Monitoring Results

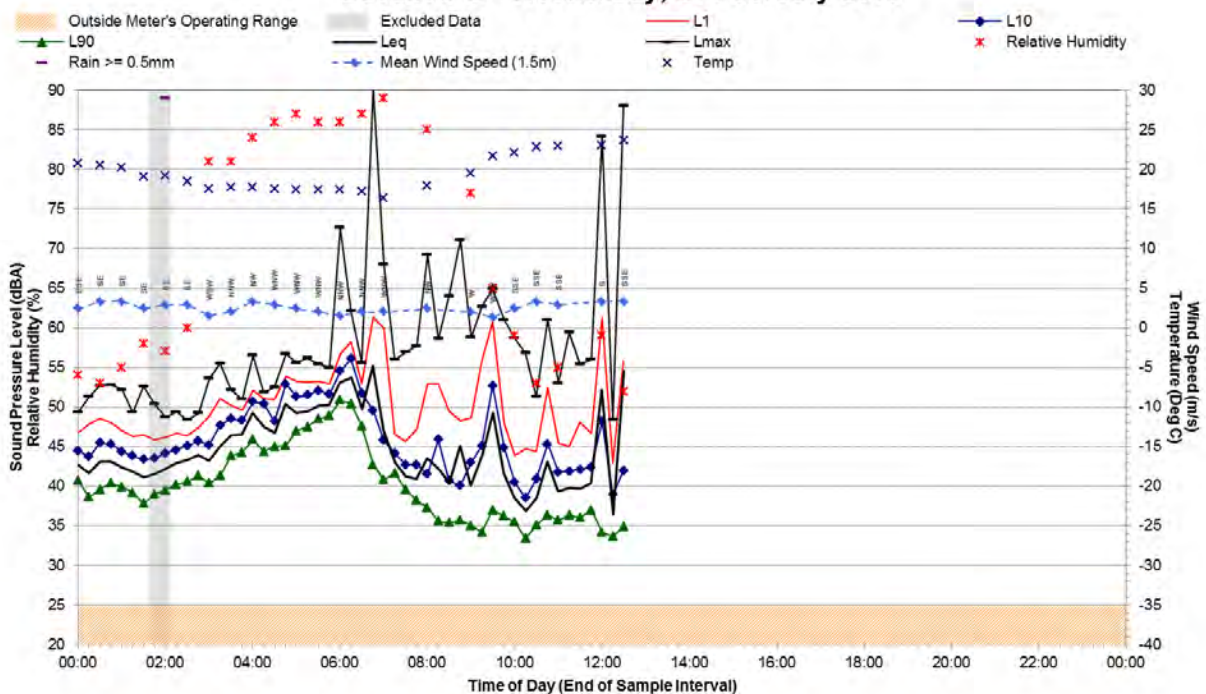
Statistical Ambient Noise Levels

Location G - Tuesday, 20 February 2018



Statistical Ambient Noise Levels

Location G - Wednesday, 21 February 2018



OPERATIONAL COMPLIANCE NOISE MONITORING

**Karuah East Quarry
Quarter 2
May 2018**

Prepared for:

Karuah East Quarry Pty Ltd
PO Box 23
KARUAH NSW 2324

SLR Ref: 630.12317-R03
Version No: -v0.1
May 2018



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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Karuah East Quarry Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.12317-R03-v0.1	31 May 2018	Jordan Murray	Martin Davenport	DRAFT

CONTENTS

1	INTRODUCTION.....	5
2	SENSITIVE RECEPTORS.....	5
3	OPERATIONAL COMPLIANCE CRITERIA.....	7
3.1	General Methodology.....	7
3.2	Operator Attended Noise Compliance Monitoring.....	7
3.3	Unattended Continuous Noise Monitoring.....	8
4	OPERATOR ATTENDED NOISE MONITORING RESULTS.....	8
4.1	Results of Operator-attended Noise Monitoring.....	8
4.2	Operator-attended Noise Monitoring Summary.....	9
5	UNATTENDED CONTINUOUS NOISE MONITORING.....	10
6	CONCLUSION.....	10

DOCUMENT REFERENCES

TABLES

Table 1	Sensitive Receptor Locations Used in this Assessment.....	5
Table 2	Operational Noise Criteria (dBA LAeq(15minute)).....	7
Table 3	Ambient Noise Monitoring Locations.....	7
Table 4	Noise Logger and Noise Monitoring Location.....	8
Table 5	Operator Attended Noise Survey Results.....	9
Table 6	Compliance Noise Assessment – Operations.....	9
Table 7	Unattended Continuous Monitoring Ambient Noise Levels (dBA).....	10

FIGURES

Figure 1	Sensitive Receptor Locations – Project Site.....	6
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CONTENTS

APPENDICES

Appendix A Acoustic Terminology

Appendix B Unattended Noise Monitoring

DRAFT

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Karuah East Quarry Pty Ltd to conduct operational compliance noise monitoring for the Karuah East Quarry located on Lots 12 and 13 DP 1024564, off the Pacific Highway, approximately 3 km north of Karuah, New South Wales (NSW) (the Project Site). Karuah East Quarry currently operates from 7 am to 6 pm Monday – Friday and 8 am to 12 pm on Saturdays.

The objectives of the operational noise compliance monitoring were as follows:

- Conduct operator-attended noise surveys at two locations (F and G) surrounding the Project Site and quantify discernible sources of noise including measured and/or estimated contribution and maximum level of individual sources.
- Conduct unattended noise monitoring at Location G to supplement the operator-attended noise measurements.
- Assess noise emissions of the Project Site with respect to the operational noise goals for the Project Site.

The operational noise compliance monitoring has been prepared with reference to Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in accordance with the Karuah East Quarry Noise Management Plan (NMP) 630.11235-R1 *Karuah East Quarry Project Noise Management Plan* dated October 2015.

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 Sensitive Receptors

The Karuah East Quarry NMP identified the closest sensitive receptors to the Project Site. These locations are listed in **Table 1** and shown in **Figure 1**.

Table 1 Sensitive Receptor Locations Used in this Assessment

Receiver ID	Details
Existing Approved Dwellings	
A	Lot 100 DP 785172
B	Lot 3 DP 785172
C	Lot 2 DP 785172
D	Lot 22 DP 1024341
E	Lot 250 DP 1092111
F	Lot 50 DP 1036893
G	Lot 1 DP 1032636
Other Structures	
Lot 11 ¹	Lot 11 DP1024564

Note 1: No currently approved residential dwelling exists on Lot 11.

Figure 1 Sensitive Receptor Locations – Project Site



Karuah East Quarry - Sensitive Receivers and Monitoring Locations
FIGURE 1

To be printed A4



3 Operational Compliance Criteria

In accordance with the Noise Management Plan, **Table 2** presents the adopted operational noise goals for the Project Site.

Table 2 Operational Noise Criteria (dBA LAeq(15minute))

Location	Criteria (day)
Residence on Lot 11 DP 1024564 ¹	43
A	40
B	37
G	38
All other residences	35

Note 1: No currently approved residential dwelling exists on Lot 11 and therefore it is considered that the noise limits do not currently apply at this location.

3.1 General Methodology

Operator-attended noise surveys were conducted to characterise and quantify the noise emissions from the Project Site. In accordance with the NMP, operator attended noise monitoring was undertaken at two locations, Location F and Location G and unattended noise monitoring undertaken at Location G (refer to **Figure 1**).

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672 2004 “*Electroacoustics – Sound Level Meters*” (parts 1 and 2) and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ± 0.5 dBA.

3.2 Operator Attended Noise Compliance Monitoring

Operator-attended noise measurements were conducted during the daytime period on Thursday 17 May 2018 at the noise monitoring locations F and G. Details of the monitoring locations are provided in **Table 3**

Table 3 Ambient Noise Monitoring Locations

Sound level meter Type/ Serial No.	Location	Location (m, UTM)	
		Easting	Northing
SVAN957 / 27522	Location F – Eastern Boundary of property	405644	6389785
	Location G – North western boundary of property ¹	408055	6389753

Note 1: Noise monitoring conducted at the property gate.

Each operator-attended noise survey was 15 minutes in duration.

3.3 Unattended Continuous Noise Monitoring

An environmental noise logger was deployed at monitoring Location G in accordance with the NMP (refer to **Figure 1**).

Noise monitoring was undertaken from Friday 4 May 2018 to Thursday 17 May 2018, inclusive. Details of the noise loggers used for the unattended continuous noise monitoring are given in **Table 4**.

The environmental noise logger was programmed to record statistical noise level indices continuously in 15 minute intervals.

Table 4 Noise Logger and Noise Monitoring Location

Location	Noise Logger/Serial Number	Date of Logging
G	ARL EL-316-16-004-038	04/05/2018 – 17/05/2018

4 Operator Attended Noise Monitoring Results

4.1 Results of Operator-attended Noise Monitoring

The results of the operator attended noise measurements are given in **Table 5**. Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds, and any other industrial operations. The table provides the following information:

- Monitoring location
- Date, start time, Wind velocity (m/s) and Temperature (°C) at the measurement location
- Typical maximum (L_{Amax}) and contributed noise levels.

Project related noise contributions listed in the tables are stated only when a contribution could be reasonably quantified.

Table 5 Operator Attended Noise Survey Results

Location	Date/ Start time/ Period/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Levels LAmax
		LAmax	LA1	LA10	LA90	LAeq	
F	17/5/2018 12:24 Day 19°C 1.5 m/s SSE	78	62	52	45	53	Local Traffic 62 – 78 Pacific Highway 44 – 46 Birdsong 40 – 53 Karuah East Project Inaudible
G	17/5/2018 10:46 Day 17°C 1.5 m/s SSE	55	52	50	44	47	Pacific Highway 40 – 50 Birds 40 – 41 Frogs 39 - 40 Karuah East Project Audible Jaw Crusher 48 – 54 General processing plant 44 – 47 Estimated LAeq(15minute) Contribution 46 dBA¹

1. Inclusive of 2 dB upward adjustment for low frequency noise.

4.2 Operator-attended Noise Monitoring Summary

Noise generated by traffic on the Pacific Highway and Branch Lane dominated ambient noise levels at noise monitoring Location F, Karuah East Quarry was inaudible. Noise generated by Karuah East Quarry was dominant at Location G with noise generated by traffic on the Pacific Highway as well as insects, birds and frog also contributing to the overall noise levels.

The results of the operational compliance assessment are given in **Table 6**.

Table 6 Compliance Noise Assessment – Operations

Location	Estimated Karuah LAeq(15minute) Contribution	Consent Conditions LAeq(15minute)	Compliance
	Day	Day	Day
F	Inaudible	35	Yes
G	46	38	No

Results presented in **Table 6** indicate that compliance with the relevant consent conditions was not achieved at Location G which was determined to be in exceedance by 8 dBA. Compliance was achieved at Location F.

5 Unattended Continuous Noise Monitoring

The unattended ambient noise logger data from monitoring Location G is presented graphically on a daily basis and attached as **Appendix B**. A summary of the results of the unattended continuous noise monitoring is given in **Table 7**. The ambient noise level data quantifies the overall noise level at a given location independent of its source or character.

Precautions can be taken to minimise influences from extraneous noise sources (eg optimum placement of the loggers away from creeks, trees, houses, etc), however, not all these sources or their effects can be eliminated. This is particularly the case during the warmer times of year when noise from insects, frogs, birds and other animals can become significant.

Weather data was obtained from the Bureau of Meteorology automatic weather station located at Williamstown Airport approximately 22 km south west of the monitoring locations. Unattended noise data corresponding with periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18km/hr) were discarded in accordance with the INP data exclusion methodology.

Table 7 Unattended Continuous Monitoring Ambient Noise Levels (dBA)

NPfl Period	LA1	LA10	LA90	LAeq
Location G				
Daytime	54	49	40	53
Evening	49	46	38	45
Night	48	45	35	44

Given the results of operator attended noise monitoring Karuah East Quarry contributes to overall noise levels at the Location G noise logger during the daytime operational period. However it is noted that other noise sources such as road noise from the Pacific Highway, local road traffic and other noise sources such as birdsong, insects and livestock also contribute to overall noise levels at this location.

6 Conclusion

SLR Consulting Australia Pty Ltd (SLR) has undertaken operational noise compliance monitoring for the Karuah East Project in accordance with the NMP.

Operator-attended noise compliance measurements were conducted during the daytime period on Thursday 17 May 2018 at monitoring locations F and G. Unattended noise monitoring was conducted at Location G from Friday 4 May 2018 to Thursday 17 May 2018 inclusive.

Karuah East Quarry was deemed to be in exceedance of the noise criteria at Location G during the 15-minute operator-attended noise survey. Compliance was achieved at Location F.

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Acoustic Terminology

1 Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that in common usage 'noise' is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	Loud
80	Kerbside of busy street	
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB Linear or dBZ.

3 Sound Power Level

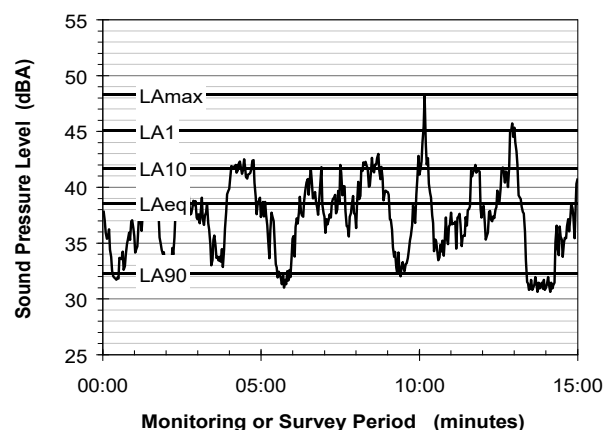
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or Lw, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

- LA1 The noise level exceeded for 1% of the 15 minute interval.
- LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- LAeq The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the 'repeatable minimum' LA90 noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or 'average' levels representative of the other descriptors (LAeq, LA10, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than 'broad band' noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

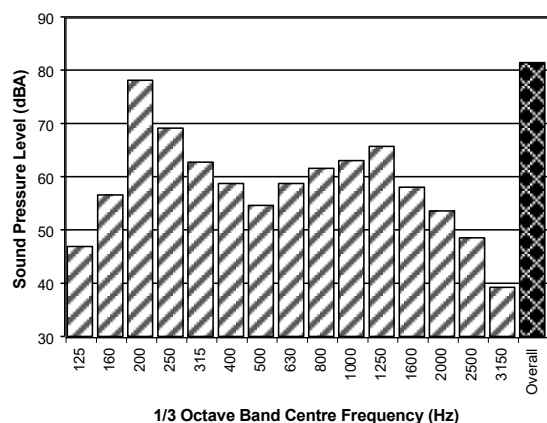
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

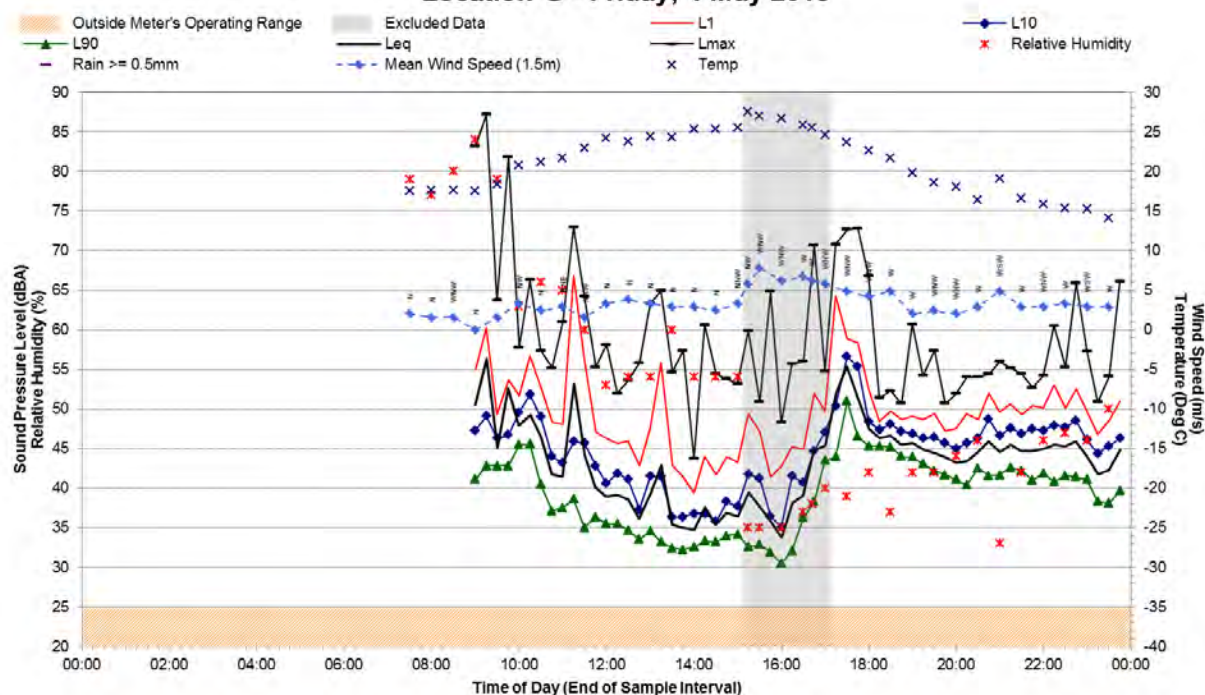
The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



Location G Continuous Statistical Ambient Noise Monitoring Results

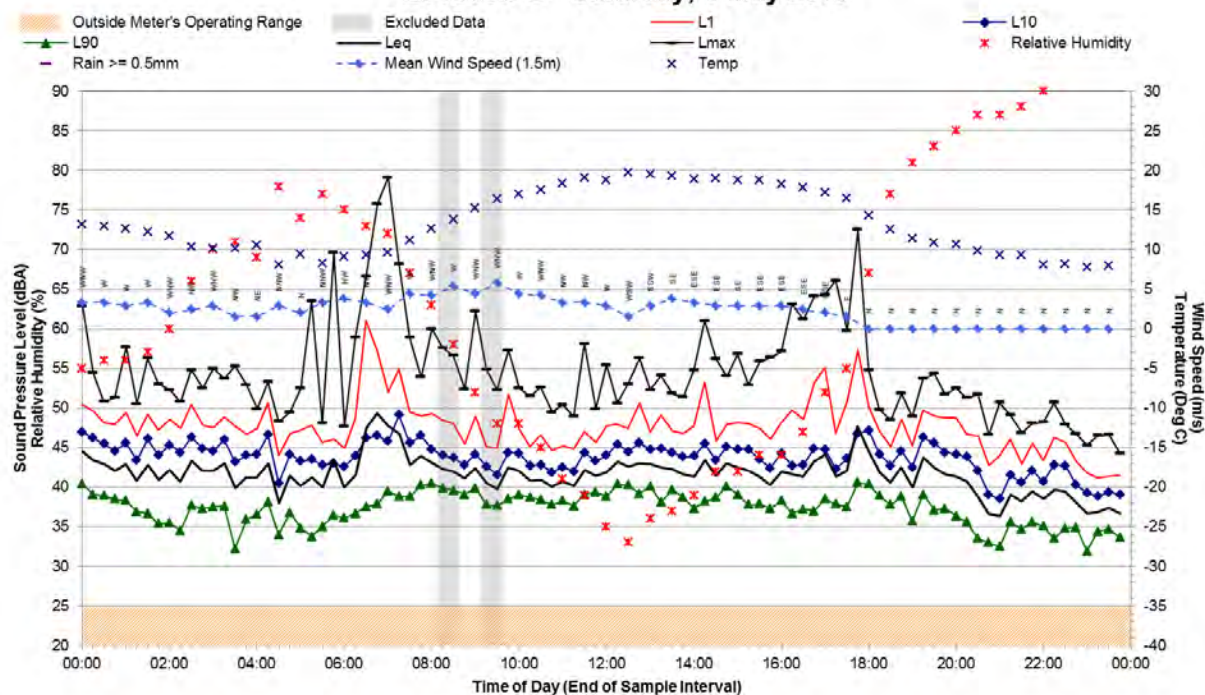
Statistical Ambient Noise Levels

Location G - Friday, 4 May 2018



Statistical Ambient Noise Levels

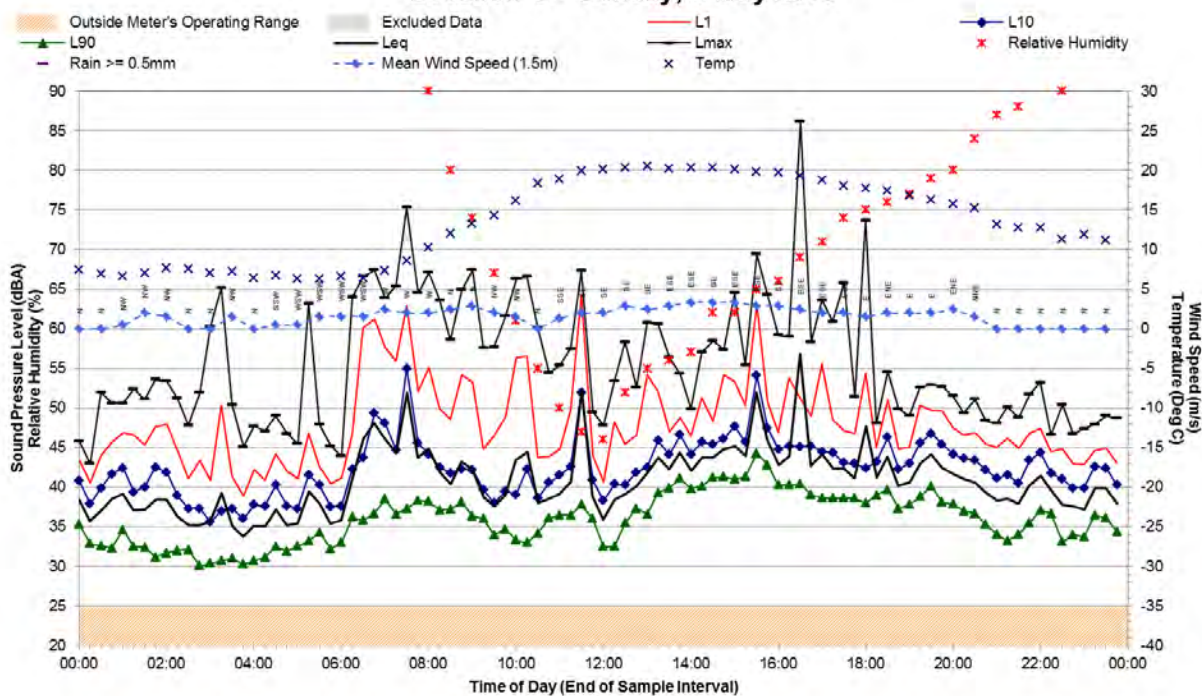
Location G - Saturday, 5 May 2018



Location G Continuous Statistical Ambient Noise Monitoring Results

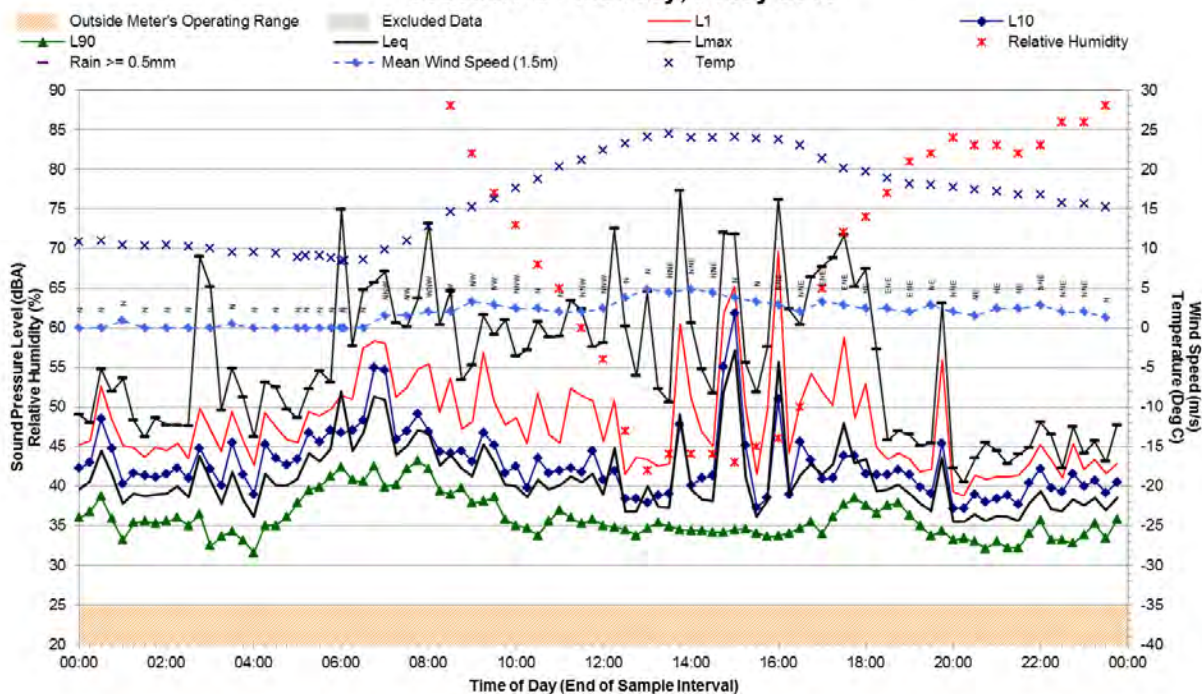
Statistical Ambient Noise Levels

Location G - Sunday, 6 May 2018



Statistical Ambient Noise Levels

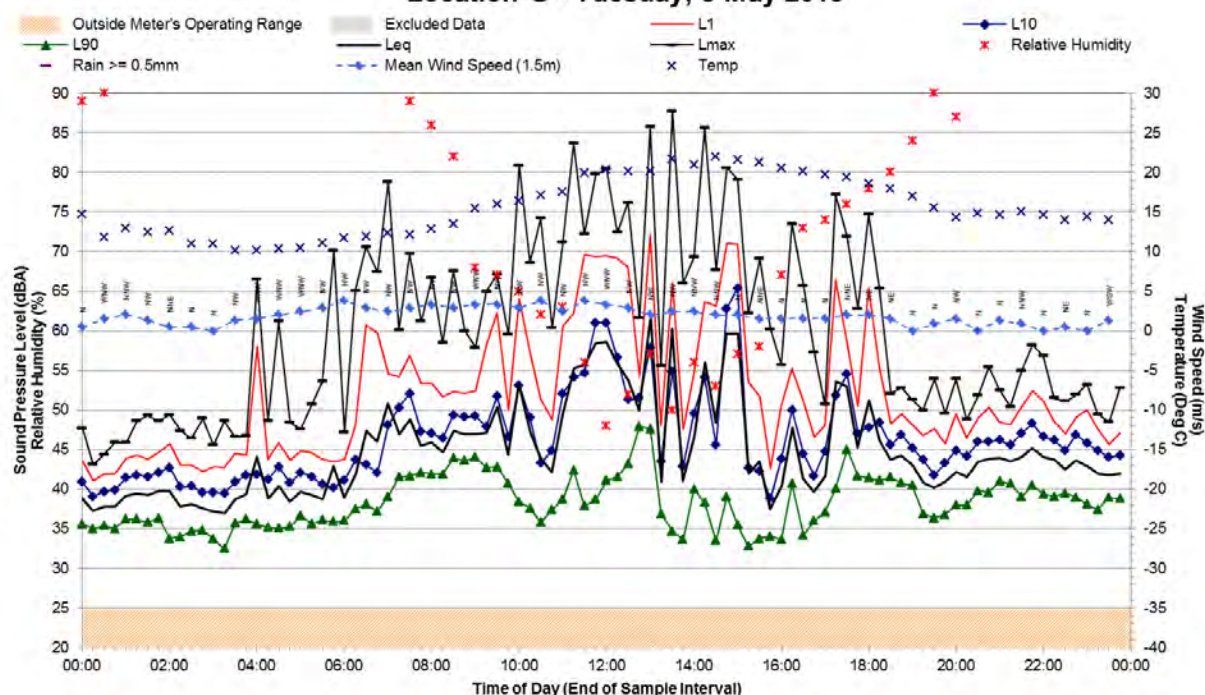
Location G - Monday, 7 May 2018



Location G Continuous Statistical Ambient Noise Monitoring Results

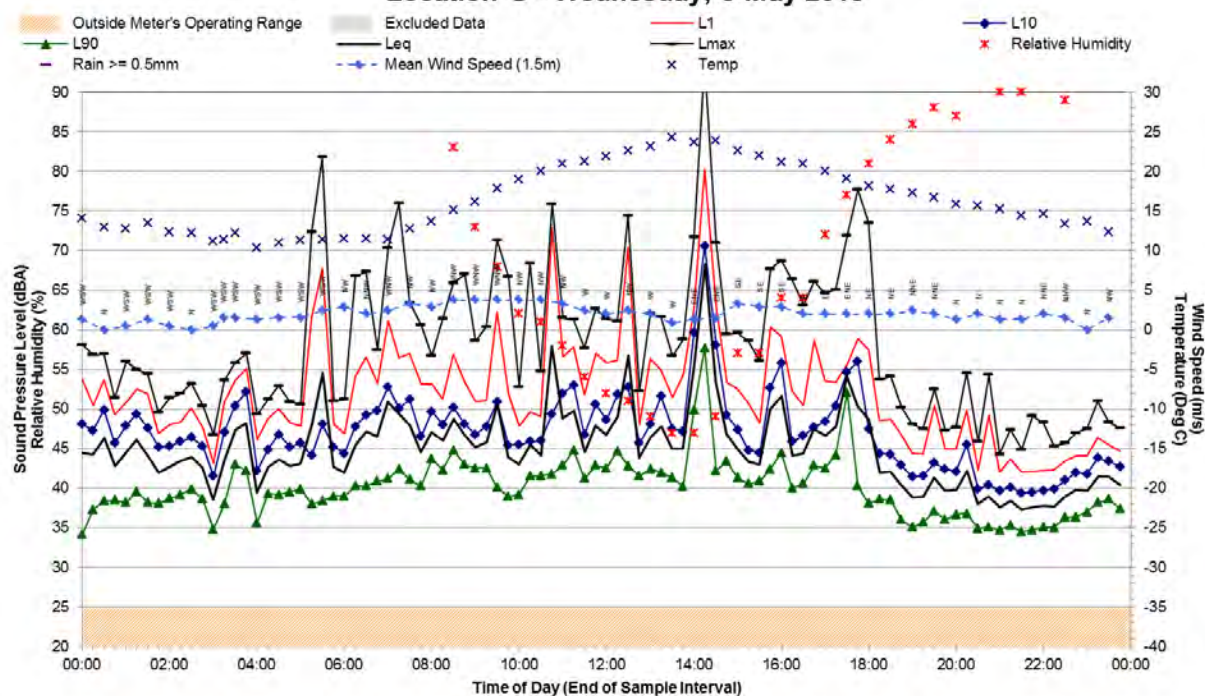
Statistical Ambient Noise Levels

Location G - Tuesday, 8 May 2018



Statistical Ambient Noise Levels

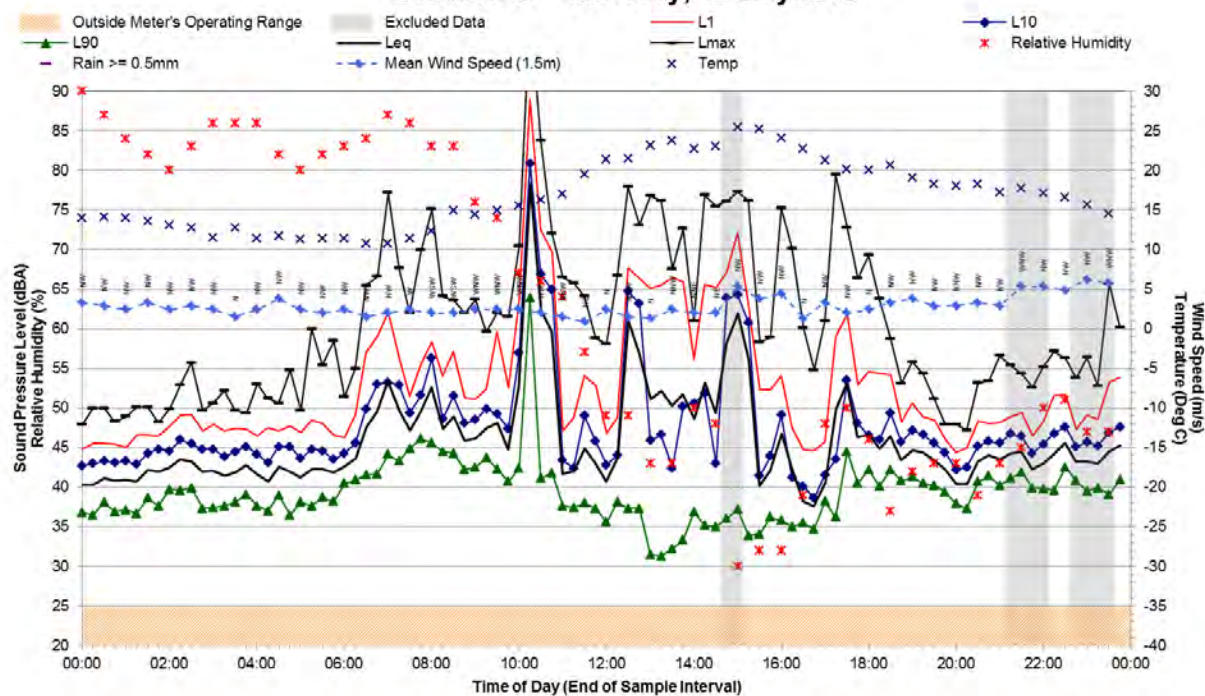
Location G - Wednesday, 9 May 2018



Location G Continuous Statistical Ambient Noise Monitoring Results

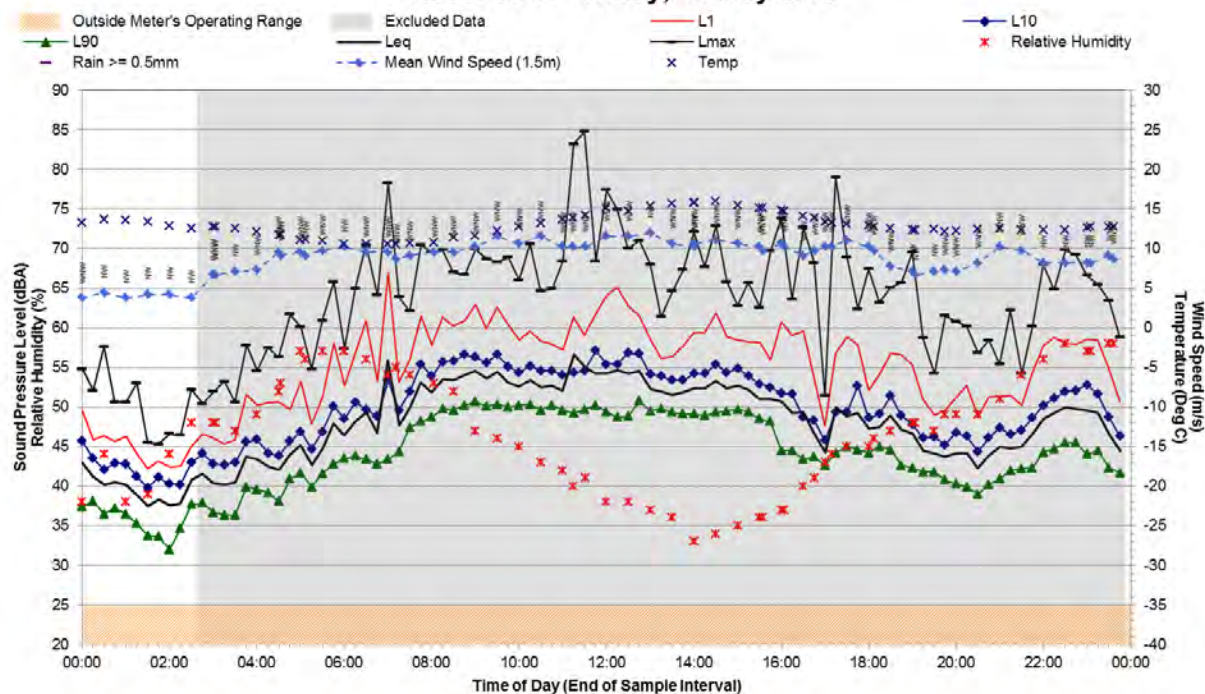
Statistical Ambient Noise Levels

Location G - Thursday, 10 May 2018



Statistical Ambient Noise Levels

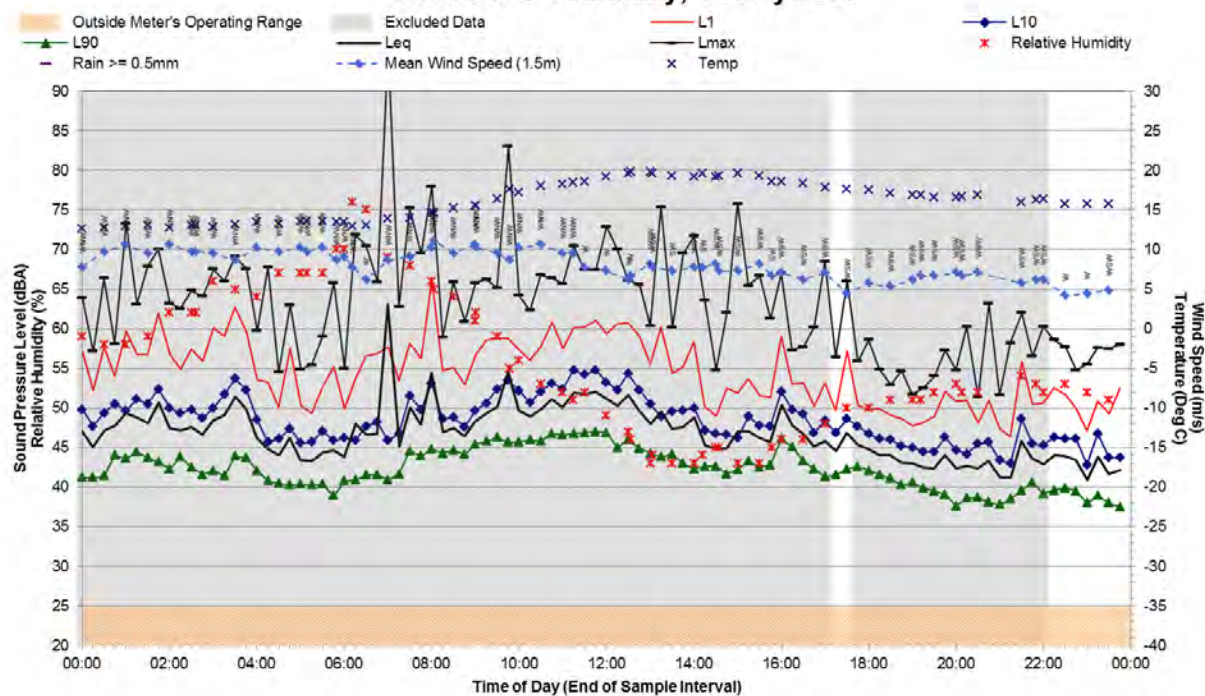
Location G - Friday, 11 May 2018



Location G Continuous Statistical Ambient Noise Monitoring Results

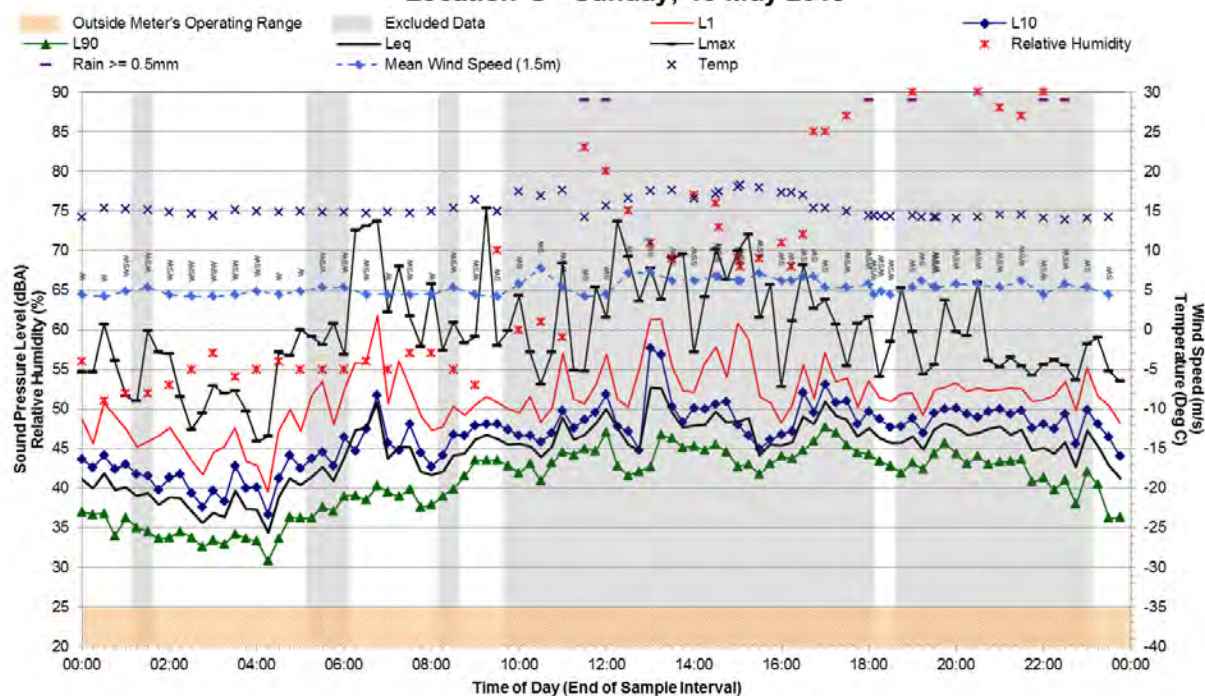
Statistical Ambient Noise Levels

Location G - Saturday, 12 May 2018



Statistical Ambient Noise Levels

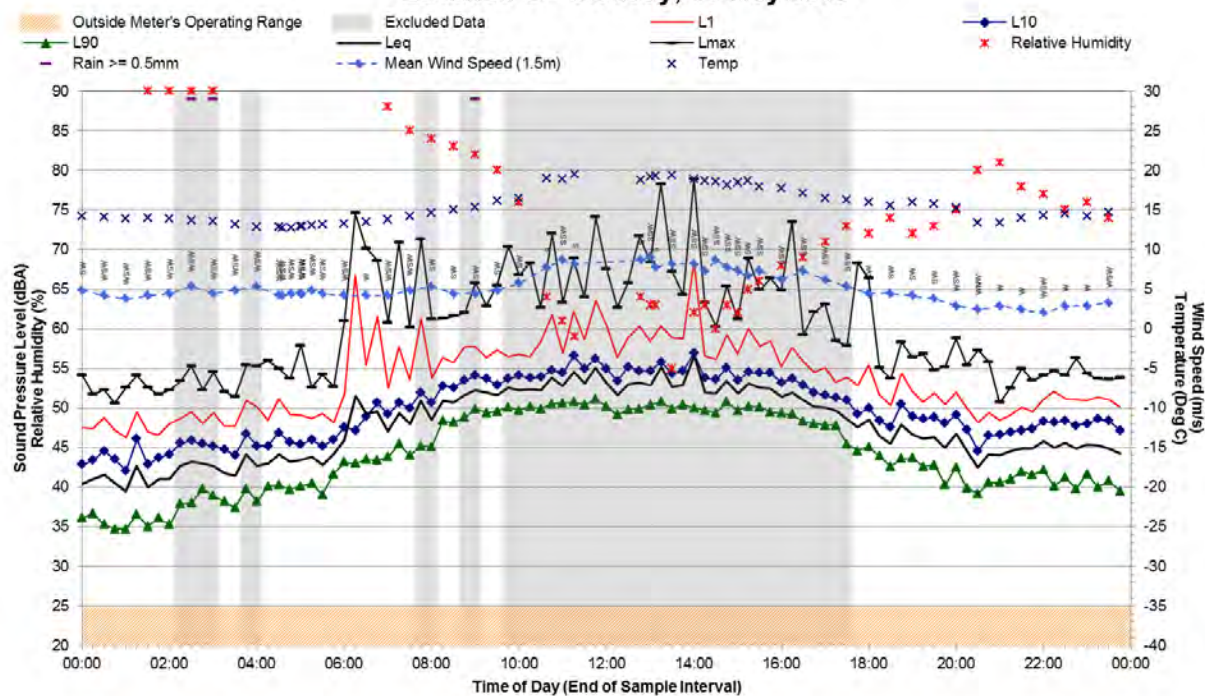
Location G - Sunday, 13 May 2018



Location G Continuous Statistical Ambient Noise Monitoring Results

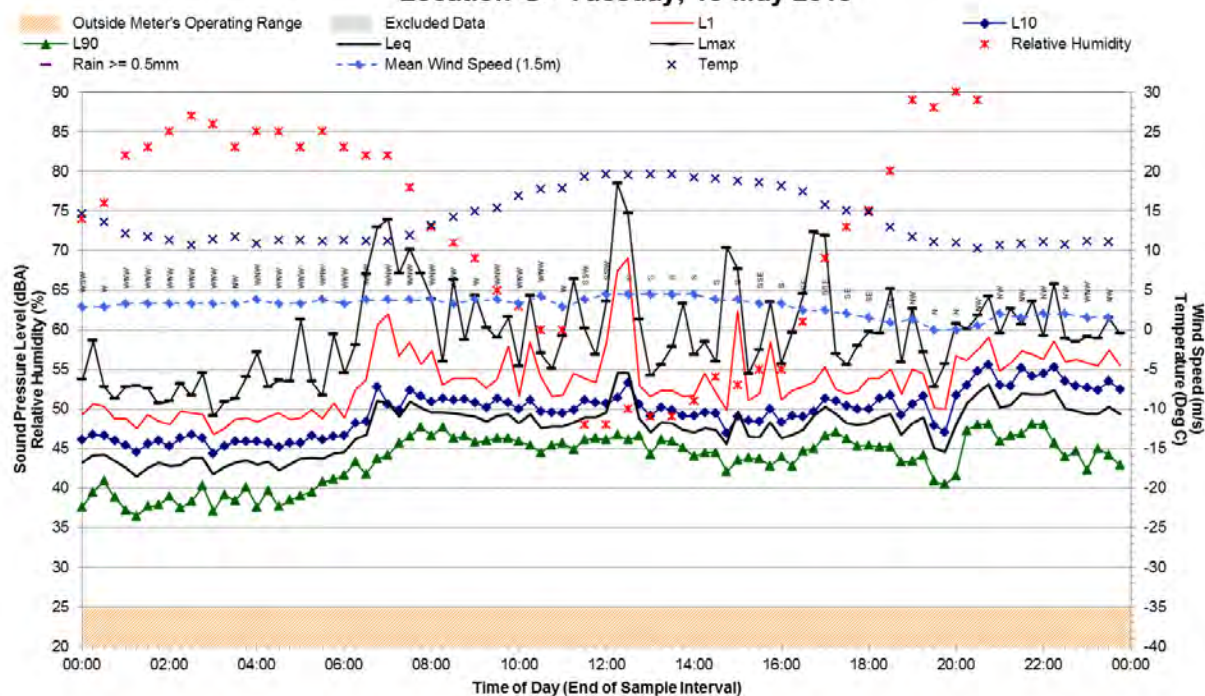
Statistical Ambient Noise Levels

Location G - Monday, 14 May 2018



Statistical Ambient Noise Levels

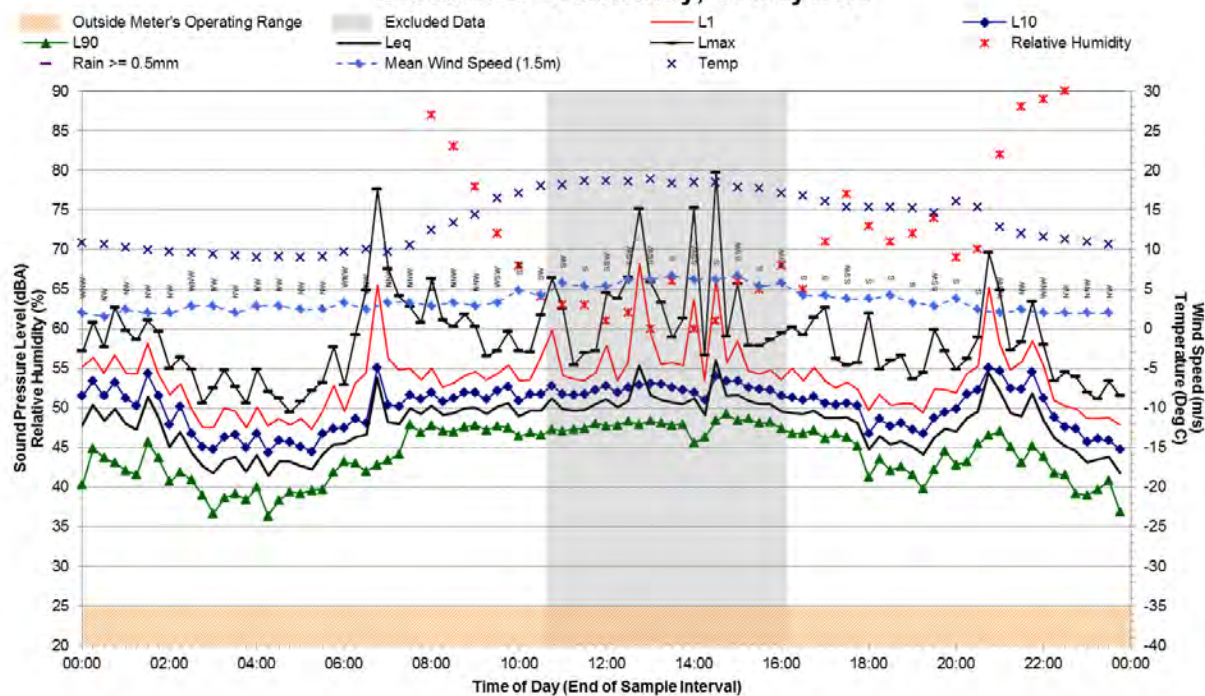
Location G - Tuesday, 15 May 2018



Location G Continuous Statistical Ambient Noise Monitoring Results

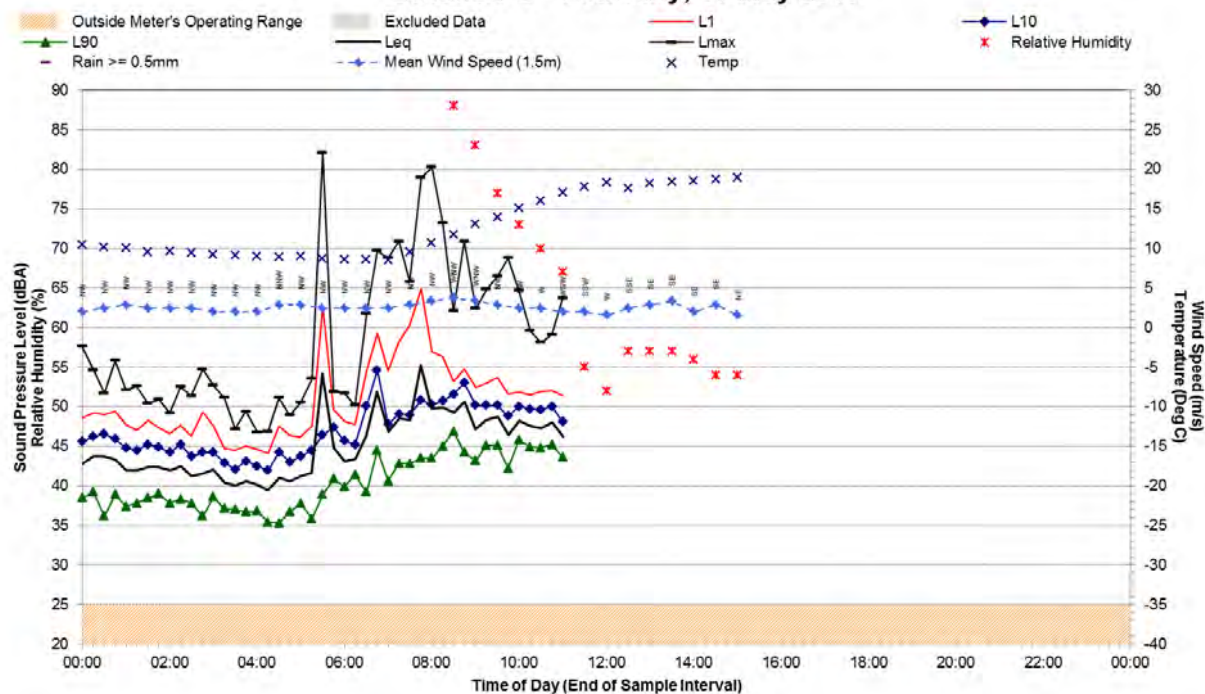
Statistical Ambient Noise Levels

Location G - Wednesday, 16 May 2018



Statistical Ambient Noise Levels

Location G - Thursday, 17 May 2018



OPERATIONAL COMPLIANCE NOISE MONITORING

**Karuah East Quarry
Quarter 3
August 2018**

Prepared for:

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SLR Ref: 630.12317-R04
Version No: -v1.0
September 2018



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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Karuah East Quarry Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.12317-R04-v1.0	4 September 2018	Jordan Murray	Martin Davenport	Martin Davenport

CONTENTS

1	INTRODUCTION.....	5
2	SENSITIVE RECEPTORS	6
3	OPERATIONAL COMPLIANCE CRITERIA	8
3.1	General Methodology.....	8
3.2	Operator Attended Noise Compliance Monitoring	9
3.3	Unattended Continuous Noise Monitoring	9
4	OPERATOR ATTENDED NOISE MONITORING RESULTS	10
4.1	Results of Operator-attended Noise Monitoring.....	10
4.1.1	Predicted Noise Levels at Receiver Locations A & B	11
4.2	Operator-attended Noise Monitoring Summary	11
5	UNATTENDED CONTINUOUS NOISE MONITORING	12
6	CONCLUSION	12

DOCUMENT REFERENCES

TABLES

Table 1	Sensitive Receptor Locations Used in this Assessment.....	6
Table 2	Operational Noise Criteria (dBA LAeq(15minute)).....	8
Table 3	Ambient Noise Monitoring Locations.....	9
Table 4	Noise Logger and Noise Monitoring Location	9
Table 5	Operator Attended Noise Survey Results.....	10
Table 6	Predicted Noise Levels at Receivers A & B	11
Table 7	Compliance Noise Assessment – Operations	11
Table 8	Unattended Continuous Monitoring Ambient Noise Levels (dBA)	12

FIGURES

Figure 1	Sensitive Receptor Locations – Project Site	7
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CONTENTS

APPENDICES

Appendix A Acoustic Terminology

Appendix B Statistical Ambient Noise Monitoring Results – Location G (Property Gate)

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Karuah East Quarry Pty Ltd to conduct operational compliance noise monitoring for the Karuah East Quarry located on Lots 12 and 13 DP 1024564, off the Pacific Highway, approximately 3 km north of Karuah, New South Wales (NSW) (the Project Site). Karuah East Quarry currently operates from 7 am to 6 pm Monday – Friday and 8 am to 12 pm on Saturdays.

The objectives of the operational noise compliance monitoring were as follows:

- Conduct operator-attended noise surveys at two locations (F and G) surrounding the Project Site and quantify discernible sources of noise including measured and/or estimated contribution and maximum level of individual sources.
- Conduct an operator attended noise survey close to the Project Site to enable the calculation of Project Site noise levels at locations A and B. Calculated noise levels can then be used to determine the likely compliance at these residential receiver locations.
- Conduct unattended noise monitoring at Location G to supplement the operator-attended noise measurements.
- Conduct an additional operator attended survey at the property gate of Location G.
- Assess noise emissions of the Project Site with respect to the operational noise goals for the Project Site.

The operational noise compliance monitoring has been prepared with reference to Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in accordance with the Karuah East Quarry Noise Management Plan (NMP) 630.11235-R1 *Karuah East Quarry Project Noise Management Plan* dated October 2015.

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

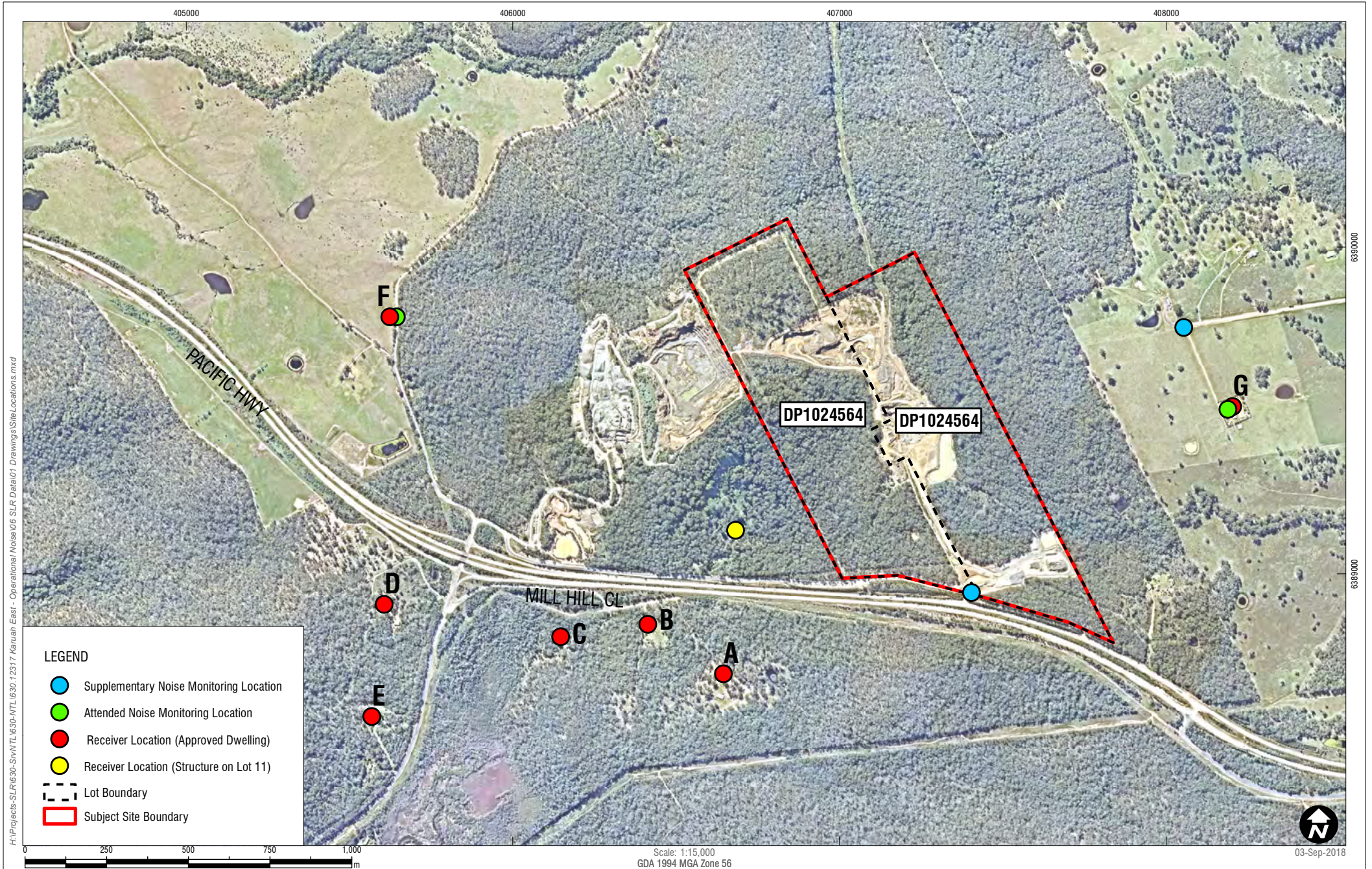
2 Sensitive Receptors

The Karuah East Quarry NMP identified the closest sensitive receptors to the Project Site. These locations are listed in **Table 1** and shown in **Figure 1**.

Table 1 Sensitive Receptor Locations Used in this Assessment

Receiver ID	Details
Existing Approved Dwellings	
A	Lot 100 DP 785172
B	Lot 3 DP 785172
C	Lot 2 DP 785172
D	Lot 22 DP 1024341
E	Lot 250 DP 1092111
F	Lot 50 DP 1036893
G	Lot 1 DP 1032636
Other Structures	
Lot 11 ¹	Lot 11 DP1024564

Note 1: No currently approved residential dwelling exists on Lot 11.



3 Operational Compliance Criteria

In accordance with the Noise Management Plan, **Table 2** presents the adopted operational noise goals for the Project Site.

Table 2 Operational Noise Criteria (dBA LAeq(15minute))

Location	Criteria (day)
Residence on Lot 11 DP 1024564 ¹	43
A	40
B	37
G	38
All other residences	35

Note 1: No currently approved residential dwelling exists on Lot 11 and therefore it is considered that the noise limits do not currently apply at this location.

3.1 General Methodology

Operator-attended noise surveys were conducted to characterise and quantify the noise emissions from the Project Site. In accordance with the NMP, operator attended noise monitoring was undertaken at two locations, Location F and Location G and unattended noise monitoring undertaken at Location G (refer to **Figure 1**).

Supplementary noise monitoring was conducted at the gate of Location G and at the Project Site weighbridge.

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672 2004 *"Electroacoustics – Sound Level Meters"* (parts 1 and 2) and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ± 0.5 dBA.

Unless otherwise noted all operator-attended noise surveys were conducted for 15 minutes in duration.

3.2 Operator Attended Noise Compliance Monitoring

Operator-attended noise measurements were conducted during the daytime period on Tuesday 14 August 2018. Details of the monitoring locations are provided in **Table 3**.

Table 3 Ambient Noise Monitoring Locations

Sound level meter Type/ Serial No.	Location	Location (m, UTM)	
		Easting	Northing
Bruel & Kjaer 2270 / 2679354	Location F – Eastern Boundary of property.	405644	6389785
	Location G – North western boundary of property ¹ .	408055	6389753
	Location G – Conducted at dwelling.	408190	6389502
	Project Site – Conducted at Karuah East Quarry weighbridge.	407405	6388942

Note 1: Noise monitoring conducted at the property gate.

3.3 Unattended Continuous Noise Monitoring

An environmental noise logger was deployed at the gate of monitoring Location G (refer to **Figure 1**).

Noise monitoring was undertaken from Tuesday 14 August 2018 to Tuesday 21 August 2018, inclusive. Details of the noise loggers used for the unattended continuous noise monitoring are given in **Table 4**.

The environmental noise logger was programmed to record statistical noise level indices continuously in 15 minute intervals.

Table 4 Noise Logger and Noise Monitoring Location

Location	Noise Logger/Serial Number	Date of Logging
G	ARL EL-316-16-203-505	14/08/2018 – 21/08/2018

4 Operator Attended Noise Monitoring Results

4.1 Results of Operator-attended Noise Monitoring

The results of the operator attended noise measurements are given in **Table 5**. Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds, and any other industrial operations. The table provides the following information:

- Monitoring location
- Date, start time, Wind velocity (m/s) and Temperature (°C) at the measurement location
- Typical maximum (L_{Amax}) and contributed noise levels.

Project related noise contributions listed in the tables are stated only when a contribution could be reasonably quantified.

Table 5 Operator Attended Noise Survey Results

Location	Date/ Start time/ Period/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Levels L _{Amax}
		L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
F	14/8/2018 11:14 Day 18°C 2 m/s WSW	80	65	51	43	54	Local Traffic 62 – 80 Pacific Highway 40 – 44 Birdsong 45 – 53 Karuah East Project Inaudible
G (NMP Monitoring Location)	14/8/2018 09:59 Day 14°C 2 m/s WSW	75	52	50	46	49	Birds 48 – 49 Domestic noise 62 – 75 Pacific Highway 46 – 51 Karuah East Project Audible Jaw Crusher 49 – 51 Reverse beeper 49 – 50 General processing plant 45 – 51 Estimated LAeq(15minute) Contribution 47 dBA
G (property gate)	14/8/2018 09:34 Day 14°C 2 m/s WSW	66	55	52	47	50	Local traffic 50 – 66 Birds 40 – 41 Karuah East Project Audible Jaw Crusher 50 – 53 General processing plant 48 – 53 Estimated LAeq(15minute) Contribution 49 dBA
Project Site (weighbridge)	14/8/2018 10:44 Day 17°C 2 m/s SW	77	74	64	57	63	Pacific Highway 59 – 65 Karuah East Project Audible Truck on weighbridge 57 – 61 Truck pass-by 74 – 77 General processing plant 45 – 50 Estimated LAeq(15minute) Contribution 56 dBA

4.1.1 Predicted Noise Levels at Receiver Locations A & B

In accordance with **Section 8.3.1** of the NMP operator-attended noise monitoring was conducted at the Project Site (refer **Figure 1** and “Project Site” in **Table 5**). The purpose of this measurement was to enable the calculation of Project Site noise levels at locations A and B. Calculated noise levels can then be used to determine the likely compliance at these residential receiver locations.

The results from the calculation of likely noise levels at receivers A and B are contained in **Table 6**. Calculations include the local topography as well as the distance from the Project Site noise sources to the receivers.

Table 6 Predicted Noise Levels at Receivers A & B

Location	Estimated noise level at receiver (LAeq(15minute))	Criteria (LAeq(15minute))
A	33 dBA	40 dBA
B	32 dBA	37 dBA

4.2 Operator-attended Noise Monitoring Summary

Noise generated by traffic on the Pacific Highway and Branch Lane dominated ambient noise levels at noise monitoring Location F, Karuah East Quarry was inaudible. Noise generated by Karuah East Quarry was dominant at Location G with noise generated by traffic on the Pacific Highway as well as insects, birds and frog also contributing to the overall noise levels.

The results of the operational compliance assessment are given in **Table 7**.

Table 7 Compliance Noise Assessment – Operations

Location	Estimated Karuah LAeq(15minute) Contribution	Consent Conditions LAeq(15minute)	Compliance
	Day	Day	Day
A	33 dBA	40 dBA	Yes
B	32 dBA	37 dBA	Yes
F	Inaudible	35 dBA	Yes
G (NMP Monitoring Location)	47 dBA	38 dBA	No
G (property gate)	49 dBA	38 dBA	No

Results presented in **Table 7** indicate that compliance with the relevant consent conditions was not achieved at Location G which was determined to be in exceedance by 9 dBA. Compliance was achieved at Locations F and considered likely to have been achieved at Locations A & B.

5 Unattended Continuous Noise Monitoring

The unattended ambient noise logger data from monitoring Location G is presented graphically on a daily basis and attached as **Appendix B**. Due to a lack of property access the noise logger was placed at the property gate. A summary of the results of the unattended continuous noise monitoring is given in **Table 8**. The ambient noise level data quantifies the overall noise level at a given location independent of its source or character.

Precautions can be taken to minimise influences from extraneous noise sources (eg optimum placement of the loggers away from creeks, trees, houses, etc), however, not all these sources or their effects can be eliminated. This is particularly the case during the warmer times of year when noise from insects, frogs, birds and other animals can become significant.

Weather data was obtained from the automatic weather station located at Karuah East Quarry. Unattended noise data corresponding with periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18km/hr) were discarded in accordance with the INP data exclusion methodology.

Table 8 Unattended Continuous Monitoring Ambient Noise Levels (dBA)

INP Period	LA1	LA10	LA90	LAeq
Location G				
Daytime	55	51	39	53
Evening	51	47	38	46
Night	48	45	35	45

Given the results of operator attended noise monitoring Karuah East Quarry contributes to overall noise levels at the Location G noise logger during the daytime operational period. However it is noted that other noise sources such as road noise from the Pacific Highway, local road traffic and other noise sources such as birdsong, insects and livestock also contribute to overall noise levels at this location.

6 Conclusion

SLR Consulting Australia Pty Ltd (SLR) has undertaken operational noise compliance monitoring for the Karuah East Project in accordance with the NMP.

Operator-attended noise compliance measurements were conducted during the daytime period on Tuesday 14 August 2018 at monitoring locations F and G. Further operator-attended monitoring was conducted at the Location G dwelling and the Project Site. Likely noise levels were calculated to receivers A & B.

Unattended noise monitoring was conducted at Location G from Tuesday 14 August 2018 to Tuesday 21 August 2018 inclusive.

Karuah East Quarry was deemed to be in exceedance of the noise criteria at Location G during the 15-minute operator-attended noise survey. Compliance was achieved at Location F and considered likely to have been achieved at Locations A & B.

APPENDIX A

Acoustic Terminology

1 Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that in common usage 'noise' is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_p are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB Linear or dBZ.

3 Sound Power Level

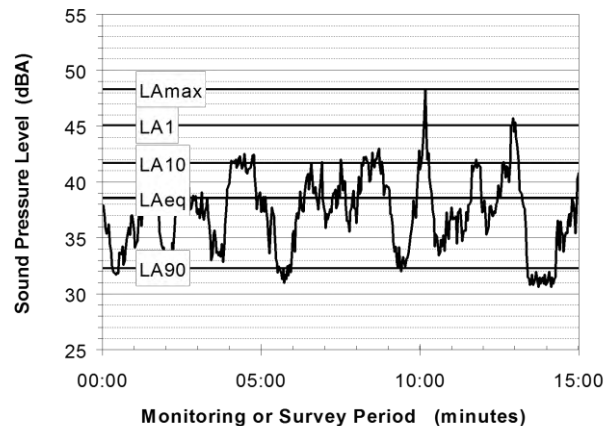
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_w , or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN} , where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA_1 is the noise level exceeded for 1% of the time, LA_{10} the noise level exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

- LA_1 The noise level exceeded for 1% of the 15 minute interval.
- LA_{10} The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- LA_{90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- LA_{eq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the 'repeatable minimum' LA_{90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or 'average' levels representative of the other descriptors (LA_{eq} , LA_{10} , etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than 'broad band' noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

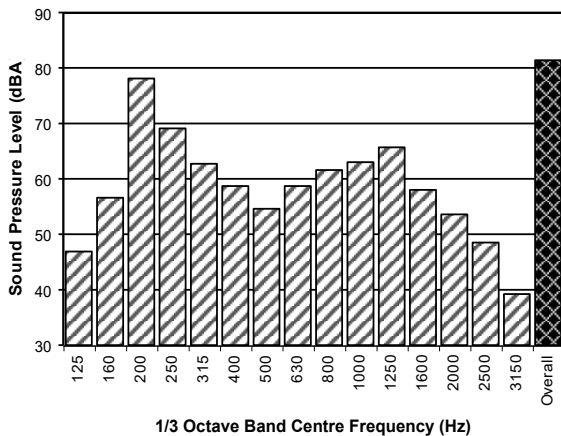
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of “peak” velocity or “rms” velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as “peak particle velocity”, or PPV. The latter incorporates “root mean squared” averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V , expressed in mm/s can be converted to decibels by the formula $20 \log (V/V_0)$, where V_0 is the reference level (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organizations.

9 Human Perception of Vibration

People are able to “feel” vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as “normal” in a car, bus or train is considerably higher than what is perceived as “normal” in a shop, office or dwelling.

10 Over-Pressure

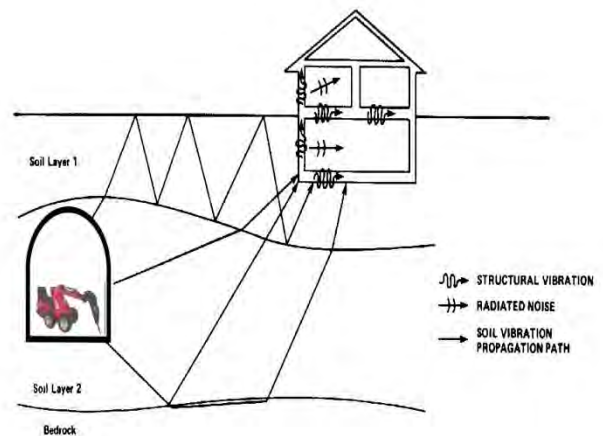
The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed “regenerated noise”, “structure-borne noise”, or sometimes “ground-borne noise”. Regenerated noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of regenerated noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and regenerated noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



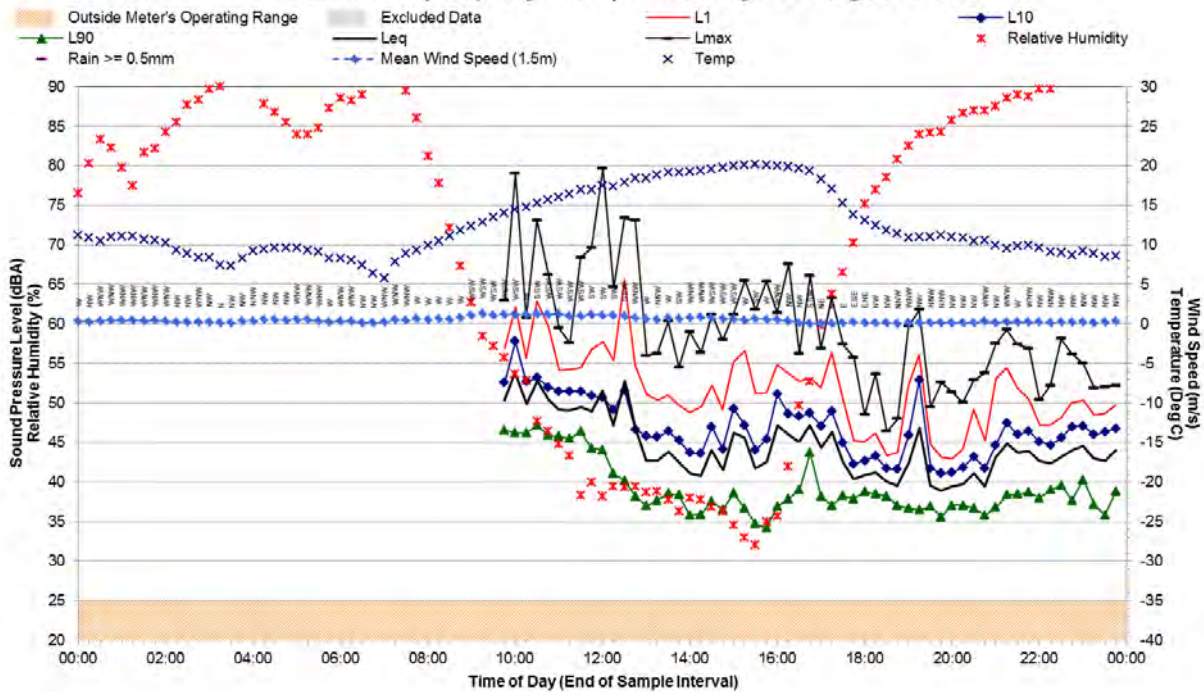
The term “regenerated noise” is also used to describe other types of noise that are emitted from the primary source as a different form of energy. One example would be a fan with a silencer, where the fan is the energy source and primary noise source. The silencer may effectively reduce the fan noise, but some additional noise may be created by the aerodynamic effect of the silencer in the airstream. This “secondary” noise may be referred to as regenerated noise.

APPENDIX B

Statistical Ambient Noise Monitoring Results Location G (Property Gate)

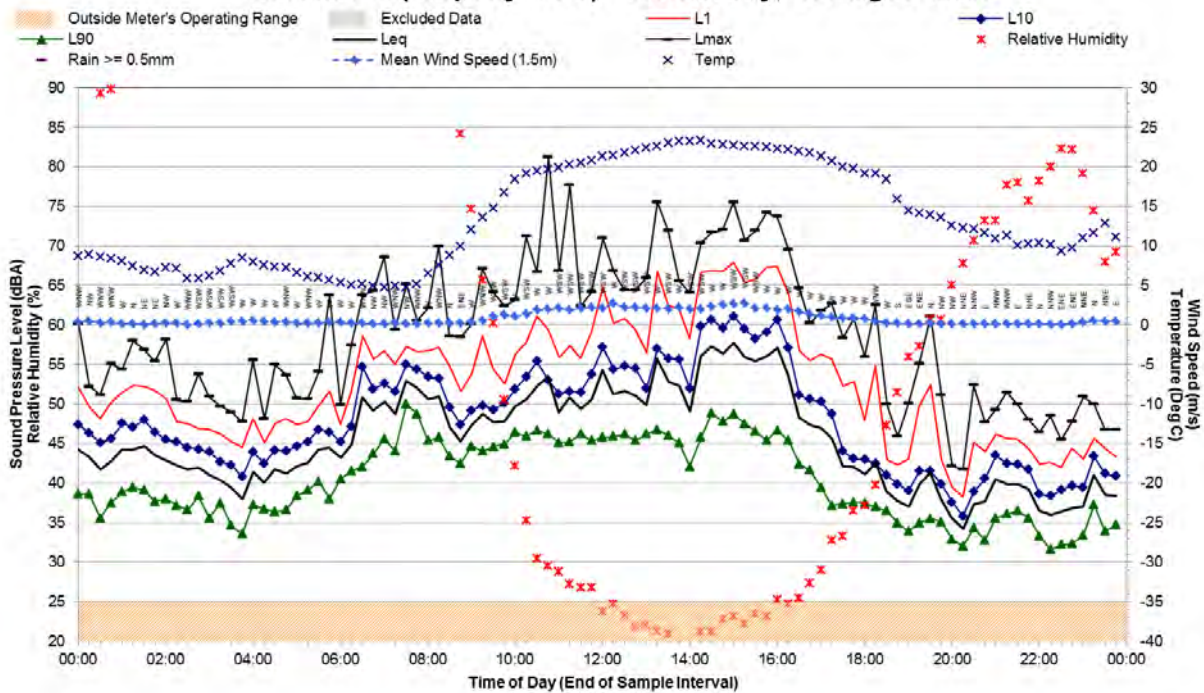
Statistical Ambient Noise Levels

Location G (Property Gate) - Tuesday, 14 August 2018



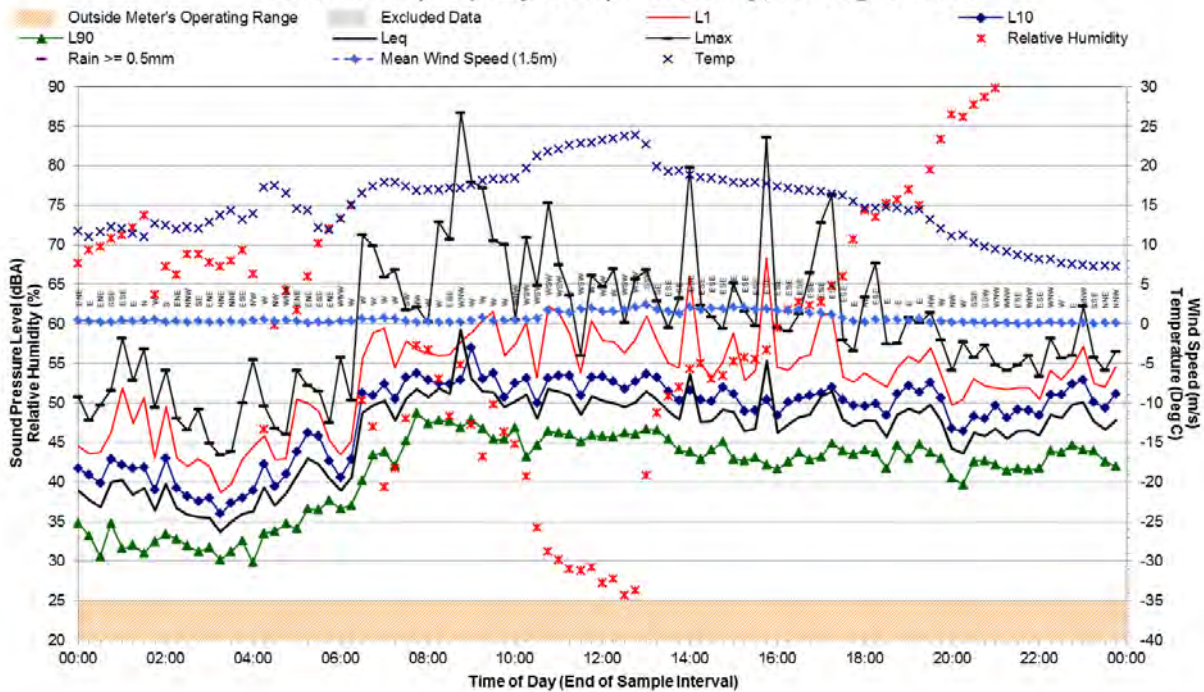
Statistical Ambient Noise Levels

Location G (Property Gate) - Wednesday, 15 August 2018



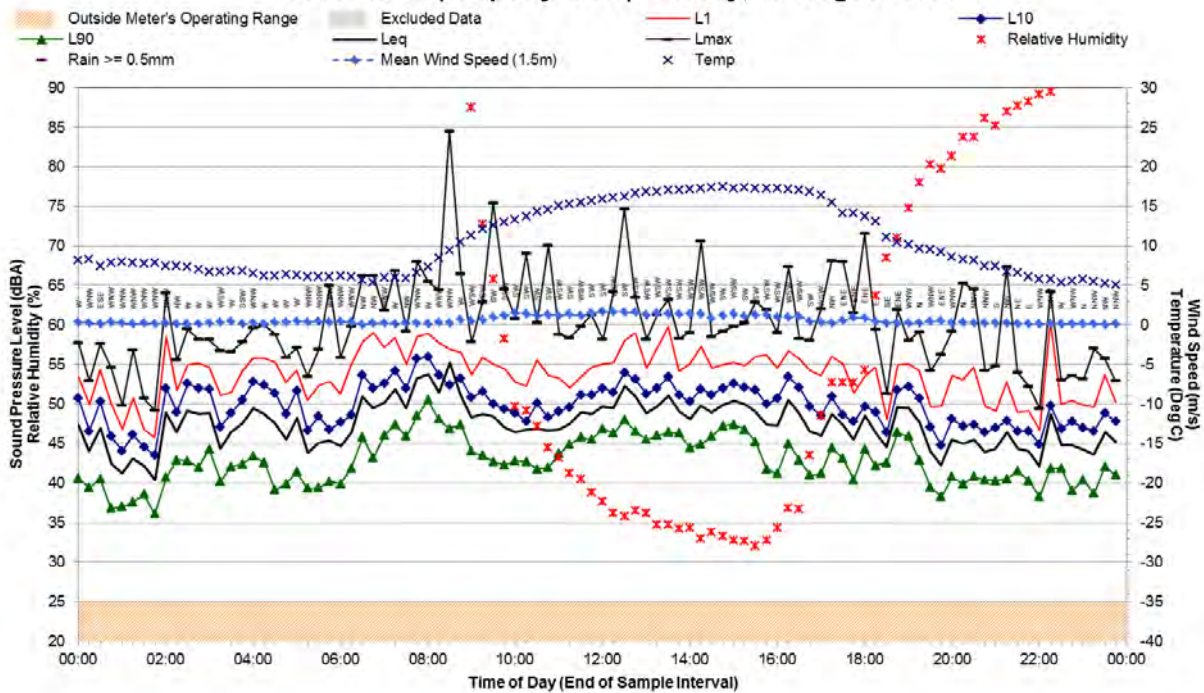
Statistical Ambient Noise Levels

Location G (Property Gate) - Thursday, 16 August 2018

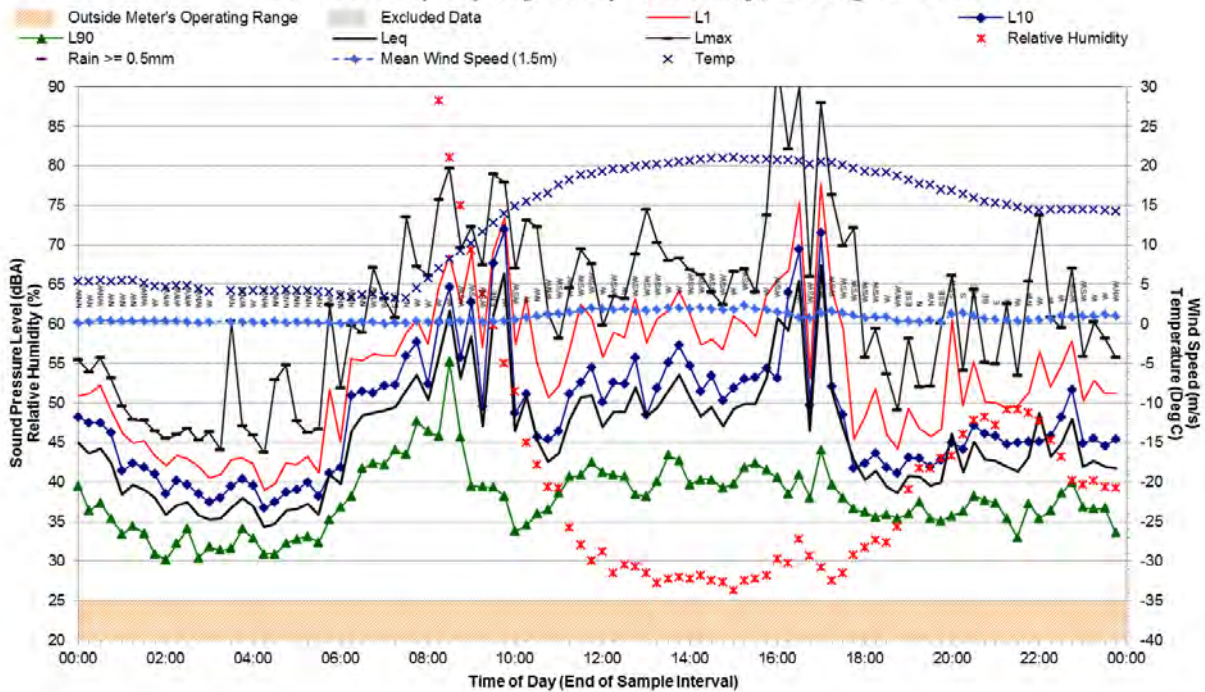


Statistical Ambient Noise Levels

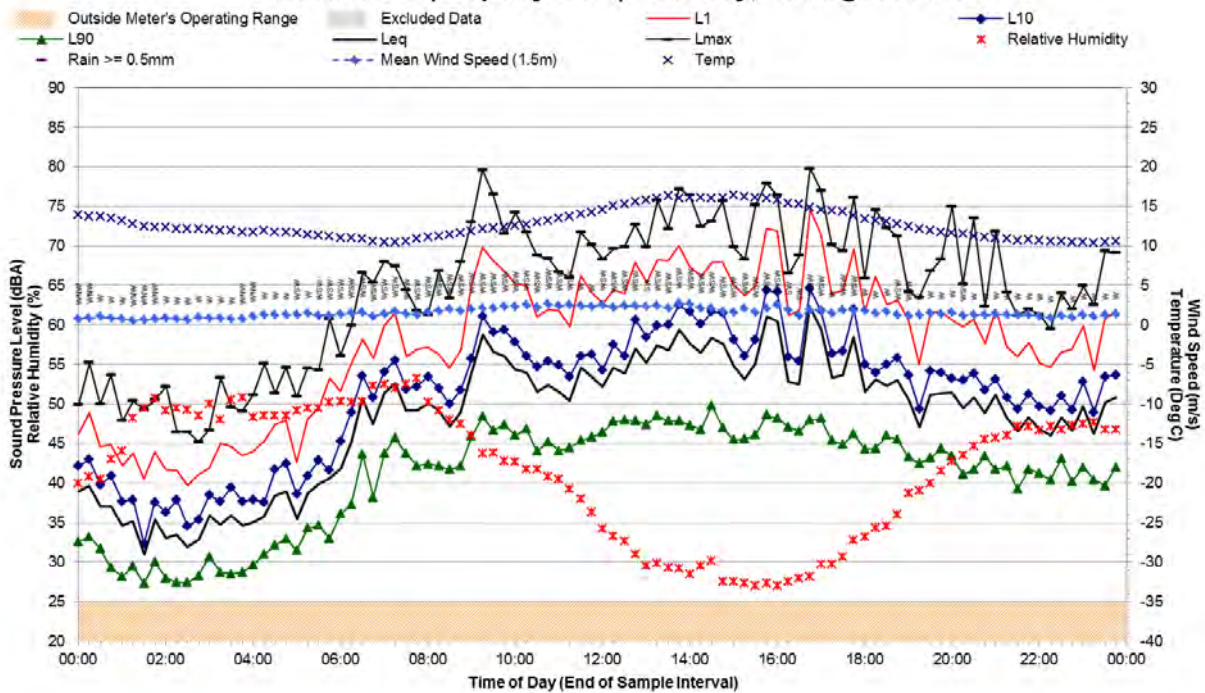
Location G (Property Gate) - Friday, 17 August 2018



Statistical Ambient Noise Levels Location G (Property Gate) - Saturday, 18 August 2018

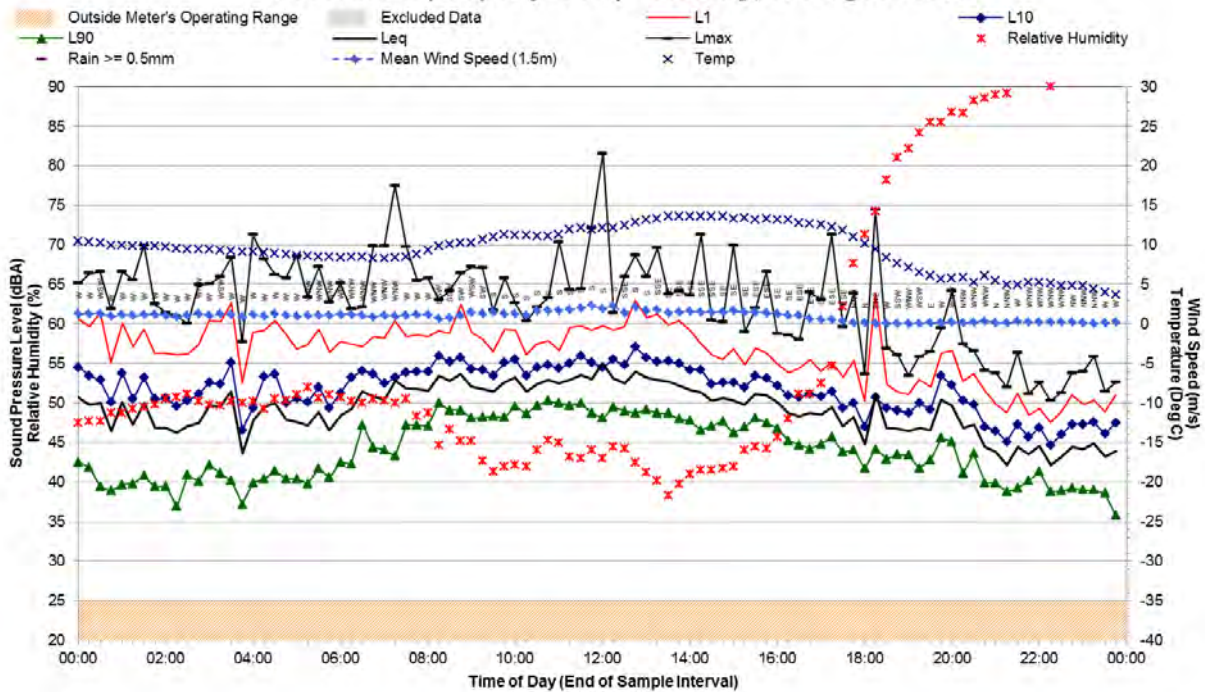


Statistical Ambient Noise Levels Location G (Property Gate) - Sunday, 19 August 2018



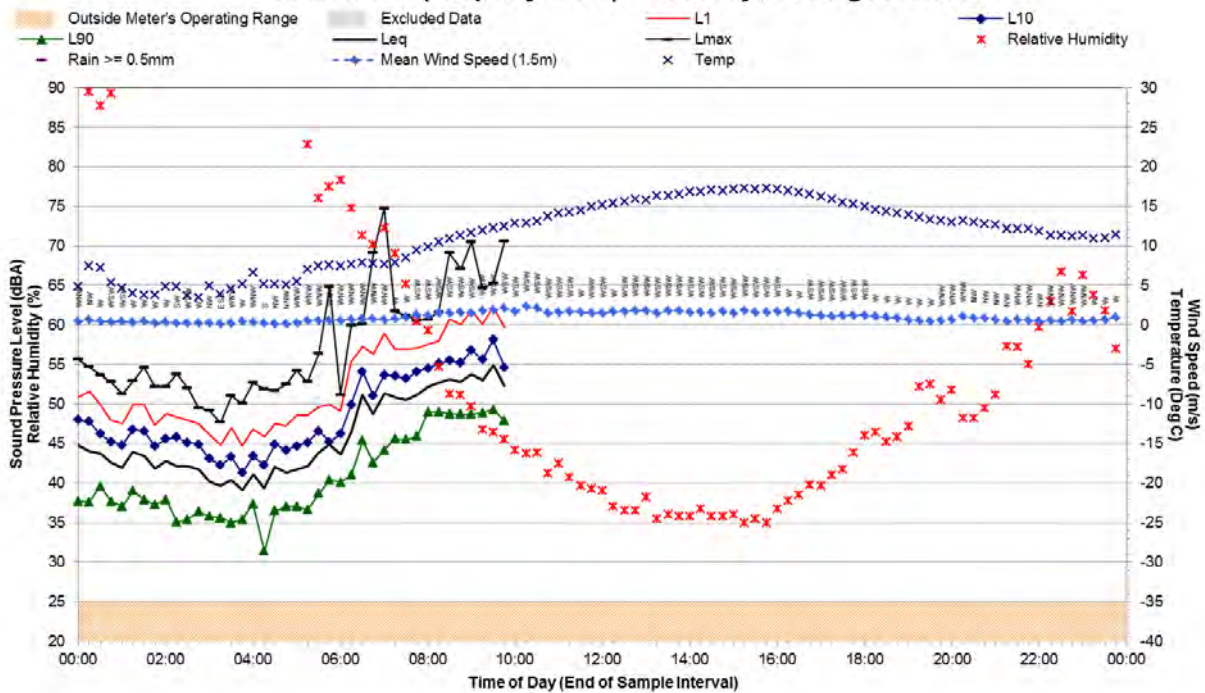
Statistical Ambient Noise Levels

Location G (Property Gate) - Monday, 20 August 2018



Statistical Ambient Noise Levels

Location G (Property Gate) - Tuesday, 21 August 2018



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OPERATIONAL COMPLIANCE NOISE MONITORING

**Karuah East Quarry
Quarter 4
November 2018**

Prepared for:

Karuah East Quarry Pty Ltd
PO Box 23
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SLR Ref: 630.12317-R05
Version No: -v1.0
March 2019



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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Karuah East Quarry Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.12317-R05-v1.0	4 March 2019	Jordan Murray	Robert Hall	

CONTENTS

1	INTRODUCTION.....	4
2	SENSITIVE RECEPTORS.....	5
3	OPERATIONAL COMPLIANCE CRITERIA.....	7
3.1	General Methodology.....	7
3.2	Operator Attended Noise Compliance Monitoring.....	8
3.3	Unattended Continuous Noise Monitoring.....	8
4	OPERATOR ATTENDED NOISE MONITORING RESULTS	9
4.1	Results of Operator-attended Noise Monitoring.....	9
4.1.1	Predicted Noise Levels at Receiver Locations A & B.....	9
5	UNATTENDED CONTINUOUS NOISE MONITORING	10
6	CONCLUSION	10

DOCUMENT REFERENCES

TABLES

Table 1	Sensitive Receptor Locations Used in this Assessment.....	5
Table 2	Operational Noise Criteria (dBA LAeq(15minute)).....	7
Table 3	Ambient Noise Monitoring Locations.....	8
Table 4	Noise Logger and Noise Monitoring Location	8
Table 5	Operator Attended Noise Survey Results.....	9
Table 6	Unattended Continuous Monitoring Ambient Noise Levels (dBA)	10

FIGURES

Figure 1	Sensitive Receptor Locations – Project Site	6
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APPENDICES

Appendix A Acoustical Terminology

Appendix B Statistical Ambient Noise Monitoring Results – Location G (Property Gate)

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Karuah East Quarry Pty Ltd to conduct operational compliance noise monitoring for the Karuah East Quarry located on Lots 12 and 13 DP 1024564, off the Pacific Highway, approximately 3 km north of Karuah, New South Wales (NSW) (the Project Site). Karuah East Quarry currently operates from 7 am to 6 pm Monday – Friday and 8 am to 12 pm on Saturdays.

The objectives of the operational noise compliance monitoring were as follows:

- Conduct operator-attended noise surveys at two locations (F and G) surrounding the Project Site and quantify discernible sources of noise including measured and/or estimated contribution and maximum level of individual sources.
- Conduct an operator attended noise survey close to the Project Site to enable the calculation of Project Site noise levels at locations A and B. Calculated noise levels can then be used to determine compliance at these residential receiver locations.
- Conduct unattended noise monitoring at Location G to supplement the operator-attended noise measurements.
- Assess noise emissions of the Project Site with respect to the operational noise goals for the Project Site.

The operational noise compliance monitoring has been prepared with reference to Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in accordance with the Karuah East Quarry Noise Management Plan (NMP) 630.11235-R1 *Karuah East Quarry Project Noise Management Plan* dated October 2015.

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 Sensitive Receptors

The Karuah East Quarry NMP identified the closest sensitive receptors to the Project Site. These locations are listed in **Table 1** and shown in **Figure 1**.

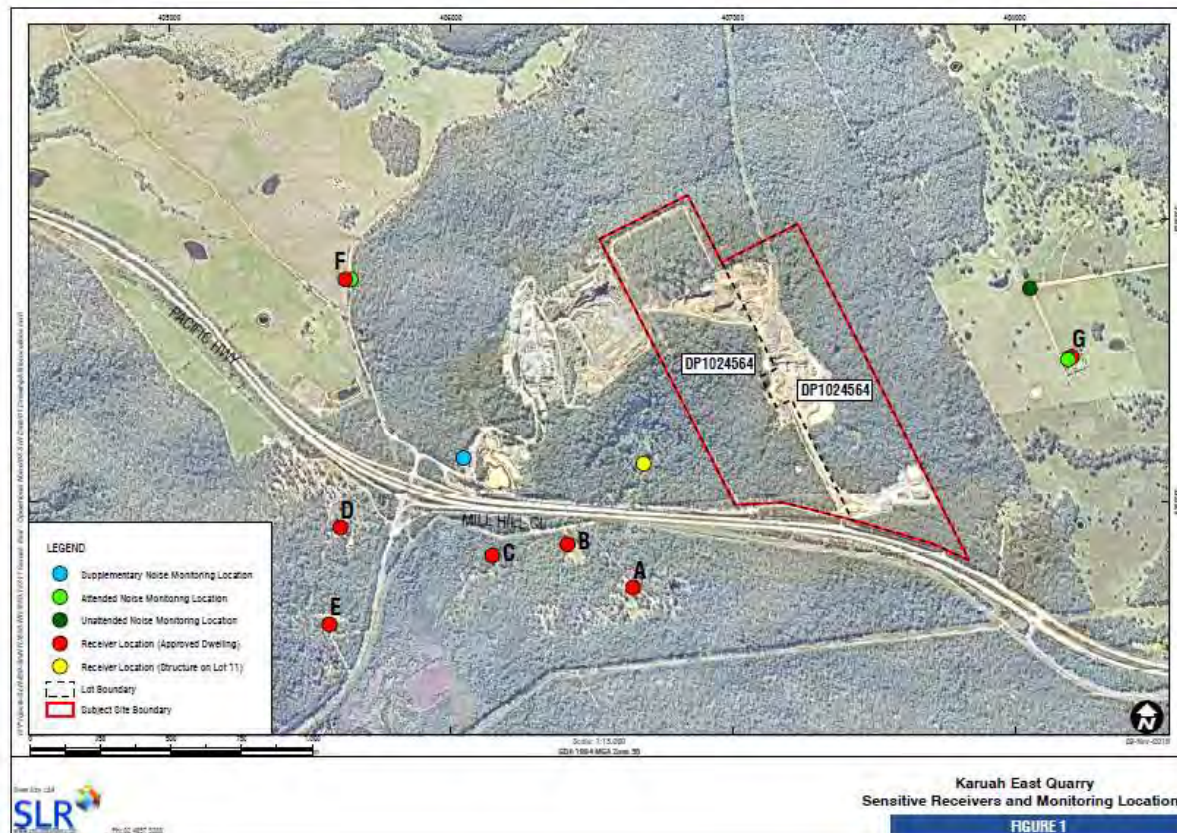
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G	Lot 1 DP 1032636
Other Structures	
Lot 11 ¹	Lot 11 DP1024564

Note 1: No currently approved residential dwelling exists on Lot 11.

Figure 1 Sensitive Receptor Locations – Project Site

(INSERT PDF)



3 Operational Compliance Criteria

In accordance with the NMP, **Table 2** presents the adopted operational noise goals for the Project Site.

Table 2 Operational Noise Criteria (dBA LAeq(15minute))

Location	Criteria (day)
Residence on Lot 11 DP 1024564 ¹	43
A	40
B	37
G	38
All other residences	35

Note 1: No currently approved residential dwelling exists on Lot 11 and therefore it is considered that the noise limits do not currently apply at this location.

3.1 General Methodology

Operator-attended noise surveys were conducted to characterise and quantify the noise emissions from the Project Site. In accordance with the NMP, operator attended noise monitoring was undertaken at two locations, Location F and Location G and unattended noise monitoring undertaken at Location G (refer to **Figure 1**).

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672 2004 “*Electroacoustics – Sound Level Meters*” (parts 1 and 2) and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ± 0.5 dBA.

Unless otherwise noted all operator-attended noise surveys were conducted for 15 minutes in duration.

3.2 Operator Attended Noise Compliance Monitoring

Operator-attended noise measurements were conducted during the daytime period on Thursday 22 November 2018. Details of the monitoring locations are provided in **Table 3**.

Table 3 Ambient Noise Monitoring Locations

Sound level meter Type/ Serial No.	Location	Location (m, UTM)	
		Easting	Northing
Bruel & Kjaer 2250 / 3011822	Location F – Eastern Boundary of property.	405644	6389785
	Location G – Conducted at dwelling.	408190	6389502
	Project Site – Conducted at Karuah Quarry weighbridge.	406045	6389153

3.3 Unattended Continuous Noise Monitoring

An environmental noise logger was deployed at the gate of monitoring Location G (refer to **Figure 1**).

Noise monitoring was undertaken from Thursday 15 November 2018 to Thursday 22 November 2018, inclusive. Details of the noise loggers used for the unattended continuous noise monitoring are given in **Table 4**.

The environmental noise logger was programmed to record statistical noise level indices continuously in 15 minute intervals.

Table 4 Noise Logger and Noise Monitoring Location

Location	Noise Logger/Serial Number	Date of Logging
G	ARL EL-316-16-203-525	15/11/2018 – 22/11/2018

4 Operator Attended Noise Monitoring Results

4.1 Results of Operator-attended Noise Monitoring

The results of the operator attended noise measurements are given in **Table 5**. Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds, and any other industrial operations. The table provides the following information:

- Monitoring location
- Date, start time, Wind velocity (m/s) and Temperature (°C) at the measurement location
- Typical maximum (L_{Amax}) and contributed noise levels.

Project related noise contributions listed in the tables are stated only when a contribution could be reasonably quantified.

Table 5 Operator Attended Noise Survey Results

Location	Date/ Start time/ Period/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Levels L _{Amax}
		L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
F	22/11/2018 08:59 Day 2 m/s SSW 25°C	84	69	47	40	57	Pacific Highway traffic 38 – 40 Local traffic 63 – 84 Birds 40 – 44 Karuah East Project Inaudible
G (NMP Monitoring Location)	22/11/2018 08:25 Day 23°C 2.5 m/s WSW	66	57	49	32	46	Birds 32 – 40 Dogs 45 – 66 Pacific Highway 33 – 35 Karuah East Project Inaudible
Karuah Quarry (weighbridge)	22/11/2018 09:32 Day 2 m/s SSE 25°C	77	74	66	56	64	Pacific Highway traffic 55 – 58 Other industry 52-77 Karuah East Project Inaudible

4.1.1 Predicted Noise Levels at Receiver Locations A & B

In accordance with **Section 8.3.1** of the NMP operator-attended noise monitoring was conducted at a location closer to the Project Site (refer **Figure 1** and “Karuah Quarry” in **Table 5**). The purpose of this measurement was to enable the calculation of Project Site noise levels at locations A and B. Calculated noise levels can then be used to determine the likely compliance at these residential receiver locations.

As the Project was inaudible at the monitoring location compliance is indicated at locations A and B.

5 Unattended Continuous Noise Monitoring

The unattended ambient noise logger data from monitoring Location G is presented graphically on a daily basis and attached as **Appendix B**. Due to a lack of property access the noise logger was placed at the property gate. A summary of the results of the unattended continuous noise monitoring is given in **Table 6**. The ambient noise level data quantifies the overall noise level at a given location independent of its source or character.

Precautions can be taken to minimise influences from extraneous noise sources (eg optimum placement of the loggers away from creeks, trees, houses, etc), however, not all these sources or their effects can be eliminated. This is particularly the case during the warmer times of year when noise from insects, frogs, birds and other animals can become significant.

Weather data was obtained from the automatic weather station located at Karuah East Quarry. Unattended noise data corresponding with periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18km/hr) were discarded in accordance with the INP data exclusion methodology.

Table 6 Unattended Continuous Monitoring Ambient Noise Levels (dBA)

INP Period	LA1	LA10	LA90	LAeq
Location G				
Daytime	50	46	34	54
Evening	51	46	39	46
Night	47	44	35	44

Given observations made during the operator attended noise survey at the monitoring location, it is likely that daytime noise levels at Location G were dominated by road traffic noise from the Pacific Highway and natural sources such as birdsong, insects, and livestock.

6 Conclusion

SLR Consulting Australia Pty Ltd (SLR) has undertaken operational noise compliance monitoring for the Karuah East Project in accordance with the NMP.

Operator-attended noise compliance measurements were conducted during the daytime period on Thursday 15 November 2018 at monitoring locations F and G. A further operator-attended survey was conducted at the Karuah Quarry weighbridge. Likely noise levels were predicted for receivers A and B.

Unattended noise monitoring was conducted at Location G from Thursday 15 November 2018 to Thursday 22 November 2018 inclusive.

Karuah East Quarry was deemed to be inaudible at all NMP receiver locations.

APPENDIX A

Acoustic Terminology

The following is a brief description of the acoustic terminology.

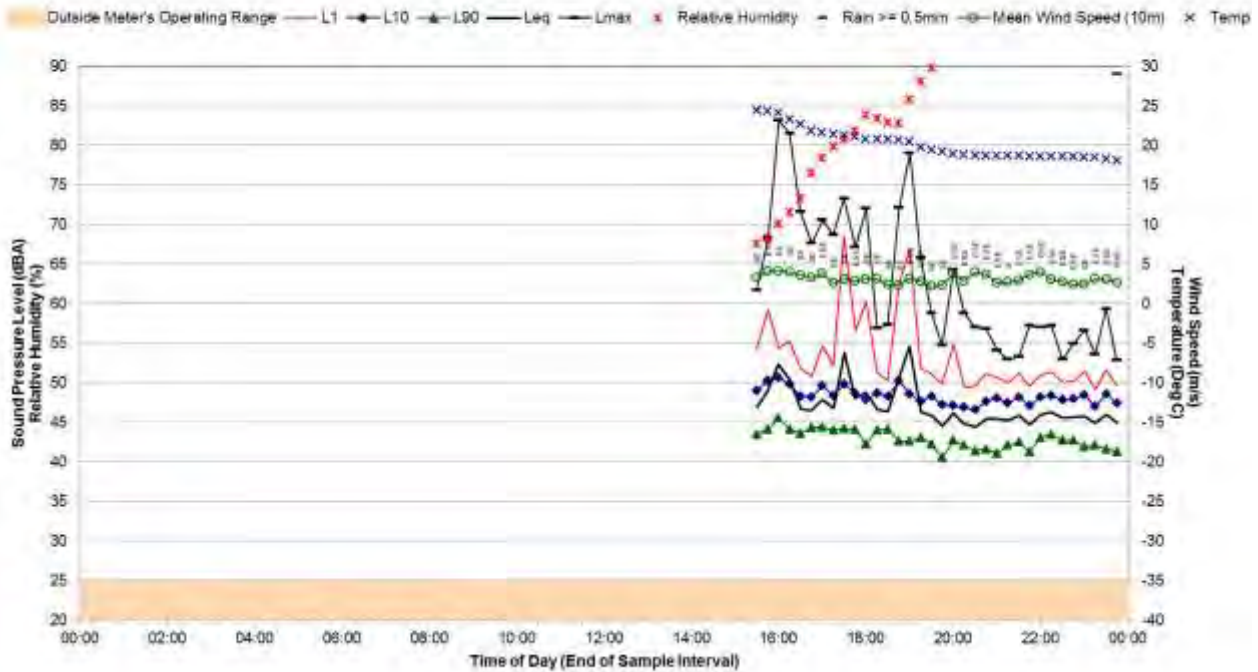
Acoustic Terminology	Description
'A' Weighted	Frequency filter applied to measured noise levels to represent how humans hear sounds.
dBA	'A' Weighted overall sound pressure level.
L90 , L10	A statistical measurement giving the sound pressure level which is exceeded for the given percentile of an observation period, i.e., L90 is the level which is exceeded for 90 percent of an observation period. L90 is commonly referred to as the background sound level.
L _{Amax}	Highest value of the A-weighted sound pressure level with a specified time weighting that occurs during a given event.

APPENDIX B

Statistical Ambient Noise Monitoring Results Location G (Property Gate)

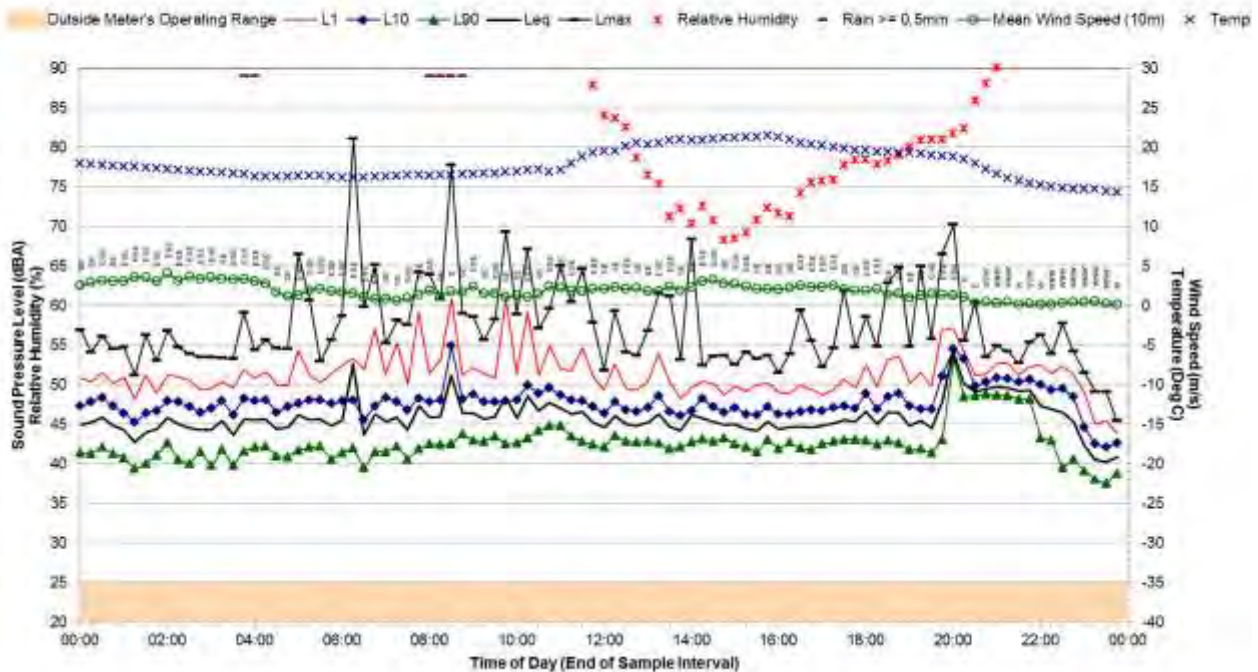
Statistical Ambient Noise Levels

Location G (property gate) - Thursday, 15 November 2018



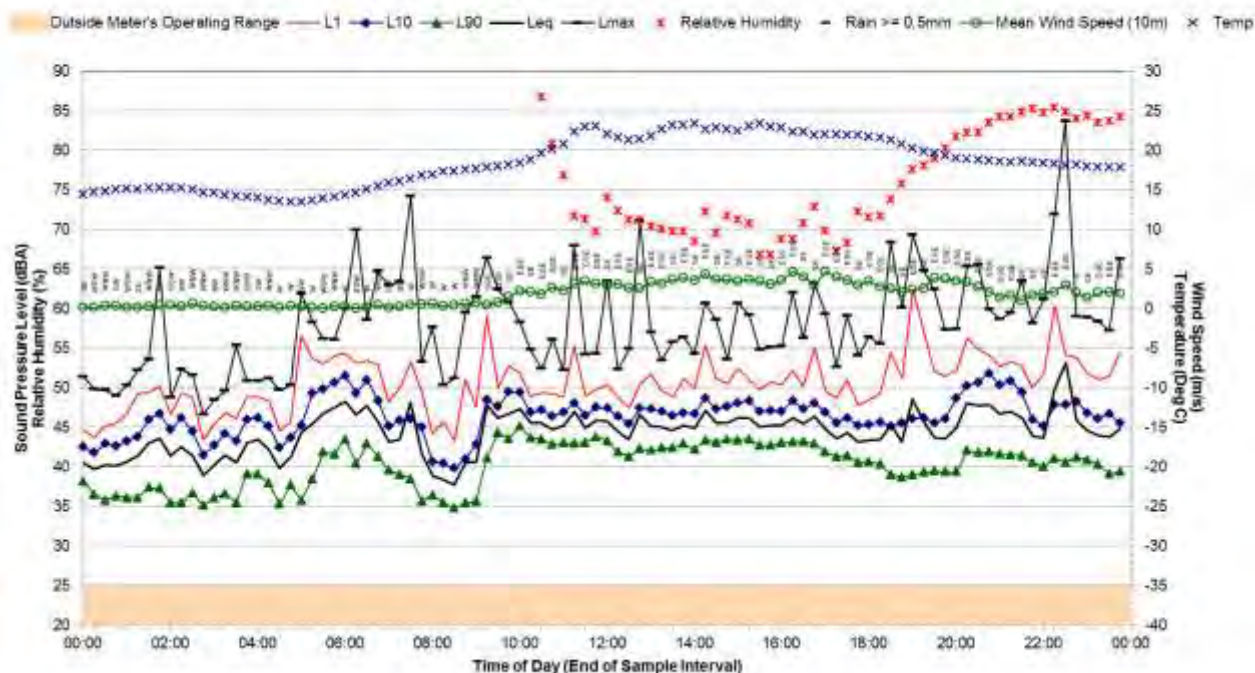
Statistical Ambient Noise Levels

Location G (property gate) - Friday, 16 November 2018



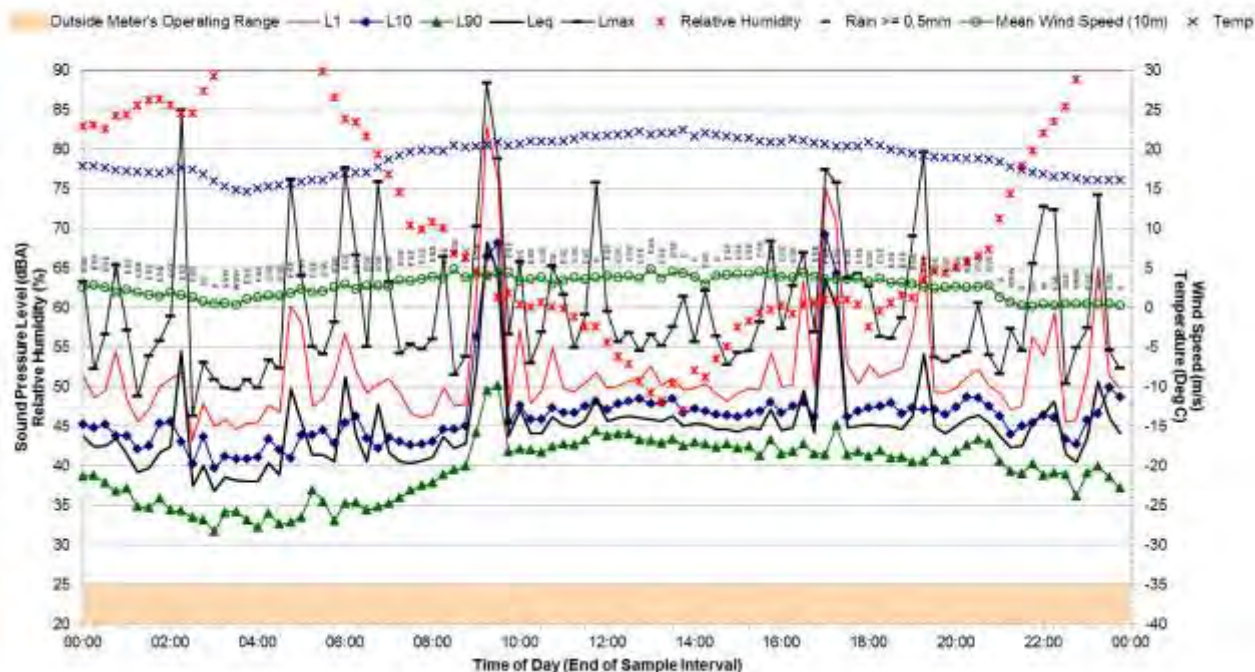
Statistical Ambient Noise Levels

Location G (property gate) - Saturday, 17 November 2018



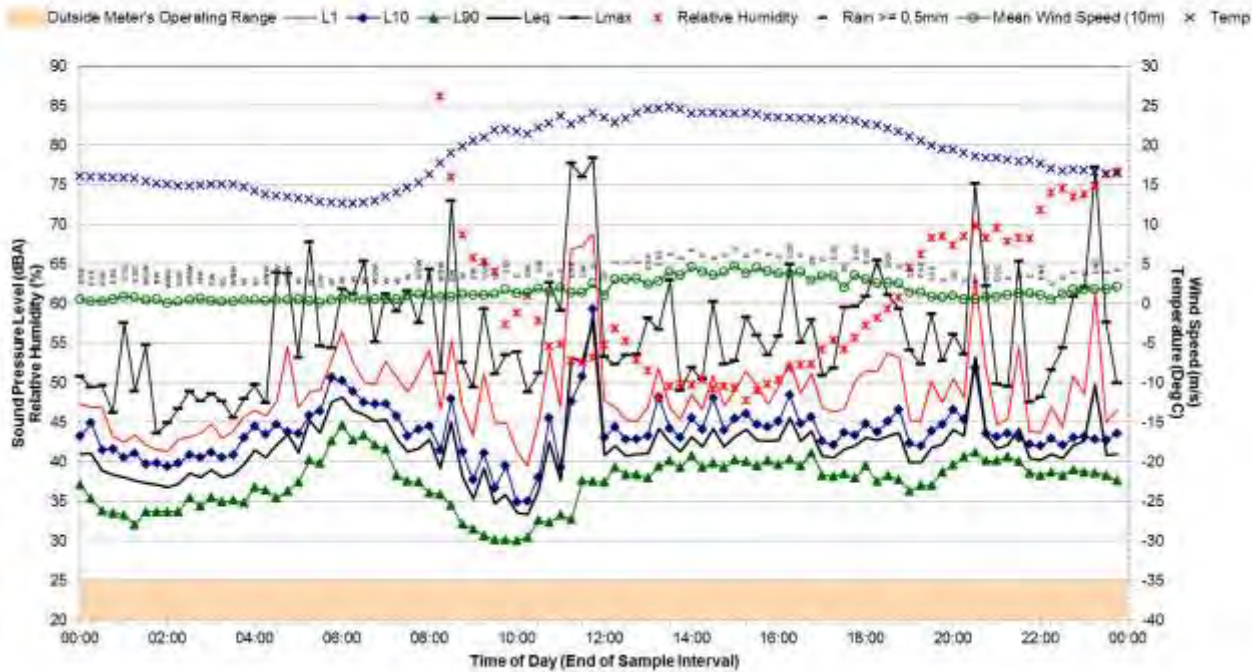
Statistical Ambient Noise Levels

Location G (property gate) - Sunday, 18 November 2018



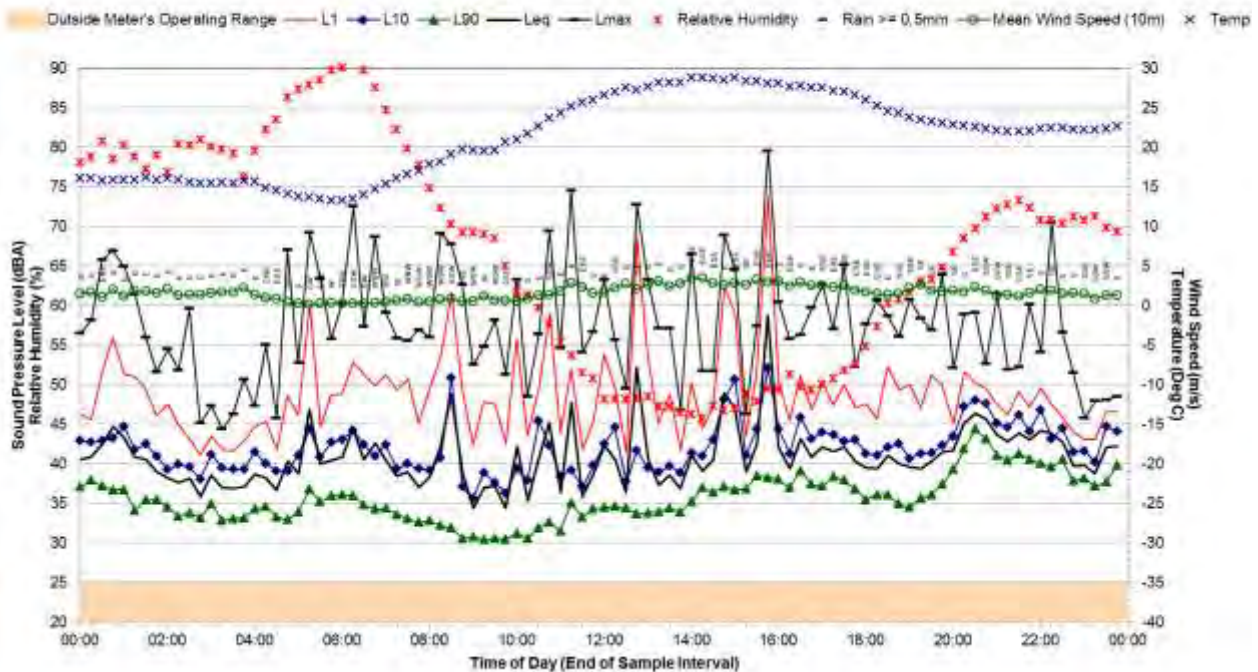
Statistical Ambient Noise Levels

Location G (property gate) - Monday, 19 November 2018



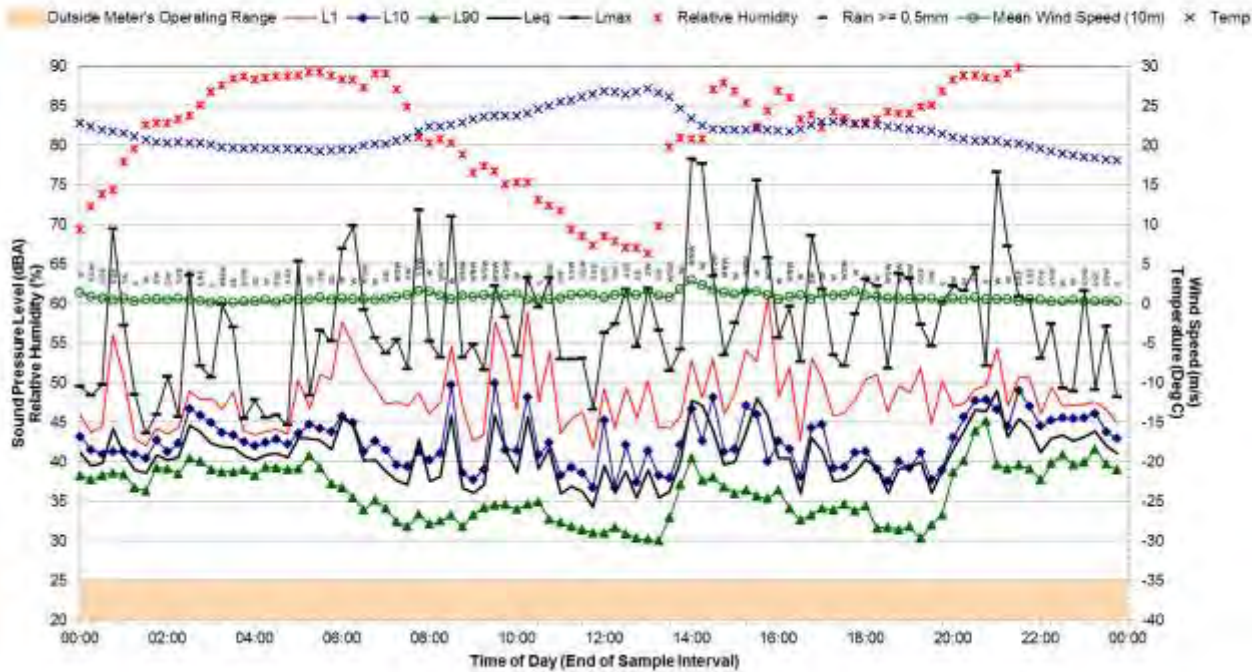
Statistical Ambient Noise Levels

Location G (property gate) - Tuesday, 20 November 2018



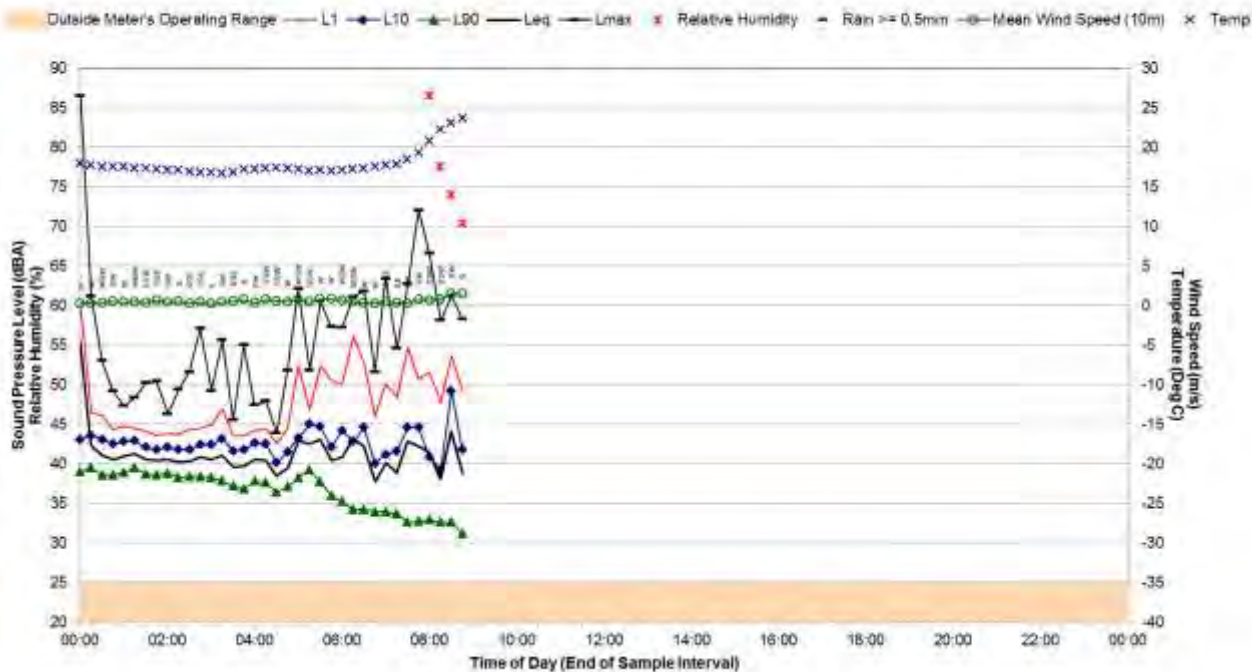
Statistical Ambient Noise Levels

Location G (property gate) - Wednesday, 21 November 2018



Statistical Ambient Noise Levels

Location G (property gate) - Thursday, 22 November 2018



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APPENDIX 5 – Ecological Monitoring Report



2018 Annual Monitoring Report



Karuah East Quarry Biodiversity Offset Area and Lot 12

Karuah East Quarry Pty Ltd

14 March 2019

2018 Annual Monitoring Report

Karuah East Quarry Biodiversity Offset Area and Lot 12

Kleinfelder Document Number: NCA19R88922

Project No: 20192281

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Prepared for:

KARUAH EAST QUARRY PTY LTD

BLUE ROCK CLOSE

KARUAH NSW 2324

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Contents

1. INTRODUCTION	1
1.1 BACKGROUND	1
1.2 SCOPE	3
1.3 KARUAH EAST QUARRY PROGRESS	4
1.4 BIODIVERSITY VALUES	6
2. METHODS	8
2.1 VEGETATION AND THREATENED FLORA MONITORING	8
2.2 SITE WALKOVER AND INSPECTION	10
3. RESULTS AND DISCUSSION	12
3.1 VEGETATION AND THREATENED FLORA MONITORING	12
3.2 WEEDS	25
3.3 FENCING AND TRACKS	28
3.4 EROSION	28
3.5 VERTEBRATE PESTS	31
3.6 HABITAT RESOURCES	31
4. PERFORMANCE CRITERIA EVALUATION	34
5. CONCLUSION	37
6. REFERENCES	38

Figures

Figure 1: Karuah East Quarry and Biodiversity Offset Area	2
Figure 2: Current extent of clearing within the Karuah East Quarry Project Area	5
Figure 3: Vegetation types and threatened flora locations	7
Figure 4: Vegetation and threatened flora monitoring locations	11
Figure 5: Weed Mapping	27
Figure 6: Fencing, Track, Erosion, and Pest Issues	29
Figure 7: Habitat resources and nest box locations	33

Tables

Table 1: Summary of annual monitoring requirements for Karuah East Quarry BOA and Lot 12	3
Table 2: Key biodiversity values recorded within the Karuah East BOA	6
Table 3: Summary of vegetation and threatened flora monitoring sites	9
Table 4: Summary of 2018 vegetation and threatened flora monitoring results	12
Table 5: Threatened species percentage change from baseline survey	23
Table 6: Current status of BOAMP performance criteria	34

Appendices

- Appendix 1. Threatened Flora Monitoring
- Appendix 2. Vegetation Monitoring Data
- Appendix 3. Photo Monitoring Points
- Appendix 4. Exotic Species Recorded in the Offset Area
- Appendix 5. Staff Contributions
- Appendix 6. Licensing

1. INTRODUCTION

1.1 BACKGROUND

The Karuah East Quarry (KEQ) Project was subject to an assessment under part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The project was approved by the Planning Assessment Commission on 17 June 2014 subject to conditions set out in Schedules 2 to 5 of the Project Approval (09_0175). A subsequent modification was approved on 27 April 2018 under Section 75J of the EP&A Act (Modification 1). A referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the project was also lodged with the Department of the Environment (DotE) on 29 July 2014 (EPBC 2014/7282). On 25 August 2014 the project was determined as a Controlled Action under the EPBC Act requiring further assessment subject to the controlling provision 'listed threatened species and communities'. The action was approved by DotE on 20 March 2015 subject to 17 conditions of approval.

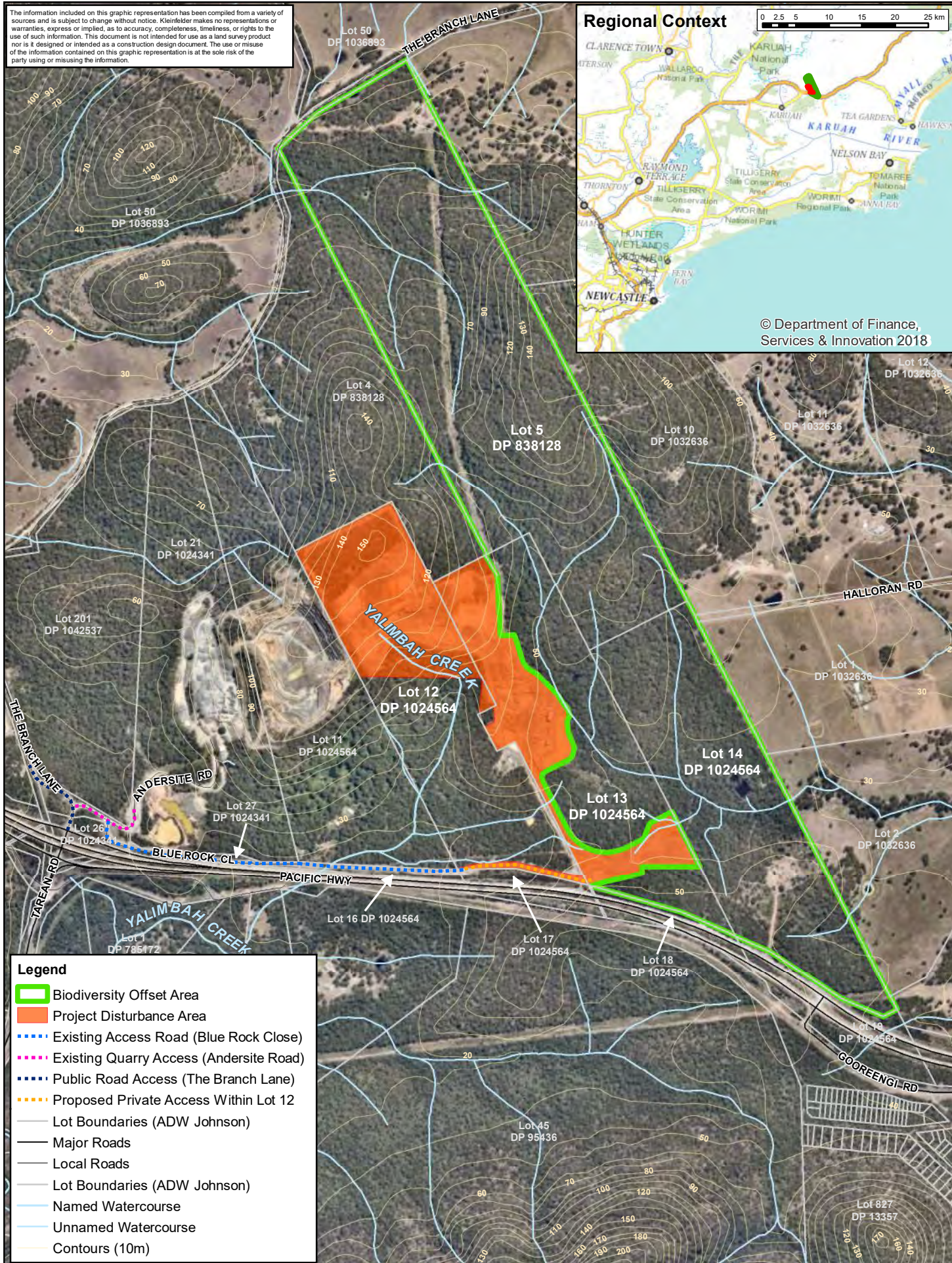
Condition 33 of the NSW Project Approval and Condition 9 of the EPBC Act approval require the implementation of a Biodiversity Offset Area Management Plan (BOAMP) for the KEQ biodiversity offset area (BOA), which is a 138.22 ha consolidated land parcel adjoining the western boundary of the project disturbance area (**Figure 1**). The BOAMP was prepared by Kleinfelder (2015) and subsequently approved by the NSW Department of Planning and Environment (DP&E) on 14 December 2015, and approved by the DotE on 16 March 2016.

Baseline ecological surveys and monitoring were undertaken in October 2015 prior to commencement of clearing and construction as required under Section 3 of the BOAMP. The baseline monitoring surveys involved the establishment of 13 permanent monitoring sites within the Karuah East BOA in accordance with the BOAMP. An additional five permanent monitoring sites were also established on the adjoining Lot 12 DP 1024564 as per Sections 3.2 and 4.1 of the Statement of Commitments in accordance with Section 11.1.3 of the Landscape and Rehabilitation Management Plan (L&RMP) (SLR 2015). In addition to establishing the permanent monitoring sites, the surveys also involved baseline assessment of fencing, access tracks, erosion, weeds and vertebrate pests in accordance with Section 3 of the BOAMP. The baseline ecological surveys and monitoring report (Kleinfelder 2016) was submitted as an addendum to the BOAMP in January 2016 (available from <http://hunterquarries.com.au/karuah-east-documents/>).














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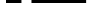


Legend

-  Biodiversity Offset Area
-  Project Disturbance Area
-  Existing Access Road (Blue Rock Close)
-  Existing Quarry Access (Andersite Road)
-  Public Road Access (The Branch Lane)
-  Proposed Private Access Within Lot 12
-  Lot Boundaries (ADW Johnson)
-  Major Roads
-  Local Roads
-  Lot Boundaries (ADW Johnson)
-  Named Watercourse
-  Unnamed Watercourse
-  Contours (10m)

Metres

0 50 100 200 300 400 500



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PROJECT REFERENCE: 20192281

DATE DRAWN: 15/02/2019 15:17 Version 1

DRAWN BY: gjoyce

DATA SOURCE:
NSW DFSI - 2017
ADW Johnson - 2015
nearmap - 2018

Karuah East Quarry
and Biodiversity Offset Area

Karuah East Quarry Pty Ltd
2018 Annual Monitoring Report
Karuah East Quarry Project

FIGURE:

—

The first year of annual monitoring of the BOA and Lot 12 was undertaken in October 2016. This report provides the results of the third annual monitoring event undertaken in October 2018. Monitoring including analysis of monitoring data to date to evaluate changes in vegetation condition and threatened flora populations in the BOA. This report also provides a summary of management actions completed within the BOA to date, and recommendations for implementation of management actions in Year 4 of the BOAMP implementation to ensure compliance with relevant performance criteria.

1.2 SCOPE

Section 3 of the BOAMP details the annual monitoring requirements for the Karuah East BOA. Additionally, Section 12.1 of the L&RMP details the ecological monitoring requirements for the Karuah East Quarry project area, adjoining vegetation within 50 m of the project area boundary on Lots 12 and 13, and along Yalimbah Creek (Lot 12). A summary of the Karuah East annual ecological monitoring requirements is provided in **Table 1**. It is noted that not all monitoring activities listed in **Table 1** are required for the 2018 monitoring (refer to the timing / frequency).

Table 1: Summary of annual monitoring requirements for Karuah East Quarry BOA and Lot 12

Monitoring Requirements	BOAMP / L&RMP Section(s)	Timing / Frequency	Completed in 2018?
Vegetation and Threatened Flora Monitoring <ul style="list-style-type: none"> The 18 permanent monitoring sites established in the BOA and Lot 12 during the baseline are to be surveyed annually in accordance with Section 3.13 of the BOAMP and Section 12.1.3 of the L&RMP. Monitoring is to be undertaken during spring to coincide with the flowering times of threatened flora species in the BOA. 	Section 3.13 of BOAMP Section 12.1.3 of L&RMP	Annually for life of quarry (LOQ)	Completed
Fencing <ul style="list-style-type: none"> Inspections of boundary fencing will be undertaken as part of annual monitoring to identify maintenance requirements and record fencing activities undertaken in previous year. The effectiveness of fencing in excluding stock and unauthorised activities (e.g. rubbish dumping) will also be evaluated during annual monitoring and any additional controls will be identified if required. 	Section 3.2 of BOAMP Section 12.1.2 of L&RMP	Annually for LOQ	Fencing contractor has been engaged and installation is has commenced. Contractor will continue as per the baseline plan.
Tracks <ul style="list-style-type: none"> Inspections of retained and redundant access tracks will be undertaken as part of annual monitoring to identify maintenance requirements and record maintenance activities undertaken in previous year. 	Section 3.3 of BOAMP	Annually for LOQ	Completed
Erosion <ul style="list-style-type: none"> Inspections of erosion sites will be undertaken as part of annual monitoring to identify maintenance requirements and record maintenance activities undertaken in previous year. Erosion and sediment control structures installed within the project disturbance area to protect retained vegetation will be inspected as part of annual ecological monitoring. 	Section 3.4 of BOAMP Section 12.1.2 of L&RMP	Annually for LOQ	Completed

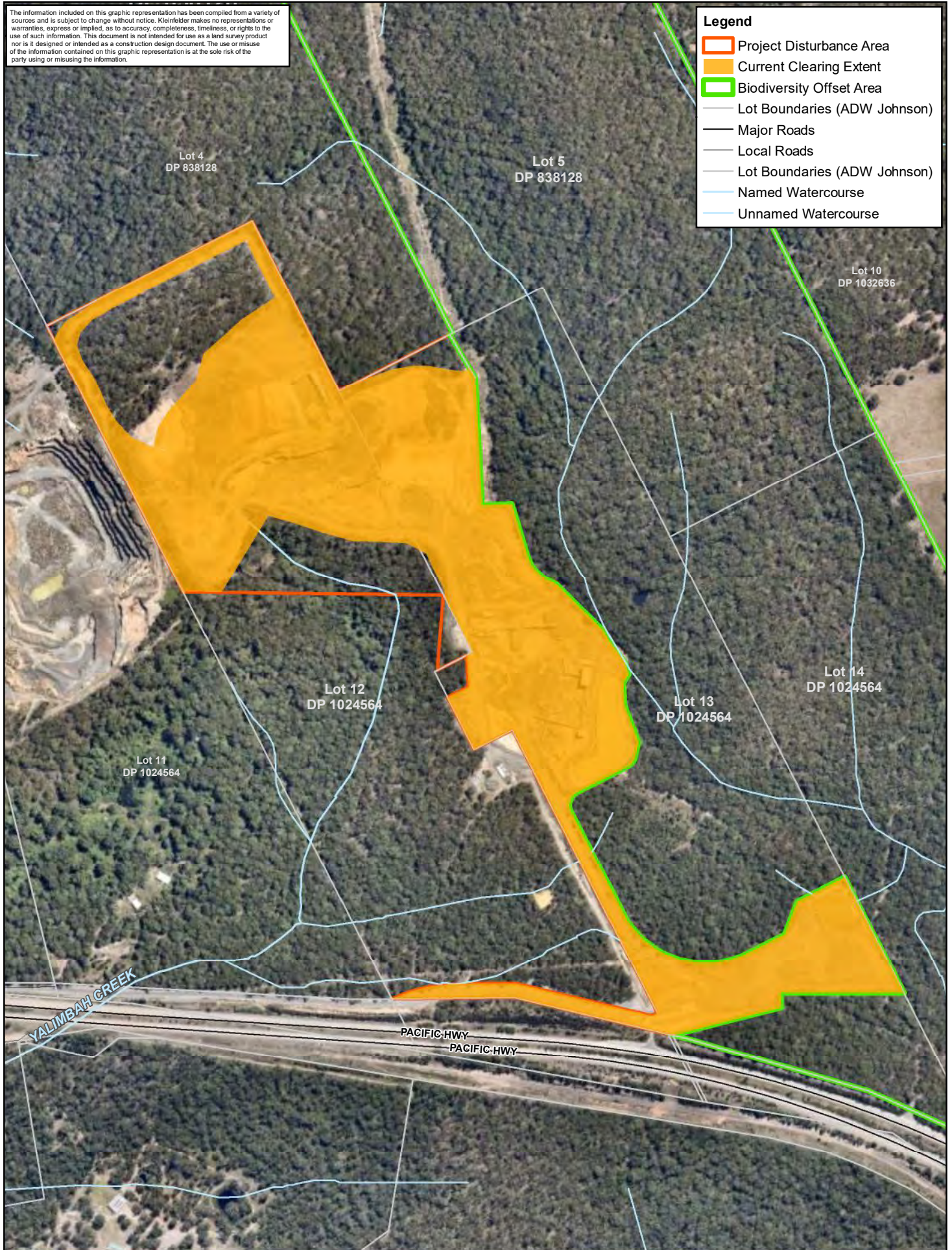
Monitoring Requirements	BOAMP / L&RMP Section(s)	Timing / Frequency	Completed in 2018?
Existing Dwellings <ul style="list-style-type: none"> Inspections of the dwellings, access tracks, and asset protection zones (APZs) will be undertaken as part of annual monitoring to identify maintenance requirements. These inspections will focus on fencing, weeds, and unauthorised access / disturbance. 	Section 3.5 of BOAMP	Annually for LOQ	Completed
Habitat Augmentation and Nest Boxes <ul style="list-style-type: none"> Nest boxes will be inspected and maintained (or replaced) every two years following installation: <ul style="list-style-type: none"> Nest boxes 1 – 30 installed in April 2016 Nest boxes 31 – 123 installed in February 2018 	Section 3.8 of BOAMP	Boxes 1-30 monitoring required in 2018.	Completed Nest Boxes 1 – 30 were monitored in June 2018.
Weeds <ul style="list-style-type: none"> Target weed species will be mapped on an annual basis within the Project Disturbance Area and adjoining vegetation on Lots 12 and 13 (within 50 m of the project disturbance area boundary). Additionally, weed mapping along Yalimbah Creek will also be undertaken as part of the ecological monitoring program. Weed mapping for the BOA will be undertaken every two years and compared to the previous mapping to assess changes in the extent and density of target weeds. Monitoring results will be used to develop a control strategy for the following two years, identifying target locations and timing for primary and follow-up control. 	Section 12.1.1 of L&RMP Section 3.10 of BOAMP	Annually (KEQ, 50 m buffer and Yalimbah Creek) Every 2 years from baseline survey for LOQ (BOA)	Completed (KEQ, 50 m buffer, Yalimbah Creek and BOA)
Vertebrate Pest Assessment <ul style="list-style-type: none"> Monitoring of vertebrate pests will be undertaken using the same methods, locations and effort as the baseline assessment unless otherwise recommended in the annual monitoring reports. This will enable results to be accurately compared to the baseline assessment. 	Section 3.11	Every 2 years from baseline survey for LOQ (BOA)	Outstanding
Aerial Fauna Crossings <ul style="list-style-type: none"> A 12-month monitoring program of the two aerial fauna crossings will be undertaken using remote motion sensing cameras mounted on each pole (four cameras in total) once the crossings have been installed. 	Section 12.1.4 of L&RMP	12 months from installation of the crossings	N/A – aerial fauna crossing not installed as Haul Road not completed
Threatened Flora Translocation – refer to <i>Tetratheca juncea</i> Translocation Management Plan (TjMP; Firebird 2015).	Refer to TjMP	Refer to TjMP	Completed – refer to Tj Translocation Monitoring Report (Firebird 2018)

1.3 KARUAH EAST QUARRY PROGRESS

The Karuah East Quarry (KEQ) Project was under construction at the time of monitoring (October 2018). Vegetation clearing commenced in April 2016 and the majority of the KEQ project area was primarily cleared between April and June 2016, with some clearing also occurring in November 2016. Clearing completed to date represents completion of the first stage of clearing for the project. Major earthworks have also been completed including construction of the haul road, detention basins, and other infrastructure areas. The current extent of clearing within the KEQ project area is shown in **Figure 2**.

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- Legend**
- Project Disturbance Area
 - Current Clearing Extent
 - Biodiversity Offset Area
 - Lot Boundaries (ADW Johnson)
 - Major Roads
 - Local Roads
 - Named Watercourse
 - Unnamed Watercourse



<p>Metres</p> <p>0 25 50 100 150 200 250</p> <p></p>	<p>PROJECT REFERENCE: 20192280</p> <p>DATE DRAWN: 15/02/2019 15:21 Version 1</p> <p>DRAWN BY: gjoyce</p>	<p>Current Extent of Clearing within the Karuah East Quarry Project Area</p>	<p>FIGURE:</p> <p>2</p>
<p></p> <p>KLEINFELDER</p> <p>Bright People. Right Solutions.</p> <p>www.kleinfelder.com</p>	<p>DATA SOURCE:</p> <p>NSW DFSI - 2017</p> <p>ADW Johnson - 2015</p> <p>nearmap - 2018</p>		

The remaining vegetation within the northern part of the project area is unlikely to be cleared for some time as the areas cleared to date contain andesite resources that will take several years to extract.

1.4 BIODIVERSITY VALUES

Section 2.3 of the BOAMP provides a detailed description of the biodiversity values identified in the Karuah East BOA during previous assessments (RPS Australia Pty Ltd 2013; Eco Logical Australia (ELA) 2013, 2014). Additional baseline ecological surveys were also undertaken within the BOA in October 2016 (Kleinfelder 2016). A summary of the key biodiversity values present (or previously recorded) within the site are provided in **Table 2**. The locations of threatened flora species and the distribution of vegetation communities across the BOA are shown in **Figure 3**.

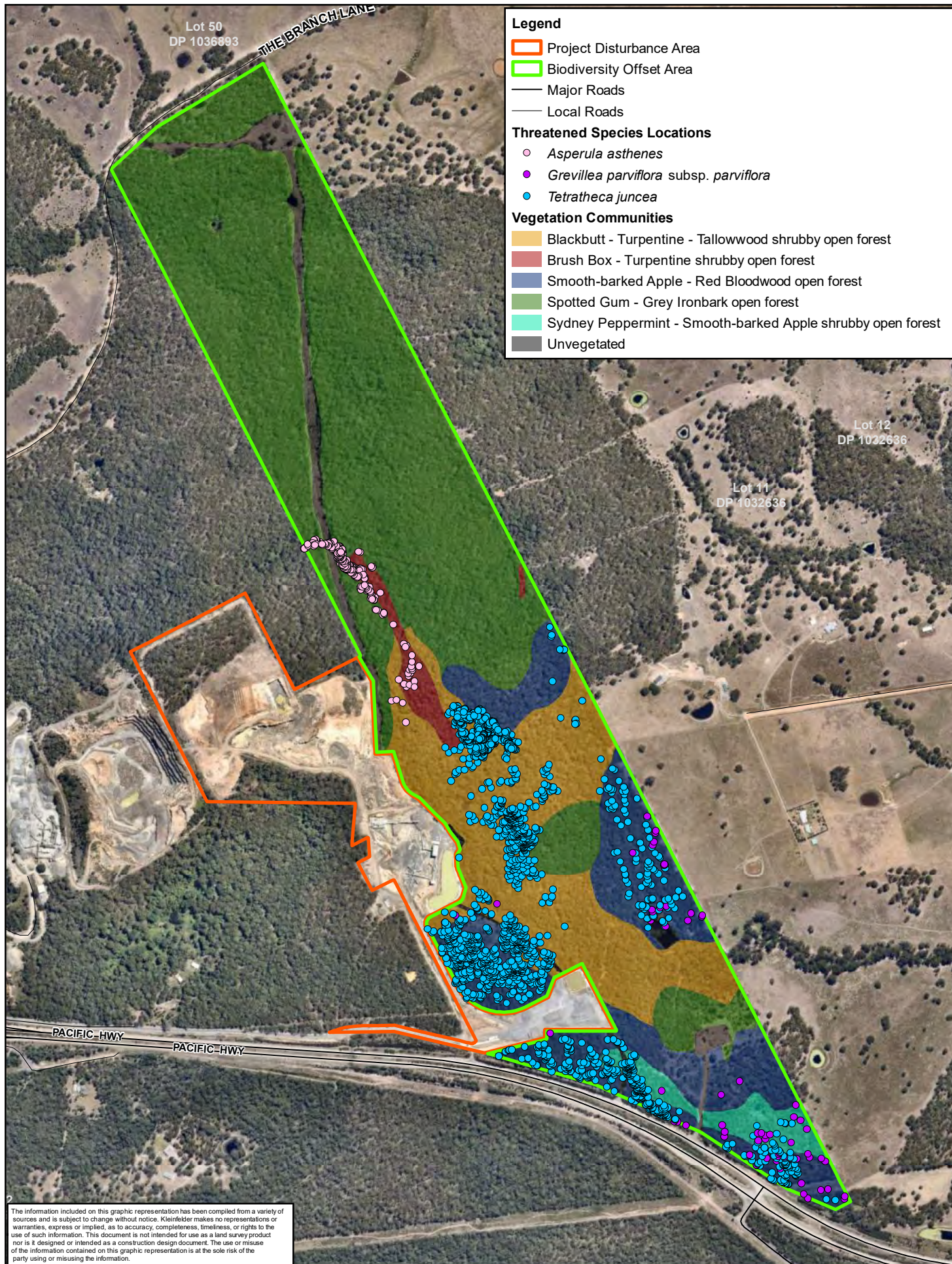
Table 2: Key biodiversity values recorded within the Karuah East BOA

Biodiversity Values		Area (ha) / No. of individuals
Vegetation Communities	Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin.	69.98
	Sydney Peppermint – Smooth barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin.	3.96
	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin.	26.58
	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast.	28.30
	Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast.	2.62
Threatened Flora Species	*^ <i>Tetradlea juncea</i> (Black-eyed Susan)	6,907
	*^ <i>Grevillea parviflora</i> subsp. <i>parviflora</i> (Small-flower Grevillea)	100+
	*^ <i>Asperula asthenes</i> (Trailing Woodruff)	399
Threatened and Migratory Fauna Species	*Eastern Falsistrelle (<i>Falsistrellus tasmaniensis</i>)	-
	*Little Bent-winged Bat (<i>Miniopterus australis</i>)	-
	*Eastern Bent-winged Bat (<i>Miniopterus orianae oceanensis</i>)	-
	*Eastern Coastal Free-tailed Bat (<i>Mormopterus norfolkensis</i>)	-
	*Southern Myotis (<i>Myotis macropus</i>)	-
	*Eastern Cave Bat (<i>Vespadelus troughtoni</i>)	-
	*Glossy Black-Cockatoo (<i>Calyptorhynchus lathami</i>)	-
	*Varied Sittella (<i>Daphoenositta chrysoptera</i>)	-
	*Powerful Owl (<i>Ninox strenua</i>)	-
	+Rufous Fantail (<i>Rhipidura rufifrons</i>)	

* = listed as Vulnerable under the BC Act 2016

^ = listed as Vulnerable under the EPBC Act 1999

+ = listed as Migratory under the EPBC Act 1999



<p>Metres</p> <p>0 50 100 200 300 400 500</p> <p>KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com</p>	<p>PROJECT REFERENCE: 20192281</p> <p>DATE DRAWN: 15/02/2019 15:21 Version 1</p> <p>DRAWN BY: gjoyce</p> <p>DATA SOURCE: NSW DFSI - 2018 ADW Johnson - 2015 nearmap - 2018</p>	<p>Vegetation Types and Threatened Flora Locations</p> <p>Karuah East Quarry Pty Ltd 2018 Annual Monitoring Report Karuah East Quarry Project</p>	<p>FIGURE:</p> <p>3</p>

2. METHODS

2.1 VEGETATION AND THREATENED FLORA MONITORING

Thirteen vegetation monitoring sites were established and surveyed within the BOA in October 2015 as per Section 3.1.3 of the BOAMP. An additional five vegetation monitoring sites were also established and surveyed within 50 m of the project disturbance area and along Yalimbah Creek on Lot 12 DP 1024564 as per Section 11.1.3 of the L&RMP. The location of each monitoring site was recorded with a handheld GPS (Trimble™ Juno 5S unit) and permanently marked with a capped star picket. As such, a total of 18 vegetation monitoring sites were established and surveyed within the BOA and Lot 12 in October 2015. These permanent monitoring sites have subsequently been surveyed in October 2016, 2017 and 2018 using the same methods as the baseline survey, which are described in the following subsections.

Vegetation Monitoring

A qualitative assessment of vegetation condition and photo monitoring was undertaken at each of the 18 monitoring points, involving collection of the following data:

- Vegetation type and structure, including dominant species and estimated percentage foliage cover of each stratum (within 20 m radius of monitoring point);
- General health and condition of vegetation, including evidence of foliage die-off;
- Weed species and abundance; and
- Any management issues or indirect impacts from the project area or adjoining lands.

Additionally, four photographs (north, south, east and west) were taken at each of the monitoring points. The locations of the vegetation monitoring points are shown on **Figure 4**.

Threatened Flora Monitoring

Monitoring of threatened flora species was also undertaken at nine of the monitoring sites as per the BOAMP and L&RMP. At these sites, all threatened flora individuals within 10 m of the monitoring point were recorded. The bearing and distance of each clump / individual from the star picket recorded during the baseline survey was used to accurately re-locate known individuals in the survey area. The bearing (degrees) for each clump was measured using a Suunto compass and the distance was determined using a tape measure attached to the star picket. Additionally, each clump / individual was permanently marked with a steel peg (positioned 20 cm to the south of each clump / individual to avoid damaging plants); a metal tag was attached to each peg which provides a unique ID number.

Tetratheca juncea individuals or 'clumps' were delineated and counted in accordance with the standardised method described by Payne *et al.* (2002), in which individual clumps occurring

30 cm or more apart are considered separate, individual plants. A 30 cm separation distance between *Grevillea parviflora* subsp. *parviflora* stems was also used to identify separate individuals. *Asperula asthenes* were delineated based on the methodology used by ELA (2014) during previous targeted surveys to ensure a consistent approach for population surveys and monitoring across the BOA. Based on this method, stems (or groups of stems) of *Asperula asthenes* occurring 40 cm or more apart are considered separate individuals.

For each individual identified in the survey area, the following information was recorded:

- Clump number;
- Distance and bearing from centre star-picket to the clump;
- The size of the clump measured across the widest and narrowest points (cm) (for *A. asthenes* and *T. juncea*) or max height (for *G. parviflora* subsp. *parviflora*);
- Presence or absence of flowers (for *A. asthenes* and *G. parviflora* subsp. *parviflora*). The number of flowers and fruit on *T. juncea* plants were recorded to enable monitoring of reproductive output of this species; and
- Notes on general health of the plant, including any die-back or disease.

Following assessment of all previously recorded individuals, an additional survey of the area was performed at each site to identify any new individuals. For all new individuals identified within the survey area, the above listed information was collected. A summary of the vegetation and threatened flora monitoring sites within the BOA and Lot 12 is provided in **Table 3**.

Table 3: Summary of vegetation and threatened flora monitoring sites

Monitoring Point	Site	Threatened Flora Species Monitored
1	BOA – Lot 5	-
2	BOA – Lot 5	-
3	BOA – Lot 5	<i>Asperula asthenes</i>
4	BOA – Lot 13	<i>Asperula asthenes</i>
5	BOA – Lot 14	-
6	BOA – Lot 13	-
7	BOA – Lot 13	<i>Tetradlea juncea</i>
8	BOA – Lot 13	<i>Tetradlea juncea</i> and <i>Grevillea parviflora</i> subsp. <i>parviflora</i>
9	BOA – Lot 13	-
10	BOA – Lot 14	-
11	BOA – Lot 14	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>
12	BOA – Lot 14	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>
13	BOA – Lot 14	-
14	Lot 12	-
15	Lot 12	<i>Tetradlea juncea</i>
16	Lot 12	-
17	Lot 12	<i>Asperula asthenes</i>
18	Lot 12	<i>Asperula asthenes</i>

2.2 SITE WALKOVER AND INSPECTION

Inspection of key management features was undertaken across the BOA and Lot 12 (within 50 m of the project area and along Yalimbah Creek) in October 2018 in accordance with Section 3 of the BOAMP. The following features were inspected and assessed:

- Internal and external fencing;
- Access tracks and gates;
- Areas of active erosion and sedimentation;
- Areas surrounding the two existing dwellings within the BOA;
- Redistribution of habitat resources salvaged during clearing for the KEQ Project;
- Extent and density of priority and environmental weeds within the project disturbance area, adjoining vegetation within 50 m of the disturbance area boundary on Lots 12 and 13, and along Yalimbah Creek.

Weed Mapping

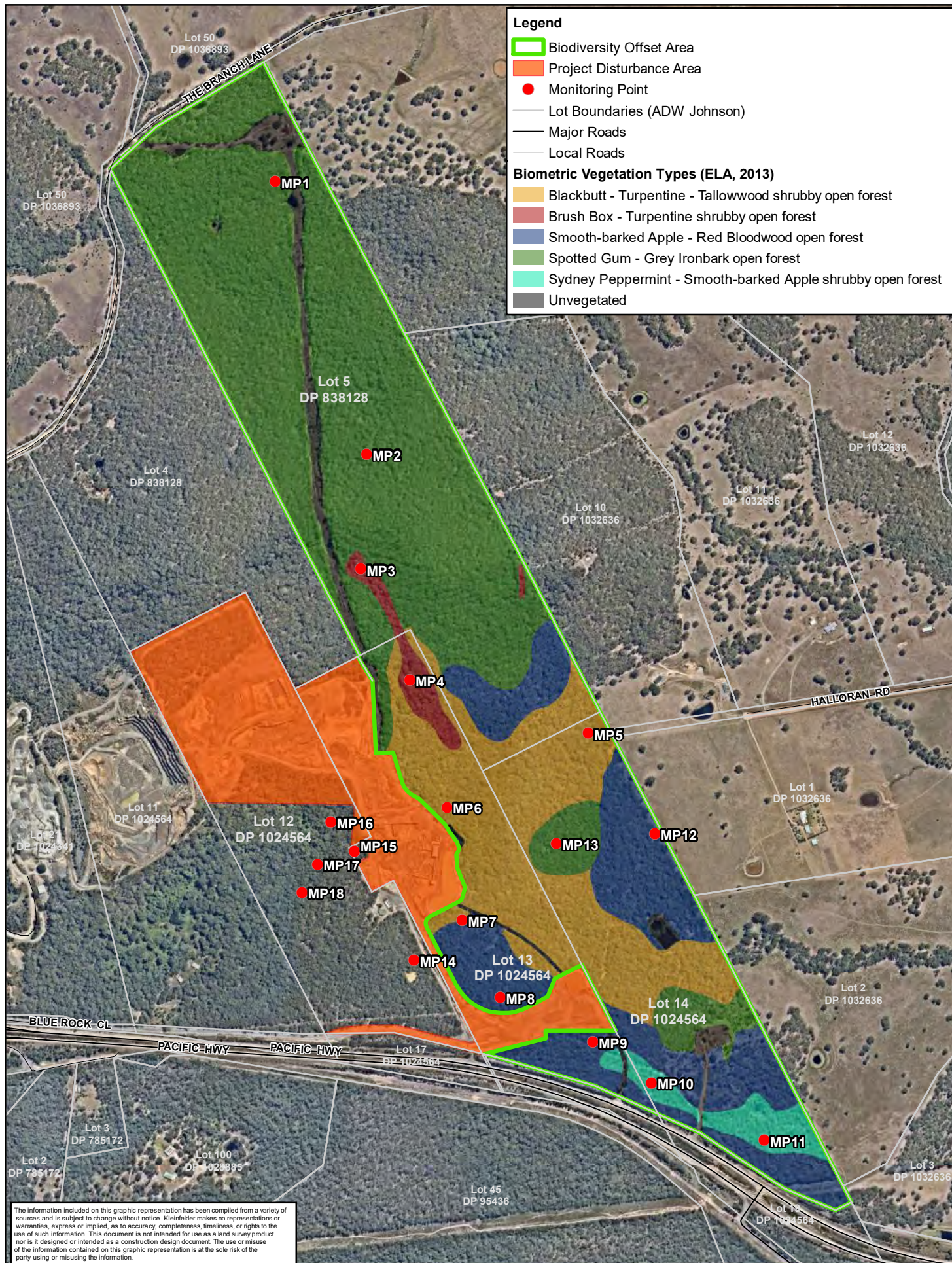
Weeds for which detailed mapping was undertaken (i.e. target weed species) are those:

- Listed under the Biosecurity Act 2015 as priority weeds within the Mid Coast Council control area;
- Identified as a Weed of National Significance (WoNS); and / or
- Environmental weeds which represent major infestations and / or have the potential to adversely affect ecological values within the BOA.

The most widespread and abundant weed species across the site is *Lantana camara* (Lantana). Four categories were used during field surveys to map areas of different Lantana density based on the percentage foliage cover:

- Nil: no Lantana observed;
- Scattered: ≤20% Lantana cover;
- Moderate: 21-60% Lantana cover; and
- High: >60% Lantana cover.

Other target weed species occurring outside moderate to high Lantana areas were mapped separately (i.e. weeds which may not be identified and treated as part of Lantana control).



<p>0 50 100 200 300 400 500</p> <p>Metres</p> <p></p> <p>KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com</p>	<p>PROJECT REFERENCE: 20192281</p> <p>DATE DRAWN: 15/02/2019 15:22 Version 1</p> <p>DRAWN BY: gjoyce</p> <p>DATA SOURCE: NSW DFSI - 2017 ADW Johnson - 2015 nearmap - 2018</p>	<p>Vegetation and Threatened Flora Monitoring Locations</p> <p>Karuah East Quarry Pty Ltd 2018 Annual Monitoring Report Karuah East Quarry Project</p>	<p>FIGURE:</p> <p>4</p>
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3. RESULTS AND DISCUSSION

3.1 VEGETATION AND THREATENED FLORA MONITORING

The results of the vegetation and threatened flora monitoring within the BOA are summarised in **Table 4**. The data from the 2015 (baseline), 2016, 2017 and 2018 surveys of threatened flora monitoring and vegetation structure/cover is provided in **Appendix 1 and 2**, respectively. Photo monitoring points (north) taken at each of the sites in 2015, 2016, 2017 and 2018 are also provided in **Appendix 3**. Due to the large number of photos, only the photos taken from the northern direction at each monitoring site are presented in this report; the remaining photos from the south, east and west directions have been provided as separate files with the report.

Table 4: Summary of 2018 vegetation and threatened flora monitoring results

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP1	Spotted Gum – Grey Ironbark open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present High fallen logs / timber Dense ground cover Low rock cover <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP1.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP1.</p>	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP2	Spotted Gum – Grey Ironbark open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present High fallen logs / timber Moderate to dense ground cover Rocky areas present Hollow-bearing trees present No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP2.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire Heavy <i>Lantana</i> infestation in the gully south west of MP2 <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP2.</p>	N/A
MP3	Brush Box – Turpentine shrubby open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present High structural complexity of vegetation High fallen timber No ephemeral pools within stream No changes in estimated foliage cover for each vegetation stratum (Appendix 2) High weed invasion (<i>Lantana</i>) Scattered <i>Ageratina riparia</i> (Mist Flower) within creek <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP3.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP3.</p>	<ul style="list-style-type: none"> A total of 14 <i>Asperula asthenes</i> individuals were recorded at MP3 in 2018. The number of individuals has increased from 12 individuals in 2017 but has declined from 17 individuals in 2016, and 16 in 2015 (12.5% reduction from baseline): <ul style="list-style-type: none"> Four individuals recorded at MP3 in 2017 were absent in 2018. Three new individuals, and two individuals not recorded in 2017 were recorded in 2018. All recorded <i>A. asthenes</i> plants at MP3 were observed to be in healthy condition; five individuals were recorded as having new growth, eleven individuals had flowers and three had fruit at the time of survey.

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP4	Brush Box – Turpentine shrubby open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present High structural complexity of vegetation Dense ground cover High fallen timber No changes in estimated foliage cover for each vegetation stratum (Appendix 2) Weed invasion (<i>Lantana</i> and <i>Tradescantia</i>) A minor increase (5%) in estimated exotic was recorded within the survey area since the previous survey (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP4.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP4.</p>	<ul style="list-style-type: none"> A total of 17 <i>Asperula asthenes</i> individuals were recorded at MP4 in 2018 compared to 18 individuals recorded in 2017, and 15 in 2015 (13% increase from Baseline): <ul style="list-style-type: none"> Eleven individuals recorded at MP4 in 2017 were not recorded in 2018. Six new individuals and four individuals not recorded in 2017 were recorded in 2018. All <i>A. asthenes</i> plants at MP4 were observed to be in healthy condition. Four plants had flowers and nine were observed to have new growth.
MP5	Blackbutt – Turpentine – Tallowwood shrubby open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present Moderate fallen logs / timber Dense ground cover No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP5.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP5.</p>	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP6	Blackbutt – Turpentine – Tallowwood shrubby open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present High fallen logs / timber Moderately dense ground cover Standing pools within creek A minor increase (5%) in estimated midstorey caused by the resprouting of <i>Zieria smithii</i> was recorded within the survey area since the previous survey (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP6.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation Disturbance from tree falling (<i>Glochidion ferdinandi</i>) within western half of MP6 No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal or dust was observed. No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP6.</p>	N/A
MP7	Smooth-barked Apple - Red Bloodwood open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present Regrowth vegetation to the north and east (previously cleared) Low fallen timber Dense ground cover No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP7.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP7.</p>	<ul style="list-style-type: none"> A total of 11 <i>Tetratheca juncea</i> individuals were recorded at MP7 in 2018 compared to 14 individuals recorded in 2017, and 14 in 2015 (21.5% reduction since Baseline): <ul style="list-style-type: none"> Three individuals recorded at MP7 in 2017 were absent in 2018. Two individuals from 2017 were merged into one large clump (stems within 30cm). One individual not present in 2017 was recorded again in 2018. The majority of the <i>T. juncea</i> plants at MP7 were observed to be in healthy condition, however, three plants were observed to have some die-off and declining in size. Conversely, three individuals were recorded as having new growth. All the plants had flowers, while four had fruit.

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP8	Smooth-barked Apple - Red Bloodwood open forest	<ul style="list-style-type: none"> One <i>Eucalyptus eugenioides</i> has further dieback (approximately 10%) from the previous year. Evidence of some die back in midstorey stratum, especially <i>Leptospermum polygalifolium</i> and <i>Acacia longifolia</i>, other vegetation strata in healthy condition Canopy and midstorey regeneration present Moderate fallen timber Dense ground cover and midstorey No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP8.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire Old track to north-east <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP8.</p>	<ul style="list-style-type: none"> A total of ten <i>Tetratheca juncea</i> clumps were recorded at MP8 in 2018, which is the same number as 2017 and 2015 (No change from Baseline): <ul style="list-style-type: none"> One <i>T. juncea</i> clump recorded in 2017 was not recorded in 2018. One additional clump was recorded in 2018. One <i>Grevillea parviflora</i> subsp. <i>parviflora</i> individual was recorded at MP8 in 2018, 2017, 2016 and 2015 (no change from baseline), All <i>T. juncea</i> plants at MP8 were observed to be in healthy condition except for 2 individuals that were observed to have died back and decreased in size. Nine <i>T. juncea</i> clumps were in flower, and all clumps had fruit. The <i>G. parviflora</i> individual was observed to be in healthy condition but did not have flowers or fruit, and no buds were present. It was smothered by <i>Cassytha glabella</i>.
MP9	Smooth-barked Apple - Red Bloodwood open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present High fallen timber Dense ground cover and midstorey A minor decrease (10%) in estimated ground cover due to a major dieback of <i>Pteridium esculentum</i> was recorded within the survey area since the previous survey (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP9.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire Old track to south <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP9.</p>	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP10	Sydney Peppermint - Smooth-barked Apple shrubby open forest	<ul style="list-style-type: none"> One <i>Eucalyptus piperita</i> was observed to have some natural foliage die-back resulting in a 5% reduction in canopy cover. All vegetation strata in healthy condition Canopy and midstorey regeneration present High fallen timber Dense ground cover No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP10.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire Several old dead stags present Some canopy gaps (from past clearing/logging) <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP10.</p>	N/A
MP11	Sydney Peppermint - Smooth-barked Apple shrubby open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present Low fallen timber Dense ground cover No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP11.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation Disturbance from tree falling along North-North-East 20 metre buffer boundary No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: One tree fall was observed since the previous survey (2017) at MP11.</p>	<ul style="list-style-type: none"> A total of 10 <i>Grevillea parviflora</i> subsp. <i>parviflora</i> individuals were recorded at MP11 in 2018 compared with 12 in 2017 and 16 individuals in 2016, and 2015 (37.5% reduction from Baseline): <ul style="list-style-type: none"> Three individuals recorded at MP11 in 2017 were absent in 2018 One new individual was identified in 2018. It was noted in 2017 that a number of <i>G. parviflora</i> at MP11 were dying-off / senescing. In 2018 the health of some of these same individuals has improved whilst others have died. Three <i>G. parviflora</i> were observed to be in healthy condition in 2018, with new growth / shoots. The remaining 7 individuals presented varying degrees of senescence of which only 2 were also observed to have resprouted. In 2018, not a single individual was observed to have flowers or fruits.

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP12	Smooth-barked Apple – Red Bloodwood open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present Very high levels of fallen timber Dense ground cover Slight decrease in estimated foliage cover of the shrub and ground strata (respectively 5% and 10%) due to material from clearing of fence line being pushed within the eastern part of monitoring point (Appendix 2) <p>Conclusion: Some notable changes in vegetation and habitat condition were observed since the previous survey (2017) at MP12, mainly disturbance to the understorey from falling timber.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from pest animals, rubbish dumping, rock / timber removal, or dust Evidence of new disturbance from clearing of canopy and midstorey trees along the fence line. The cleared material has been pushed within the eastern part of the monitoring point smothering vegetation Some evidence of herbivory on shrub and ground layer No signs of recent fire Cleared grazing land 20 m to east adjacent to BOA with exotic grasses, but no weeds within BOA in this area. <p>Conclusion: Evidence of new disturbance due to clearing of fence line observed since the previous survey (2017) at MP12.</p>	<ul style="list-style-type: none"> A total of eleven <i>Grevillea parviflora</i> subsp. <i>parviflora</i> individuals were recorded at MP12 in 2018, compared to five individuals recorded in 2017, and seven in 2015 (120% increase from Baseline): <ul style="list-style-type: none"> Two individuals recorded at MP12 in 2017 were absent in 2018. 5 new individuals were recorded in 2018. All recorded <i>G. parviflora</i> plants at MP12 were observed to have a lot of new growth and one clump was observed to present insect damage. It was noted in 2018 that several large trees had been cut and pushed within MP12 smothering <i>G. parviflora</i> plants since the previous survey. The sharp increase in individual numbers is probably due to the flattening of older clump, which have then resprouted on either side of the felled trees. While individual stems were more than 30 cm apart, the impossibility of identifying the base of the clumps under the logs meant that some stems were identified as separate individuals, as per the methodology, while they are likely to be arising from the one location. No individuals were observed to be in flower at the time of survey.

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP13	Spotted Gum – Grey Ironbark open forest	<ul style="list-style-type: none"> Some natural die-back present in canopy trees All vegetation strata in healthy condition Canopy and midstorey regeneration present High fallen logs / timber Dense ground cover Moderate rock cover A minor increase (10%) in estimated ground cover (grasses) was recorded within the survey area since the previous survey (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP13.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP13.</p>	N/A
MP14	Smooth-barked Apple - Red Bloodwood open forest	<ul style="list-style-type: none"> Some evidence of foliage die-back in one <i>Eucalyptus eugenioides</i> and one <i>Eucalyptus paniculata</i> All vegetation strata in healthy condition Canopy and midstorey regeneration present Low fallen/ timber Dense ground cover No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP14.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire Exotic grasses around dam to south and along access track <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP14.</p>	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP15	Blackbutt - Turpentine - Tallowood shrubby open forest	<ul style="list-style-type: none"> Some evidence of continued foliage die-back in <i>Acacia irrorata</i> towards edge of disturbance area All vegetation strata in healthy condition Canopy and midstorey regeneration present Regrowth vegetation to the north and east (previously cleared) High fallen timber Very dense ground cover and leaf litter Rocky areas present No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP15.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP15.</p>	<ul style="list-style-type: none"> A total of eleven <i>Tetratheca juncea</i> individuals were recorded at MP15 in 2018 compared to 17 individuals recorded in 2017, and 30 in 2015 (63% decline from Baseline): <ul style="list-style-type: none"> Nine individuals recorded at MP15 in 2017 was absent in 2018. One new individual was recorded at MP15 in 2018. All <i>T. juncea</i> plants that were recorded at MP15 were observed healthy with a number of plants having new growth. Eight individuals had flowers and seven had fruits. The significant decline in the <i>T. juncea</i> at MP15 is most likely due to the lower than average rainfall during the past couple of years, exacerbated by the location of the monitoring point; upper slopes of exposed hill side.
MP16	Spotted Gum – Grey Ironbark open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present Moderate fallen timber Dense ground cover and leaf litter Low rock cover Minor increase (10%) from the previous year in <i>Lantana</i> cover but otherwise no changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP16. The increase in <i>Lantana</i> cover has been recorded this year only and no long-term trend can be established.</p>	<ul style="list-style-type: none"> No evidence of erosion and sedimentation No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire Several old dead stags present <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP16.</p>	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP17	Brush Box - Turpentine shrubby open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present High fallen timber Dense ground cover Rocky areas along ephemeral creek No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP17.</p>	<ul style="list-style-type: none"> Very minor scouring along creek bank No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP17.</p>	<ul style="list-style-type: none"> A total of six <i>Asperula asthenes</i> individuals were recorded at MP17 in 2018 compared to 2 individuals recorded in 2017 and eleven individuals recorded in 2015 (45% decline from Baseline): <ul style="list-style-type: none"> Three new individuals were recorded in 2018 All <i>A. asthenes</i> were observed to be in good health. Four plants had flowers and 3 had fruits Two individuals increased in size substantially in 2018. The decline in <i>A. asthenes</i> in 2018 since the baseline survey is most likely due to lower than average rainfall over the previous couple of years and MP17 being positioned on a rocky area on the periphery of the creek (less protected than other monitoring locations).

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP18	Brush Box - Turpentine shrubby open forest	<ul style="list-style-type: none"> No evidence of foliage die-back All vegetation strata in healthy condition Canopy and midstorey regeneration present High fallen timber and leaf litter Dense ground cover Rocky areas along ephemeral creek No changes in estimated foliage cover for each vegetation stratum (Appendix 2) <p>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2017) at MP18.</p>	<ul style="list-style-type: none"> Very minor scouring along creek bank No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust No signs of recent fire <p>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2017) at MP18.</p>	<ul style="list-style-type: none"> A total of four <i>Asperula asthenes</i> individuals were recorded at MP18 in 2018 same number as 2017 but compared to 13 individuals recorded in 2016 and 2015 (69% decline from Baseline): <ul style="list-style-type: none"> 3 individuals recorded at MP18 in 2017 were absent in 2018. 3 additional <i>A. asthenes</i> was recorded since the previous survey in 2017. The remaining <i>A. asthenes</i> were observed to be healthy condition, with only one plant observed to have flowers and no plant was observed to bear fruits. The decline in <i>A. asthenes</i> in 2018 is most likely due to the below average rainfall over the past couple of years, compounded by the site being positioned high on the creek bank in a less protected area than other monitoring locations. More individuals were observed outside of the monitoring point, within the creek bed.

The 2018 threatened species monitoring identified a decrease in threatened flora abundance at half of the monitoring locations. Table 5 illustrates the percentage of decline in threatened flora from the baseline to the current surveys. It should be noted that monitoring points: MP4, MP7, MP8, MP15 and MP17 are considered close to the impact area (as per BOAMP) and MP3, MP11, MP12 and MP18 are located further away from the impact area within the BOA.

Table 5: Threatened species percentage change from baseline survey.

Monitoring Point	Species	Change from Baseline (%)	Average Change
3 (Away from Impact Area)	<i>Asperula asthenes</i>	-12.5%	29% Decline
4 (Close to Impact Area)		12%	
17 (Close to Impact Area)		-45%	
18 (Away from Impact Area)		-69%	
7 (Close to Impact Area)	<i>Tetradlea juncea</i>	14%	16% Decline
8 (Close to Impact Area)		0%	
15 (Close to Impact Area)		-63%	
8 (Close to Impact Area)	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	0%	27.5% Increase
11 (Away from Impact Area)		-37.5%	
12 (Away from Impact Area)		120%	

Decline in threatened species abundance cannot be confidently attributed to the quarry disturbance as there is no correlation between monitoring points with higher percentage of decline and proximity to the quarry; high levels of decline (>10%) was observed at both sites close to and away from the impact area. A likely cause for the decrease in threatened species abundance is the below average rainfall experienced throughout 2018 in the region as shown in the graph below illustrating 2018 rainfall against the average rainfall from 1881 to 2018 (**Chart 1**). Rainfall for the year was 182.4 mm below average at the Nelson Bay weather station and vegetation in the region is showing signs of drought stress. This was evident within the BOA during the 2018 survey event. *Asperula asthenes* is particularly vulnerable to climatic change with preferred habitat is damp sites often along river banks on the east coast from Bulahdelah to Kempsey in scattered clumps (OEH 2017). Continued ecological monitoring is required to ensure that the species recover as conditions become more favourable. It should be noted that the large increase in the number of *Grevillea parviflora* individuals at Monitoring

Point 12 is most likely due to the flattening of clumps by fallen timber. Due to the difficulty of identifying the root structure of plants under fallen logs and the requirement to count individuals according to the methodology (stipulating that stems more than 30cm apart should be counted as separate individuals) the 120% increase in the number of individuals at this location may not reflect the actual state of the local population that has been in decline since the 2015 baseline.

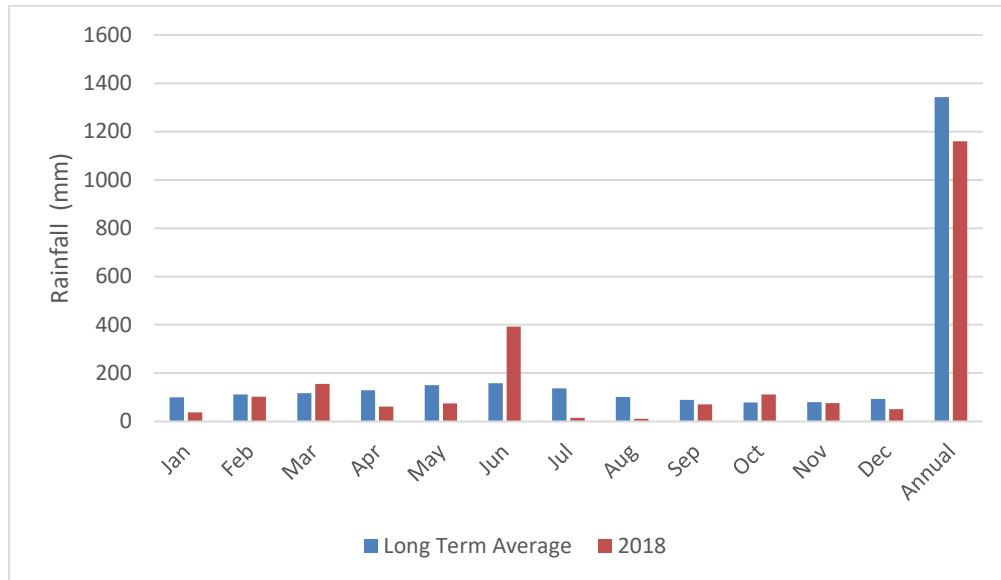


Chart 1: 2018 monthly rainfall compared to average rainfall at Nelson Bay weather station (source BOM)

While there was a decline in the populations of threatened species across the BOA at half of the monitoring locations, some sites did exhibit growth and had healthy plants. Typically, these sites were more protected, occurring lower areas and along protected creek lines. Increases in threatened species was observed at MP 4, 7 and 12. Flowering and fruiting was generally higher than the previous survey events for both *Tetradlea juncea* and *Asperula asthenes*. *Grevillea parviflora* subsp. *parviflora* was not observed to be flowering or fruiting at any of the Monitoring Points. However, both fruit and flowers were observed on individuals within the vicinity of MP8. (**Plate 1**).



Plate 1: *Grevillia parviflora* subsp. *parviflora* with flowers in Lot 13.

3.2 WEEDS

Figure 5 shows the distribution of weeds mapped across the BOA, within the project disturbance area, within 50 m of the project disturbance area, and along Yalimbah Creek on Lot 12. *Lantana camara* (Lantana) (Priority Weed within the Mid Coast LGA) is the most abundant weed species across the site, with the majority of infestations occurring on the northern part of the BOA. Dense infestations of Lantana were primarily observed along the drainage lines in Lot 5. Two other Priority Weed species were also identified in the BOA: *Asparagus aethiopicus* (Ground Asparagus) and *Senecio madagascariensis* (Fireweed) are both listed as Priority Weeds within the Mid Coast LGA. These two species only occur as small discrete patches in a few locations in the BOA.

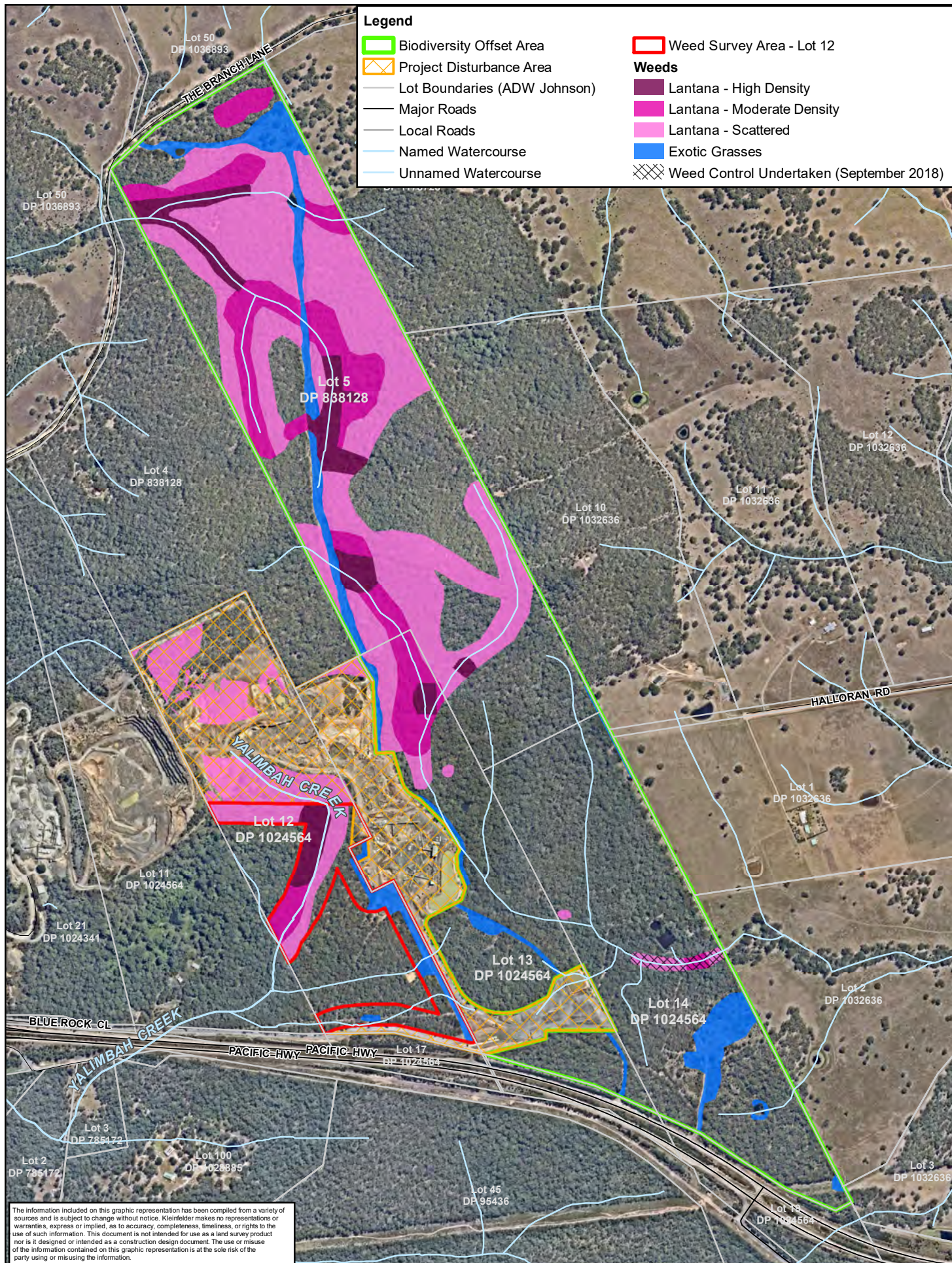
Notable areas of exotic perennial grasses have also been mapped (**Figure 5**). The dominant exotic grass species in these areas include *Setaria sphacelata* (South African Pigeon Grass), *Andropogon virginicus* (Whisky Grass), and *Axonopus fissifolius* (Narrow-leafed Carpet Grass), as well as a variety of annual and perennial exotic herbs. The areas dominated by exotic grasses are primarily restricted to the power line easement, around existing dwellings, track edges, perimeter of quarry disturbance area and previously cleared regrowth areas on the southern part of Lot 14. While the dense areas of exotic grasses have been mapped, they are not considered target weed species at this stage as they represent a relatively low threat to the integrity of ecological values within the site. The exotic grasses occurring in the areas of native regrowth are also likely to be shaded out over time as the canopy and midstorey cover continue

to regenerate. However, the distribution of exotic grasses will continue to be monitored, and any increases will be evaluated to determine if management is required.

It was observed during the 2018 annual monitoring event that weed density had reduced with signs of stress evident within lot 5. This is most likely due to the dry conditions experienced onsite especially on higher poor soils when compared with areas further south. Some areas further south in more sheltered locations, especially along creeklines have witnessed an increase in weed density.

It is recommended weed control works for the next 12 months should focus on the Lantana infestations in the south-west portion of Lot 5 and north-east part of Lot 13. Additionally, manual control of exotic grasses within 10 m of the *Asperula asthenes* individuals in the powerline easement on Lot 5 should also be undertaken. These weed control activities must be undertaken in spring in accordance with the procedures detailed in Section 3.10 of the BOAMP due to the presence of threatened flora (*Asperula asthenes*) in these areas.

A combined list of weed species from the surveys completed by ELA (2013) and Kleinfelder (2017) across the BOA is provided in **Appendix 4**.



 www.kleinfelder.com	PROJECT REFERENCE: 20192281 DATE DRAWN: 14/03/2019 12:01 Version 1 DRAWN BY: gjoyce	Weed Mapping Karuah East Quarry Pty Ltd 2018 Annual Monitoring Report Karuah East Quarry Project	FIGURE: <div style="font-size: 2em; text-align: center;">5</div>
	DATA SOURCE: NSW DFSI - 2017 ADW Johnson - 2015 Nearmap - 2018		

3.3 FENCING AND TRACKS

Figure 6 shows the layout of existing and required fencing, gates and tracks across the BOA. Boundary fencing is required around the entire KEQ project area. Fencing of KEQ project area / BOA boundary has commenced (approximately 70% completed in 2017). A new fence was installed along the eastern boundary of the BOA adjoining Lot 10 in 2017. Fencing along the remaining 30% of project area / BOA boundary, and Lot 5 / Lot 14 boundary is required. Internal fencing is also required around the existing dwellings on Lot 5 and Lot 14. It is noted that the dwelling in Lot 5 is not currently occupied. This internal fencing must be installed prior to this dwelling being occupied. All fencing works shall be undertaken in accordance with Section 3.2 of the BOAMP.

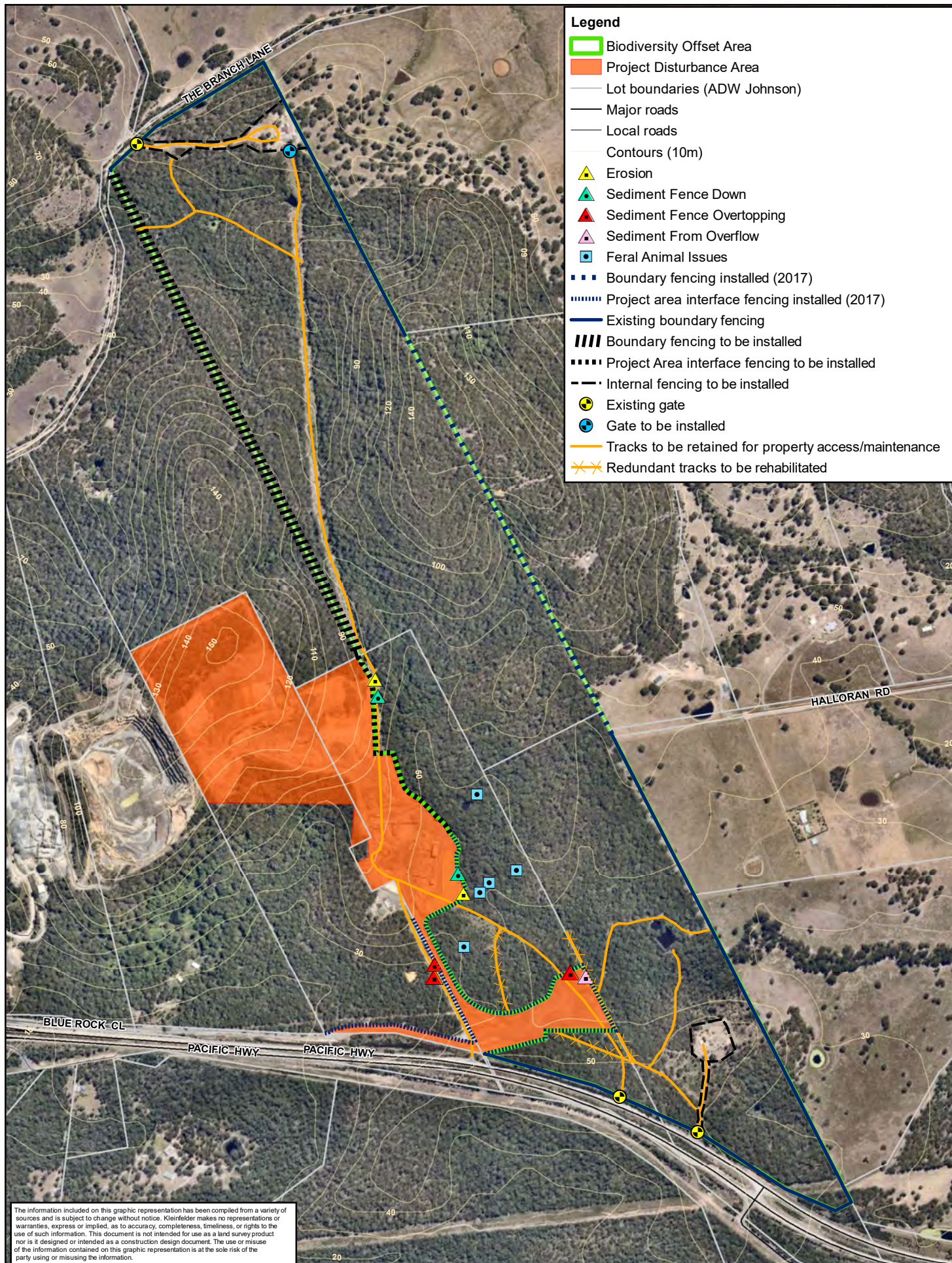
Several access tracks occur throughout the BOA. The majority of these tracks are important for facilitating access for management activities across the BOA, and as such it is recommended that these tracks be maintained. Several sections of tracks on the southern part of the BOA are not considered critical for ongoing management. These sections have been rehabilitated with branches, hollow logs / sections and other organic debris salvaged from the KEQ disturbance area during vegetation clearing.

The existing tracks to be retained in the BOA were assessed as being in adequate condition for 4WD access during the 2018 surveys and no maintenance is recommended at this stage. However, it is noted that some initial repairs may be required for the tracks to be suitable for emergency fire-fighting vehicles. Additionally, the track located within the powerline easement is overgrown and while still in decent condition, will require some slashing to facilitate access. The need for initial repairs will be determined during development of the Fire Management Strategy as per Section 3.12 of the BOAMP.

3.4 EROSION

No areas of major active erosion were identified within the BOA during the 2018 monitoring. Minor scouring was observed in several locations along the drainage lines within Lot 5. However, this scouring is considered to be natural stream bank erosion as there was no evidence of unnatural disturbance in these areas, and overall the streams have relatively high ground vegetation cover and appear stable. There are also some areas of bare ground on the access tracks within the BOA; however, these areas also appeared to be stable and no substantial active erosion or sedimentation was observed in these areas.

Certain areas of the BOA (primarily the steep slopes on Lot 5) have the potential to develop erosion following Lantana control works. The need for erosion or soil stabilisation measures following initial treatment of moderate and high density Lantana areas on steep slopes will be assessed at each maintenance / monitoring event.



<p>0 50 100 200 300 400 500</p> <p>Metres</p> <p>KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com</p>	<p>PROJECT REFERENCE: 20192281</p> <p>DATE DRAWN: 14/03/2019 11:56 Version 1</p> <p>DRAWN BY: gjoyce</p> <p>DATA SOURCE: NSW DFSI - 2017 ADW Johnson - 2015 Nearmap - 2018</p>	<p>Fencing, Track, Erosion, and Pest Issues</p> <p>Karuah East Quarry Pty Ltd 2018 Annual Monitoring Report Karuah East Quarry Project</p>	<p>FIGURE:</p> <p>6</p>
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Sediment fencing and bund walls / diversion drains were in place in all areas downslope of disturbed areas except for the area north of Dam 1. However, the sediment fences installed along the eastern side of the overburden stockpile and the area south east of Dam 1 had failed at the time of the 2018 inspection. Active erosive processes are evident in several locations where rill erosion can be observed along the wall of Dam 1 and the overburden stockpile wall. These processes are washing away sediments and rocks overtopping the sediment fence and spilling over the surrounding bushland. Erosion issues were observed at three areas surrounding the quarry disturbance area:

- In three locations the installed sediment fencing was overtopping and therefore no longer providing active sediment control (**Figure 6**). It was observed in these locations that some sediment had been deposited within the surrounding environment but it was still contained within the project disturbance area and no sediment overflow had entered the BOA.
- It was noted during the 2017 monitoring event that the overflow for Dam 3 was depositing small amounts of sediment into the receiving environment with water being retained in the bushland east of the basin for a period. It was noted during the 2018 monitoring event that a small trough had been dug to allow the overflow from the dam to drain out of the area and into Bulga Creek. While some minor erosion and sedimentation was observed on the discharge side of the dam wall, it was still contained within the project disturbance area. This management action has remediated the waterlogging issue and no die-back or change in vegetation structure and composition was observed in 2018. Ongoing annual monitoring will be required to assess the effectiveness of the drainage and ensure no die-back or change in vegetation structure and composition occurs.
- Two area of unmanaged active erosion were observed along the eastern side of the overburden stockpile area and the south-eastern bank of Dam 1. The bank is actively eroding due to a lack of ground cover and / or erosion control devices. While sediment fences have been installed since the previous monitoring event, they have been buried by eroded material, and small amount of sediment is depositing along the fringe of the adjacent bushland as shown in **Plate 2**. These fences should be re-erected to provide active sediment control.
- It was observed during the 2018 monitoring event that the wall of Dam 3 was being colonized by native species of plants actively protecting it from further erosion. However, the wall of Dam 1 as well as the overburden stockpile wall were only sparsely colonized by plants and were still actively eroding in some areas.



Plate 2: Erosion along the south-eastern bank of Dam 1 (top and bottom left) and the overburden stockpile (bottom right)

3.5 VERTEBRATE PESTS

A number of diggings were observed in the southern half of the BOA area during the site inspection (**Figure 6**). These disturbances were identified as Feral Pig diggings. Karuah East Quarry has engaged a contractor to undertake feral animal control in the BOA. Pig trapping in Lot 14 has commenced in March 2019.

3.6 HABITAT RESOURCES

Salvage and Redistribution of Habitat Resources

Section 6.3.1 of the L&RMP and Section 3.8 of the BOAMP detail the protocol and requirements for salvaging habitat resources (i.e. logs, hollows and other large organic debris) during the KEQ project, and redistributing into the rehabilitation or offset areas. Vegetation clearing undertaken in 2016 for the KEQ project has included the salvage of a large quantity of organic material (primarily large trees and logs). These resources are currently stockpiled on the

boundaries of the KEQ project area (**Figure 7**), which will be respread across rehabilitation areas as the project progresses.

In addition to this, a number of hollows and hollow log sections (total of 77) have been salvaged and are in the process of being prepared for redistribution into the BOA (**Plate 3**). The location of the hollow logs to be redistributed throughout the BOA is shown on **Figure 7**. The quantity and locations of hollows and other salvaged organic materials that are redistributed in the BOA will be recorded as part of future monitoring. As clearing for the first stage of the KEQ project has been completed as of November 2016, the salvaged hollows will need to be installed to offset loss of hollows at a 1:1 ratio as per Section 3.8 of the BOAMP



Plate 3: Hollow sections salvaged for redistribution into the BOA

Nest Boxes

A total of 30 nest boxes were installed within the BOA in April 2016 as per Section 3.8 of the BOAMP. A further 93 nest boxes were installed between the 3rd and 6th of February 2018 and two large owl boxes were installed by quarry staff on 14 February 2018 (totalling 125) offsetting the original clearing works and loss of hollows at a 1:1 ratio assuming the 77 salvaged hollows are distributed throughout the BOA. The locations of these nest boxes are shown in **Figure 7**. In June 2018, the initial 30 nest boxes were monitored as per Section 3.8 of the BOAMP. Results showed that all 30 boxes were deemed to be available for use with no damaged or unusable boxes. Eight Glider boxes showed signs of use including one being actively occupied by two Sugar Gliders (*Petaurus breviceps*). None of the Microchiropteran bat exhibited signs of use during the survey.

Figure 7: Habitat resources and nest box locations

4. PERFORMANCE CRITERIA EVALUATION

Table 5 details the management actions and associated BOAMP performance criteria relevant to the BOAMP implementation. This provides an evaluation of the current status of each relevant management action and indicates if further works are required to complete the action (priority actions in **bold text**).

It is noted that the BOAMP was endorsed by all consent authorities (i.e. Council, NSW DP&E and Commonwealth DotE) as of March 2016. As such, all Year 1 management actions should be completed before March 2017 to ensure compliance with the relevant performance criteria.

Table 6: Current status of BOAMP performance criteria

Action	Performance Criteria	Current Status (2019)
FENCING, GATES AND SIGNAGE		
Fence mapping	Completed by end of year 1	Baseline fence mapping completed in October 2015.
Boundary fencing, gates and signage installation / repairs	Completed by end of year 1	Outstanding Installation of boundary fencing, gates and signage required.
Redundant fencing removal	Completed by end of year 3	N/A – no redundant fencing identified during baseline fence mapping.
Fencing inspections	Completed annually	Annual inspection completed.
Fencing maintenance	Boundary fencing in place and signage present by end of year 1	Outstanding Installation and repair of boundary fencing, gates and signage required.
ACCESS TRACKS		
Access track mapping and assessment	Completed by end of year 1	Baseline track mapping and assessment completed in October 2015.
Access track repairs	Completed by end of year 3 Track repair does not impact on ecological values and is restricted to defined limits	No major track repair requirements identified. Access tracks assessed as being in suitable condition for 4WD access during the 2018 monitoring. The powerline easement access track requires minor clearing to ensure proper access for the 2019 monitoring event.
Redundant access track rehabilitation	Completed by end of year 3	Rehabilitation of redundant tracks completed and natural regeneration occurring.
Access track inspections	Completed annually	Annual inspection completed.
EROSION, SEDIMENTATION AND SOIL MANAGEMENT		
Erosion and sedimentation mapping	Completed by end of year 1	Baseline assessment completed in October 2015.
Erosion repair and management	Completed by end of year 3 Repair of erosion within BOA does not impact on ecological values	During the 2018 survey, three areas were identified as requiring repair or management, these actions should be undertaken immediately. The effectiveness of erosion and sediment control measures within the Karuah East Quarry project area such as silt fencing and diversion drains should be inspected and maintained regularly and after rain events.

Action	Performance Criteria	Current Status (2019)
Erosion inspections	Completed annually	Annual inspection completed in October 2018.
EXISTING DWELLINGS		
Exclusion of existing dwellings from Conservation Agreement	Completed by end of year 1	The survey plan excluded the two existing dwellings.
Fencing and signage installation	Completed by end of year 1	Outstanding Installation of fencing, gates and signage required.
Inspections	Completed annually	Annual inspection completed in October 2018.
Maintenance and weed control	No noxious weeds present within excised areas. No unauthorised disturbance outside of excised areas in the BOA.	No environmental weeds impacting on the integrity of the BOA were identified in excised areas during 2018 monitoring. No unauthorised disturbance observed outside of excised areas in the BOA during 2018 monitoring.
REVEGETATION AND REGENERATION*		
Confirm extent of revegetation areas	Completed by end of year 1	Completed. No revegetation works were assessed as being required within the BOA during the 2015, 2016, 2017 or 2018 monitoring. The requirement for revegetation works within the BOA will be reassessed each year.
HABITAT AUGMENTATION		
Salvage and redistribution of habitat resources	Redistribution of salvaged resources by end of Year 3 Redistribution of salvaged resources does not impact on ecological values of BOA, including threatened flora	Salvage and redistribution of habitat resources in progress (refer to Section 3.5).
Nest box installation	30 nest boxes installed in BOA prior to commencement of clearing. Remaining nest boxes installed within three months following completion of clearing.	30 nest boxes were installed in the southern part of the BOA in April 2015 prior to commencement of clearing. An additional 95 were installed in February 2018.
Nest box monitoring and maintenance	Nest boxes inspected every two years. Repairs / maintenance implemented within 6 months of biennial inspection.	Monitoring of nest box was carried in April 2018, monitoring of boxes 31-125 due in February 2020.
THREATENED FLORA TRANSLOCATION		
<i>Tetratheca juncea</i> translocation	Translocation completed by end of year 1 Maintenance and monitoring undertaken in accordance with the TjMP	Refer to Tj Translocation Monitoring Report (Firebird 2017).
WEED CONTROL		
Baseline weed mapping	Completed by end of year 1	Baseline assessment completed in October 2015 (Kleinfelder 2015).

Action	Performance Criteria	Current Status (2019)
Delineation of threatened flora prior to weed control works	No impacts on threatened flora populations within BOA from weed control activities.	N/A – no weed control works undertaken surrounding threatened species locations to date.
Weed control	20% reduction in extent or density (cover) of target weeds per year compared to baseline mapping by end of Year 3. Weed control activities do not impact on ecological values.	Small area of Lantana along the creek line in Lot 14 was sprayed in September 2018. Substantial amount of dieback in this area has occurred by February 2019.
Weed monitoring	Completed biennially (every two years) (for BOA). Completed annually (KEQ, 50 m buffer and Yalimbah Creek).	Weed mapping revisited for KEQ project area, adjoining vegetation within 50 m of the project area boundary on Lots 12 and 13, along Yalimbah Creek (Lot 12), and BOA in October 2017.
VERTEBRATE PEST MANAGEMENT		
Baseline vertebrate pest assessment	Completed by end of year 1	Baseline assessment completed in October 2015 (Kleinfelder 2015).
Vertebrate pest control	No non-target species affected by control works. Reduction in abundance of target species across BOA compared to baseline assessment.	Feral animal trapping (pigs) commenced in March 2019.
Monitoring	Completed biennially (every two years).	Outstanding 2017 biennially vertebrate pest monitoring required.
FIRE MANAGEMENT		
Fire management strategy	Completed by end of year 1	Outstanding A fire management strategy is to be prepared for the BOA.
Bushfire mitigation	Bushfire mitigation measures in the L&RMP adhered to at all times	Refer to KEQ Annual Environmental Report.
ECOLOGICAL MONITORING		
Additional baseline surveys	Completed prior to clearing	Baseline surveys completed (refer to Kleinfelder 2016).
Vegetation and threatened flora monitoring	Baseline ecological monitoring undertaken prior to clearing in year 1. Less than 10% decline in <i>Tetradlea juncea</i> , <i>Grevillea parviflora</i> subsp. <i>parviflora</i> and <i>Asperula asthenes</i> population sizes (at monitoring sites) compared to baseline assessment. No major changes in vegetation health or condition across BOA.	Baseline ecological monitoring completed (refer to Kleinfelder 2016). No major changes in vegetation health or condition were observed in the BOA in 2018. An average of 6% decline in threatened flora species at monitoring sites was observed during 2018 survey.

*Criteria relating to revegetation within the project area is outlined in the Landscape and Rehabilitation Management Plan (L&RMP).

5. CONCLUSION

While some species are stressed from dry conditions, the results from the 2018 monitoring indicate that the vegetation and fauna habitats within the Karuah East Biodiversity Offset Area (BOA) and Lot 12 are in good condition and remain relatively unchanged since the baseline survey in 2016.

A significant change was recorded within the threatened flora populations sampled at some of the monitoring sites. It is likely these declines are a result of a dry year with below average rainfall. There was not obvious association between the monitoring site proximity to the disturbance area and the level of decline in threatened species; decline was observed both close to and away from the disturbance area. Continued annual monitoring is required to ensure the species respond as conditions become more favourable.

Some of the management and monitoring actions required prior to the end of Year 1 (i.e. March 2017) and Year 2 (i.e. March 2018) have not been completed. The 2018 monitoring has identified several key management actions that are required to be completed, which have been highlighted in **Section 4** of this report. These include sediment fence repair, fence installation, salvaged habitat installation, weed control, fire management plan and vertebrate pest monitoring. These actions should be undertaken in accordance with the relevant sections of the BOAMP and this monitoring report.

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APPENDIX 1. THREATENED FLORA MONITORING

Appendix 1.1 – Biodiversity Offset Area Monitoring Sites

Monitoring Point 3 - *Asperula asthenes* monitoring results

Number	Distance (cm)	Bearing (degrees)	Clump Size (cm)				Flower / Fruit Present (2018)	Comments
			2015	2016	2017	2018		
3A	160	140	30 x 25	70 x 40	10 x 5	30x10	-	New growth
3B	280	150	20 x 25	-	5 x 5	-	-	Not found
3C	160	120	40 x 30	40 x 30	170 x 90	200x50	Flower / Fruit	Several large clumps
3D	460	110	50 x 20	30 x 20	-	-	-	Not found, high level of leaf litter
3E	500	110	55 x 30	30 x 30	45 x 40	5x5	Flower	1 shoot
3F	530	105	50 x 10	30 x 30	60 x 20	60x20	Flower	2 new shoots
3G	590	115	25 x 35	25 x 40	170 x 80	-	-	Not present, high level of leaf litter
3H	650	110	20 x 20	40 x 20	-	100x100	Flower / Fruit	Some dieback, herbivory
3I	690	130	40 x 25	30 x 20	-	-	-	Not found
3J	780	120	35 x 20	20 x 20	-	80x50	Flower	Individual rerecorded, several new shoots
3K	850	120	30 x 30	30 x 30	60 x 15	-	-	Not found
3L	900	145	35 x 45	20 x 10	-	-	-	Not found
3M	680	260	40 x 35	40 x 35	25 x 30	40x20	Flower	2 new shoots, herbivory
3N	790	270	30 x 25	30 x 20	-	-	-	Not found
3O	990	300	55 x 25	-	-	20x5	-	Individual rerecorded, several new shoots
3P	240	70	40 x 20	40 x 15	40 x 15	40x20	Flower	Several new shoots
3Q	590	105	-	40 x 10	-	-	-	Merged with H
3R	930	115	-	30 x 30	-	-	-	Not found
3S	700	275	-	20 x 30	5 x 5	-	-	Not found
3T	300	80	-	-	5 x 25	-	-	Not found, animal tracks
3U	800	280	-	-	30 x 20	50x20	Flower	New shoots
3V	800	105	-	-	-	5x5	Flower	1 single stem
3W	780	115	-	-	-	80x50	Flower	Several new shoots
3X	770	125	-	-	-	5x5	Flower / Fruit	1 single stem

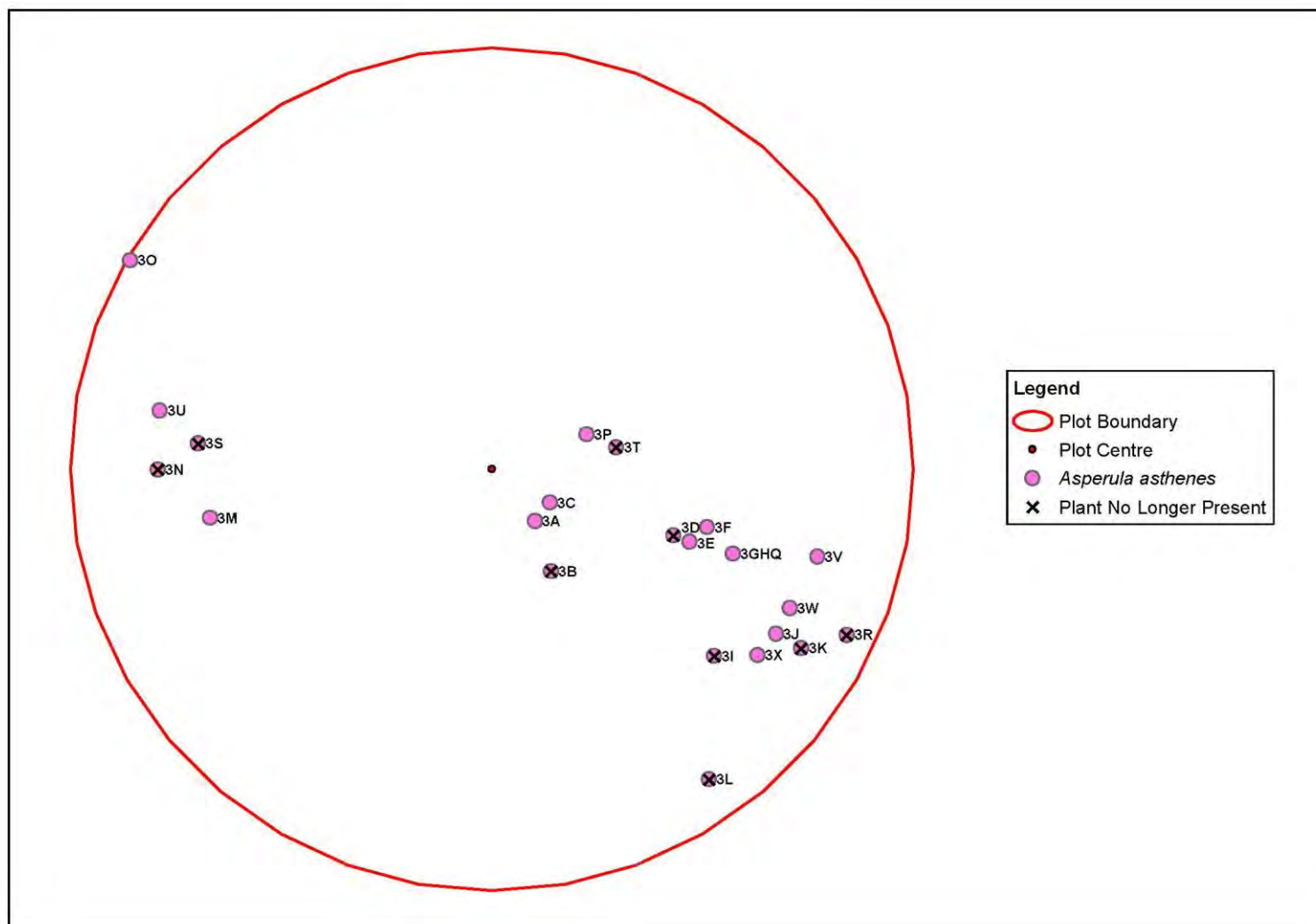


Figure A1-1: *Asperula asthenes* locations – monitoring point 3

Monitoring Point 4 - *Asperula asthenes* monitoring results

Number	Distance (cm)	Bearing (degrees)	Clump Size (cm)				Flower / Fruit Present (2018)	Comments
			2015	2016	2017	2018		
4A	160	195	30 x 20	30 x 20	5 x 5	-	-	Not found
4B	620	215	55 x 20	45 x 25	-	20x10	-	Individual rerecorded, 2 new shoots
4C	660	215	30 x 15	30 x 30	-	5x5	-	Individual rerecorded, 1 new shoots
4D	630	220	20 x 20	20 x 20	-	20x10	-	Individual rerecorded, Several new shoots
4E	760	220	65 x 20	40 x 20	10 x 5	-	-	Not found
4F	810	210	70 x 45	70 x 40	10 x 5	-	-	Not found
4G	940	205	40 x 15	50 x 10	30 x 10	5x10	-	1 single stem
4H	740	205	50 x 30	50 x 30	20 x 10	40x30	-	Covered in vegetation
4I	740	200	80 x 15	60 x 40	-	5x10	-	Individual rerecorded, 2 new shoots
4J	110	325	80 x 30	60 x 30	70 x 10	10x70	Flower	Several new shoots
4K	890	25	30 x 30	40 x 30	60 x 60	-	-	Not Found
4L	920	20	55 x 35	50 x 25	50 x 30	5x3	-	1 single stem, high level of leaf litter
4M	210	105	115 x 30	90 x 40	90 x 10	-	-	Not found
4N	840	185	110 x 30	100 x 40	50 x 10	40x30	-	2 buds
4O	590	70	40 x 25	50 x 50	80 x 5	-	-	Not found
4P	850	235	-	20 x 20	40 x 2	-	-	Not found
4Q	680	355	-	20 x 30	180 x 80	60x20	Flower	Several new shoots
4R	155	270	-	-	20 x 5	50x10	Flower	2 clumps within 30cm
4S	590	80	-	-	10 x 15	-	-	Not Found, high level of leaf litter
4T	890	15	-	-	10 x 5	-	-	Not found
4U	30	0	-	-	20 x 10	-	-	Not found
4V	680	225	-	-	80 x 50	-	-	Not found
4W	770	350	-	-	-	20x5	-	1 stem
4X	640	345	-	-	-	50x20	-	2 clumps 30cm apart

Number	Distance (cm)	Bearing (degrees)	Clump Size (cm)				Flower / Fruit Present (2018)	Comments
			2015	2016	2017	2018		
4Y	600	345	-	-	-	50x20	-	Some dieback, new shoots
4Z	875	350	-	-	-	30x5	-	2 new shoots 30cm apart
4Aa	995	345	-	-	-	10x10	-	Several new shoots
4Ab	700	215	-	-	-	10x5	Flower	-

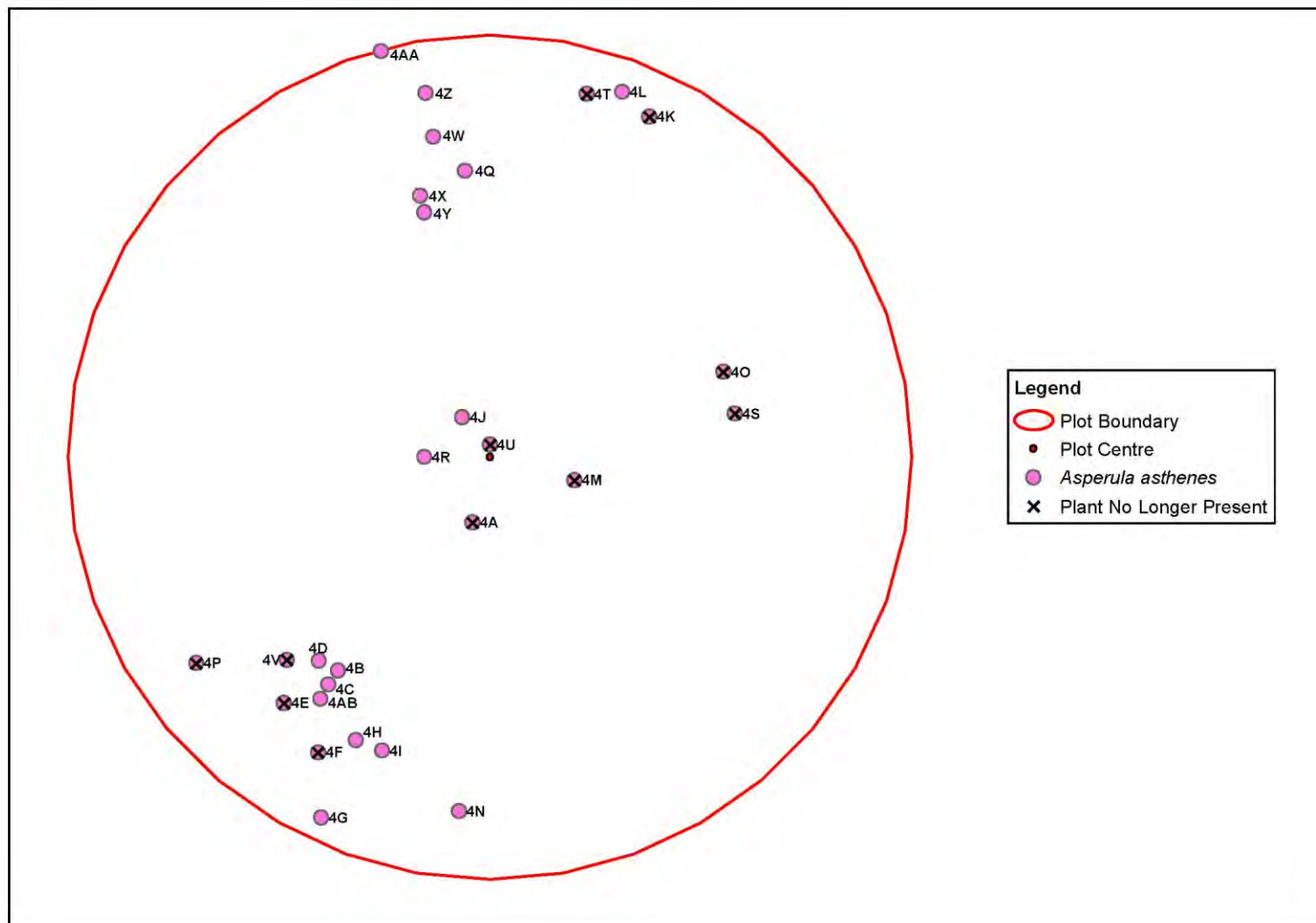


Figure A1-2: *Asperula asthenes* locations – monitoring point 4

Monitoring Point 7 - *Tetradlea juncea* monitoring results

Number	Distance (cm)	Bearing (degrees)	Clump Size (cm)				Flower (2018)	Fruit (2018)	Comments
			2015	2016	2017	2018			
7A	440	160	70 x 40	60 x 40	60 x 50	10x60	2	5	Dieback
7B	470	155	5 x 5	10 x 5	-	10x10	3	-	Individual rerecorded
7C	500	155	35 x 15	40 x 15	70 x 30	60x30	12	3	New growth
7D	770	135	50 x 20	60 x 40	90 x 50	70x40	4	-	Dieback
7E	730	95	60 x 50	90 x 40	100 x 70	100x50	37	24	-
7F	800	275	60 x 10	70 x 20	20 x 5	-	-	-	Not found
7G	780	270	40 x 40	40 x 40	60 x 20	-	-	-	Merge with H
7H	710	270	50 x 10	50 x 10	90 x 20	100x50	30	20	Merge with G
7I	510	265	30 x 10	30 x 10	20 x 5	-	-	-	Not found
7J	460	255	40 x 20	40 x 30	90 x 30	100x50	14	6	New growth
7K	420	260	70 x 45	80 x 40	70 x 70	100x80	43	25	New growth
7L	400	240	45 x 10	50 x 10	55 x 10	20x10	1	-	Dieback
7M	570	205	110 x 70	110 x 70	110 x 80	60x20	4	2	-
7N	610	195	45 x 35	45 x 35	35 x 50	80x30	2	5	-
7O	310	240	-	20 x 20	20 x 15	-	--	-	Not found

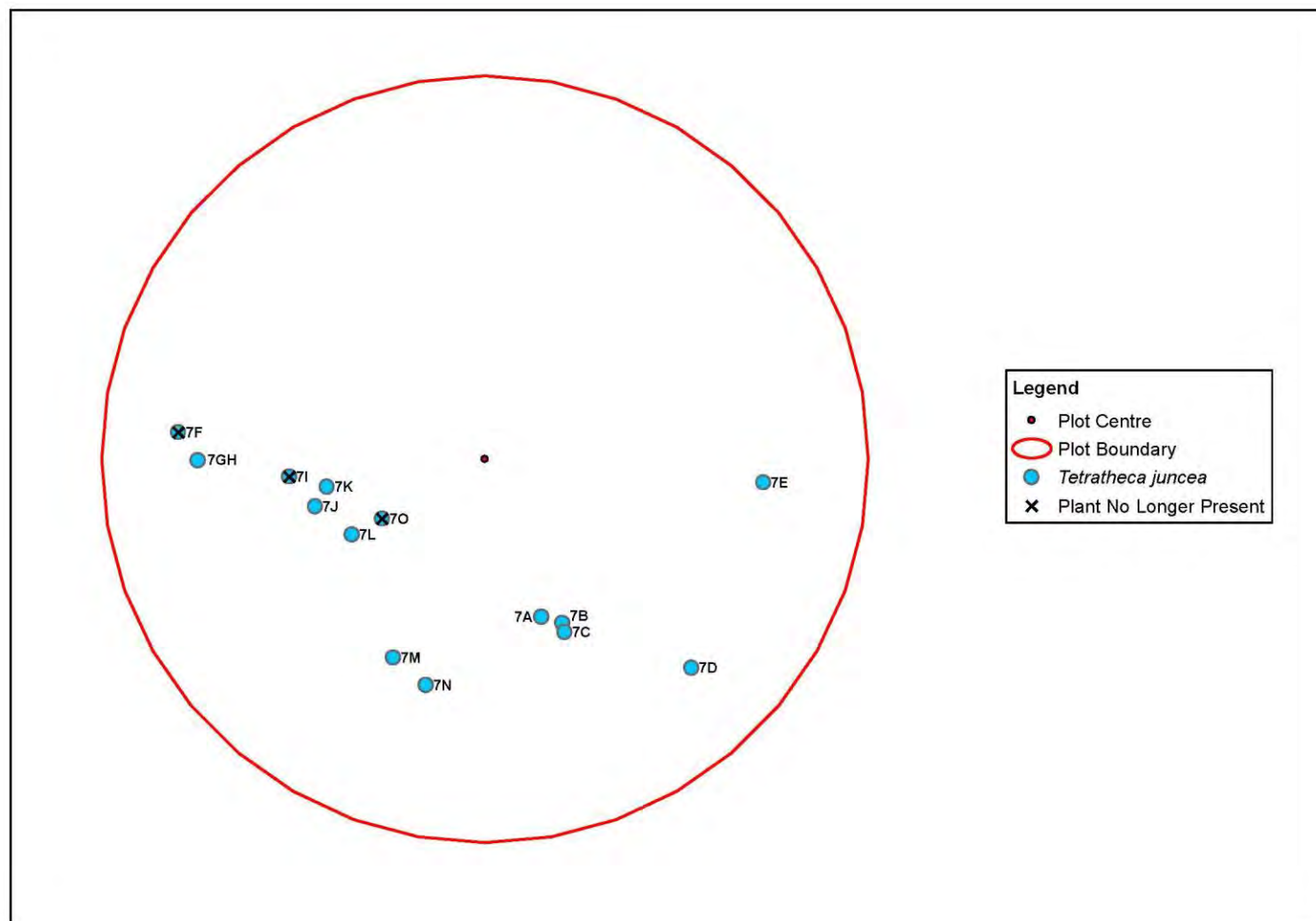


Figure A1-3: *Tetratheca juncea* locations – monitoring point 7

Monitoring Point 8 - *Tetradlea juncea* and *Grevillea parviflora* monitoring results

Number	Species	Distance (cm)	Bearing (degrees)	Clump Size (cm) / Maximum Stem Height				Flower (2018)	Fruit (2018)	Comments
				2015	2016	2017	2018			
8A	<i>Tetradlea juncea</i>	210	235	110 x 70	110 x 80	130 x 80	80 x 110	25	20	Dieback
8B	<i>Tetradlea juncea</i>	480	225	40 x 30	60 x 30	90 x 20	80 x 20	2	2	New growth
8C	<i>Tetradlea juncea</i>	560	225	120 x 110	120 x 100	-	-	-	-	Not found
8D	<i>Tetradlea juncea</i>	650	230	110 x 110	110 x 110	120 x 60	45 x 10	1	6	Dieback, High level of leaf litter
8E	<i>Tetradlea juncea</i>	750	230	65 x 30	65 x 30	40 x 80	60 x 30	3	1	Dieback, new growth
8F	<i>Tetradlea juncea</i>	620	240	80 x 30	90 x 30	120 x 50	120 x 40	5	8	New growth, 3 groups of stems
8G	<i>Tetradlea juncea</i>	710	240	100 x 50	100 x 50	80 x 50	100 x 50	6	5	Dieback, new growth
8H	<i>Tetradlea juncea</i>	730	250	60 x 50	60 x 50	100 x 40	-	-	-	Not found, high level of leaf litter
8I	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	310	280	30	30	30	70	-	-	Dieback, smothered by <i>Cassytha</i>
8J	<i>Tetradlea juncea</i>	390	275	50 x 10	50 x 10	65 x 10	60 x 20		4	Dieback, new growth
8K	<i>Tetradlea juncea</i>	400	195	60 x 20	60 x 20	90 x 90	170 x 50	39	52	New growth
8L	<i>Tetradlea juncea</i>	920	280	-	-	70 x 70	70 x 80	6	11	Dieback, new growth
8M	<i>Tetradlea juncea</i>	850	280	-	-	-	40 x 20	1	1	New growth

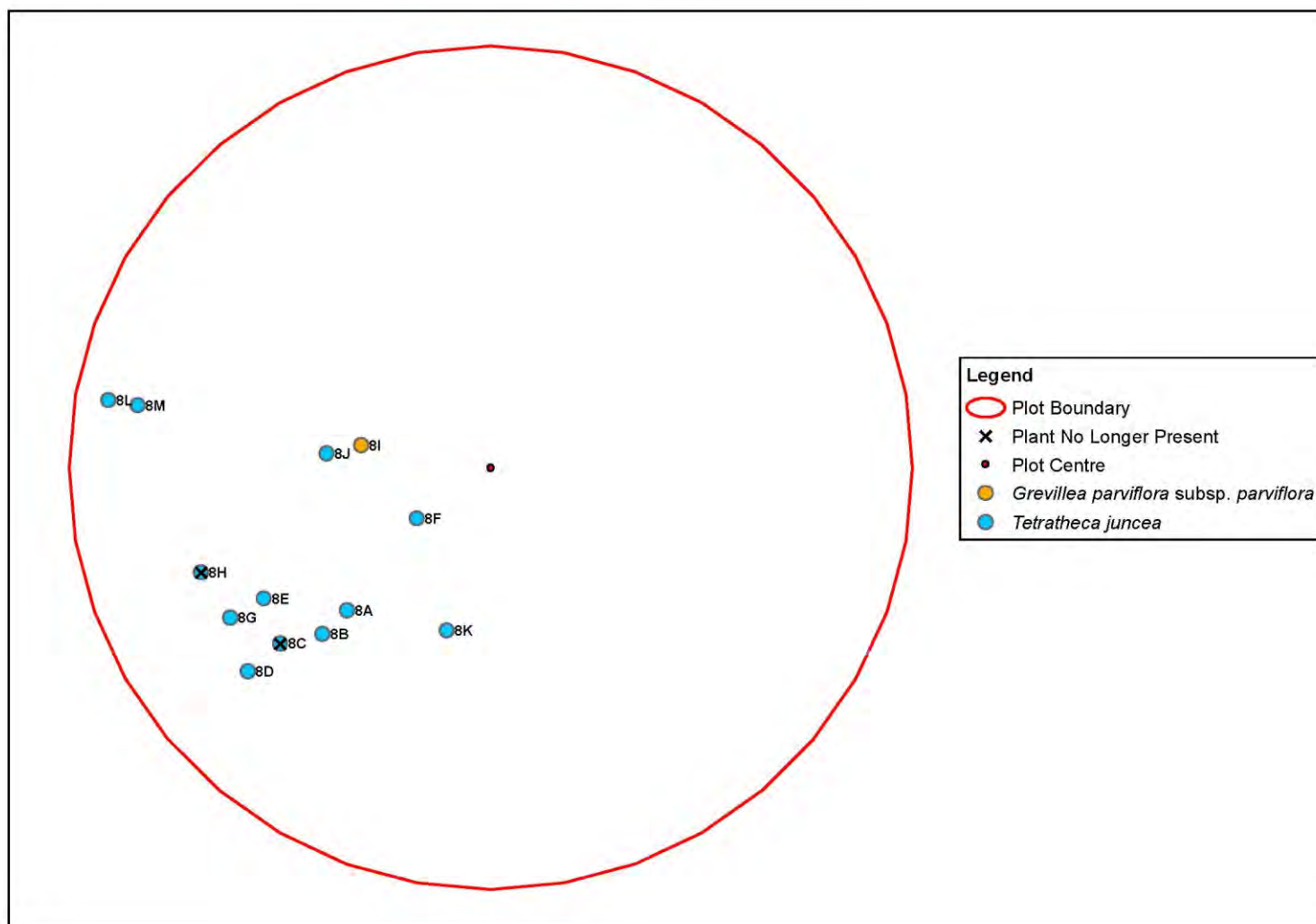


Figure A1-4: *Tetratheca juncea* locations – monitoring point 8

Monitoring Point 11 - *Grevillea parviflora* monitoring results

Number	Distance (cm)	Bearing (degrees)	Maximum Stem Height (cm)				Flowers / fruit (2018)	Comments
			2015	2016	2017	2018		
11A	560	165	90	90	50	45	-	2 stems, 20cm apart
11B	565	110	20	45	-	-	-	Not found
11C	610	105	55	-	-	-	-	Not found
11D	650	105	100	65	-	-	-	Not found, dead stem
11E	720	100	75	75	41	-	-	Not found, dead stem
11F	770	100	20	10	-	-	-	Not found
11G	830	85	110	110	80	100	-	3 clumps, 20cm apart
11H	900	100	60	60	30	65	-	Healthy plant, new growth
11I	620	80	50	50	60	60	-	Dieback
11J	460	70	45	35	40	-	-	Not found, dead stem
11K	620	80	40	40	40	40	-	New growth
11L	610	75	45	55	55	65	-	Dieback
11M	700	75	65	70	65	75	-	2 clumps, 30cm apart, dieback, new growth
11N	540	80	35	40	45	45	-	Dieback, new growth
11O	630	70	20	30	-	-	-	Not found
11P	490	80	45	70	50	30	-	Dieback, new growth 20cm from clump
11Q	430	80	-	20	60	-	-	Not found
11R	730	80	-	-	-	65	-	Healthy plant

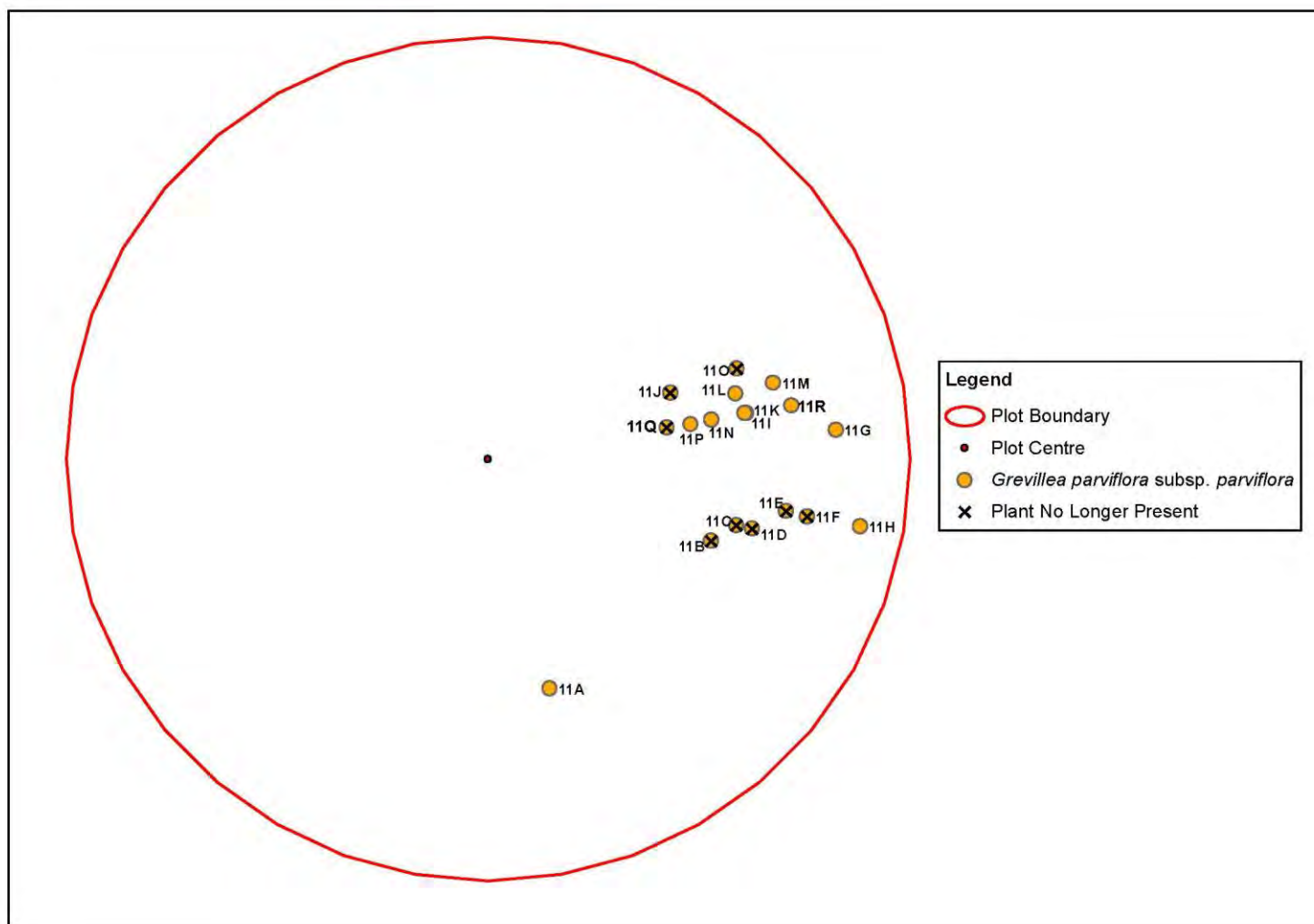


Figure A1-5 *Grevillea parviflora* locations – monitoring point 11

Monitoring Point 12 - *Grevillea parviflora* monitoring results

Number	Distance (cm)	Bearing (degrees)	Maximum Stem Height (cm)				Flowers / fruit (2018)	Comments
			2015	2016	2017	2018		
12A	430	40	80	80	80	50	-	Flattened by fallen tree, lots of new growth
12B	570	40	80	90	60	25	-	Flattened by fallen tree, lots of new growth
12C	580	35	65	70	-	50	-	Flattened by fallen tree, lots of new growth
12D	540	35	20	25	40	30	-	Flattened by fallen tree, lots of new growth
12E	710	35	25	30	-	-	-	Not found
12F	660	30	25	25	-	-	-	Not found
12G	550	25	50	50	40	10	-	New growth
12H	260	110	-	25	55	70	-	-
12I	430	30	-	-	-	50	-	Flattened by fallen tree, lots of new growth
12J	570	30	-	-	-	25	-	Flattened by fallen tree, new growth insect damage
12K	590	45	-	-	-	60	-	Stems sprouting in 3 clumps 25cm apart
12L	550	45	-	-	-	30	-	Some new growth
12M	570	50	-	-	-	55	-	-

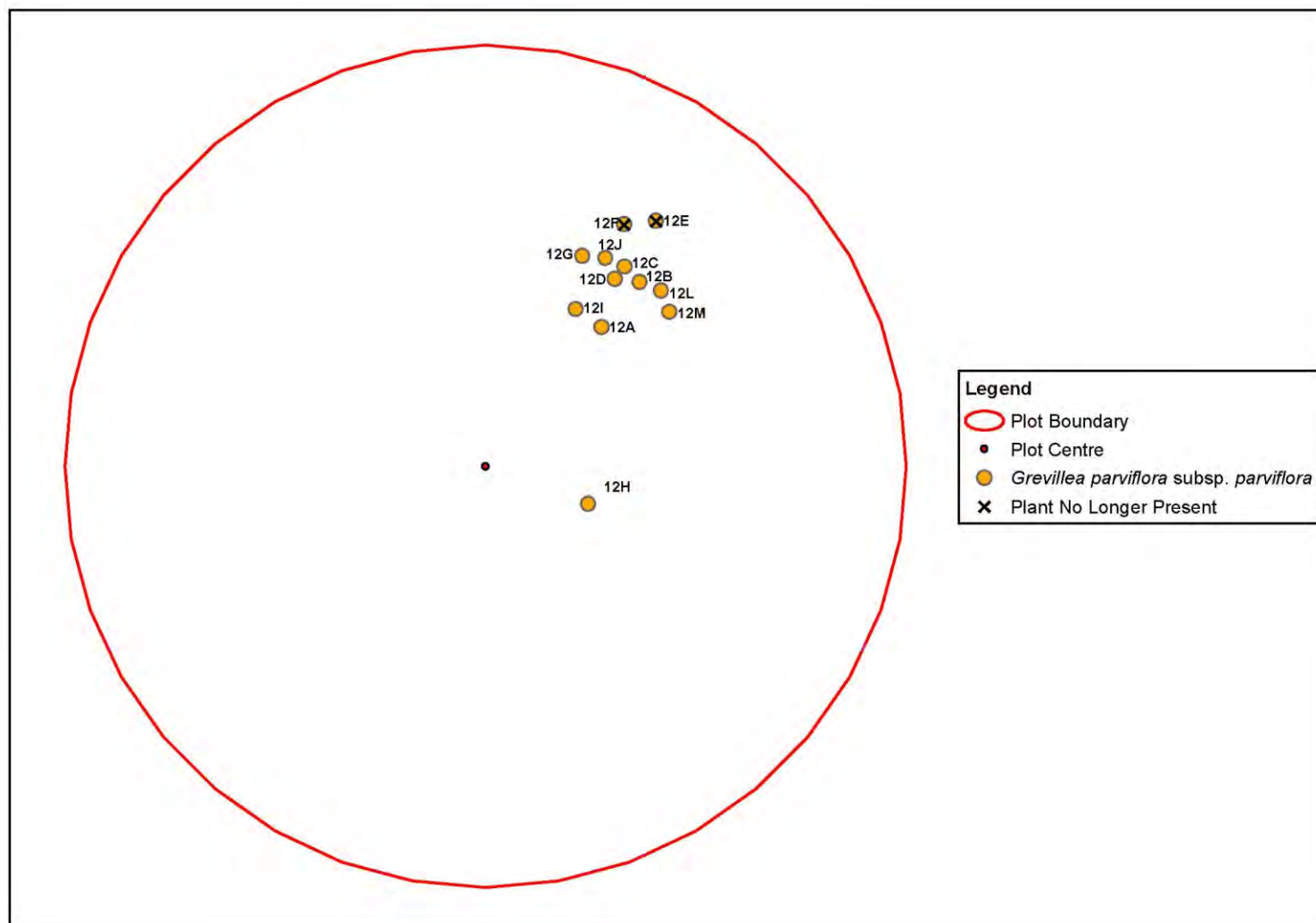


Figure A1-6 *Grevillea parviflora* locations – monitoring point 12

Appendix 1.2 – Lot 12 Monitoring Sites

Monitoring Point 15 - *Tetradlea juncea* monitoring results

Number	Distance (cm)	Bearing (degrees)	Clump Size (cm)				Flowers (2018)	Fruit (2018)	Comments
			2015	2016	2017	2018			
15A	420	80	20 x 10	30 x 10	-	-	-	-	Not found
15B	990	65	5 x 5	10 x 5	-	-	-	-	Not found
15C	1000	50	50 x 50	60 x 40	100 x 30	-	-	-	Not found
15D	870	45	40 x 40	40 x 40	65 x 20	-	-	-	Not found
15E	960	40	75 x 20	80 x 20	90 x 20	-	-	-	Not found
15F	780	45	30 x 15	40 x 15	40 x 15	30 x 40	-	1	No buds, 4 stems
15G	800	35	40 x 25	50 x 25	40 x 20	-	-	-	Not found
15H	790	10	5 x 5	10 x 5	-	-	-	-	Not found
15I	620	10	60 x 30	60 x 30	-	-	-	-	Not found
15J	730	0	20 x 30	40 x 20	40 x 10	-	-	-	Not found
15K	730	355	50 x 20	40 x 20	-	-	-	-	Not found
15L	480	0	30 x 10	30 x 10	15 x 10	30 x 20	-	2	No buds, 3 stems
15M	270	5	40 x 10	50 x 10	-	50 x 20	3	1	
15N	300	355	40 x 10	40 x 10	50 x 10	-	-	-	Not found
15O	100	275	20 x 5	20 x 40	-	-	-	-	Not found
15P	770	270	60 x 20	50 x 30	50 x 30	40 x 10	1	1	
15Q	510	260	60 x 50	70 x 50	90 x 50	90 x 30	6	1	
15R	590	245	70 x 50	70 x 50	80 x 15	-	-	-	Not found
15S	910	195	20 x 10	20 x 10	-	-	-	-	Not found
15T	400	230	30 x 10	30 x 10	-	-	-	-	Not found
15U	870	190	10 x 10	30 x 10	30 x 5	70 x 20	3	1	-
15V	550	180	30 x 15	40 x 20	40 x 10	-	-	-	Not found
15W	670	175	5 x 5	10 x 5	-	-	-	-	Not found
15X	290	155	40 x 10	40 x 10	30 x 5	-	-	-	Not found
15Y	360	170	5 x 5	30 x 5	-	20 x 5	1	-	-
15Z	470	165	30 x 40	50 x 30	60 x 70	60 x 20	-	-	-
15AA	570	170	25 x 20	50 x 20	20 x 50	80 x 20	2	-	-
15AB	810	170	5 x 5	10 x 5	-	-	-	-	Not found
15AC	520	135	40 x 10	50 x 15	15 x 50	40 x 30	3	-	-
15AD	560	160	20 x 30	20 x 30	-	-	-	-	Not found
15AE	370	130	-	20 x 10	-	-	-	-	Not found
15AF	370	310	-	-	-	10 x 10	3	3	2 stems

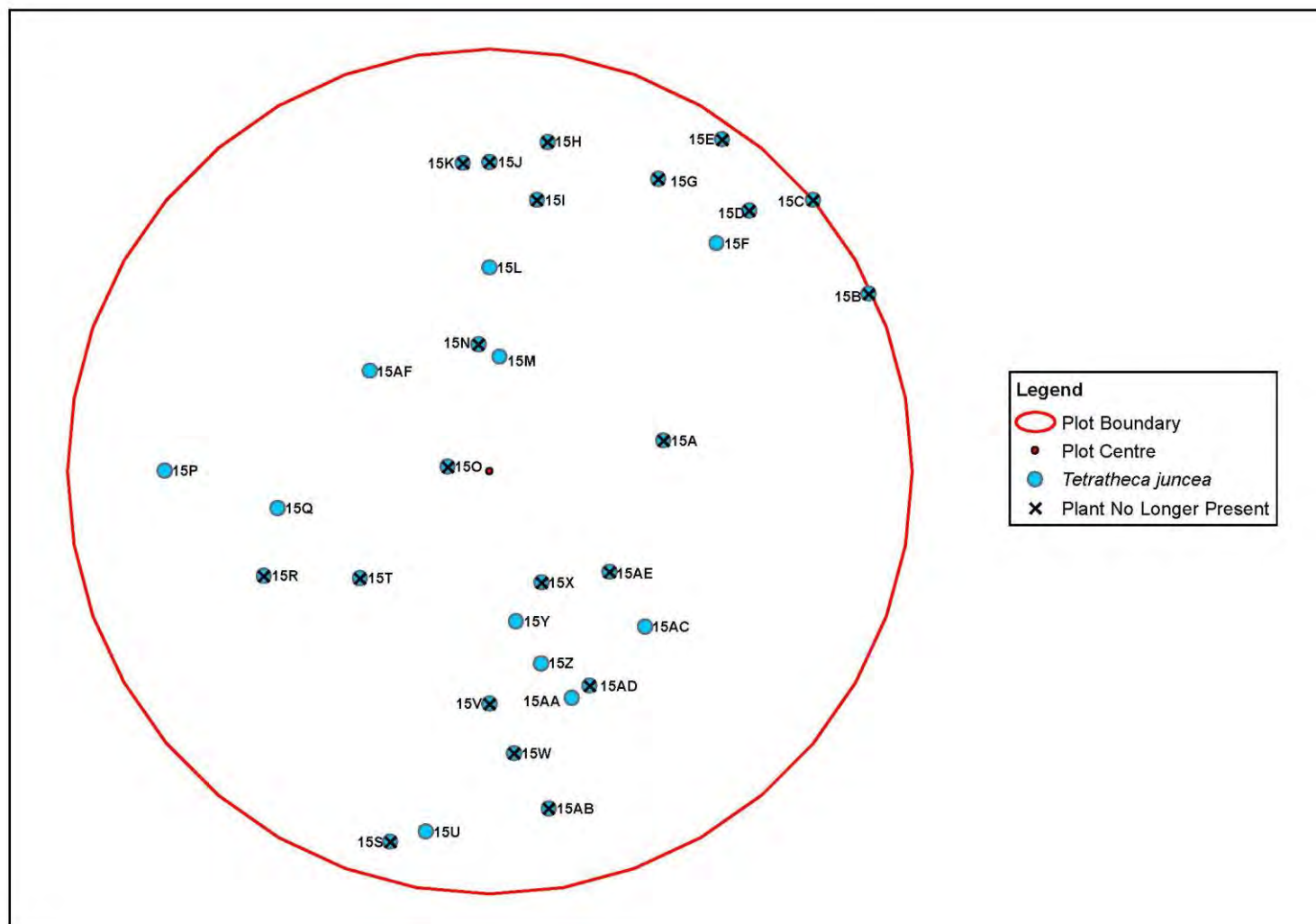


Figure A1-7 *Tetratheca juncea* locations – monitoring point 15

Monitoring Point 17 - *Asperula asthenes* monitoring results

Number	Distance (cm)	Bearing (degrees)	Clump Size (cm)				Flowers / fruit present (2018)	Comments
			2015	2016	2017	2018		
17A	140	220	20 x 5	20 x 5	-	-	-	Not found
17B	270	235	35 x 15	20 x 10	-	-	-	Not found
17C	300	255	40 x 5	30 x 5	-	-	-	Not found
17D	340	250	5 x 5	10 x 5	-	-	-	Not found
17E	550	230	80 x 80	80 x 80	-	70 x 90	Flowers / Fruits	-
17F	640	225	20 x 25	20 x 25	30 x 5	30 x 60	Flowers / Fruits	-
17G	870	240	20 x 10	20 x 10	-	-	-	Not found
17H	760	265	90 x 35	90 x 35	-	-	-	Not found
17I	810	245	35 x 20	25 x 10	-	-	-	Not found
17J	840	245	40 x 60	40 x 50	-	-	-	Not found
17K	710	235	20 x 5	20 x 10	30 x 10	130 x 55	Flowers / Fruits	Many stems present
17L	810	265	-	-	-	10 x 5	-	2 stems
17M	605	265	-	-	-	5 x 5	-	1 stems
17N	580	250	-	-	-	10 x 5	Flowers	2 stems

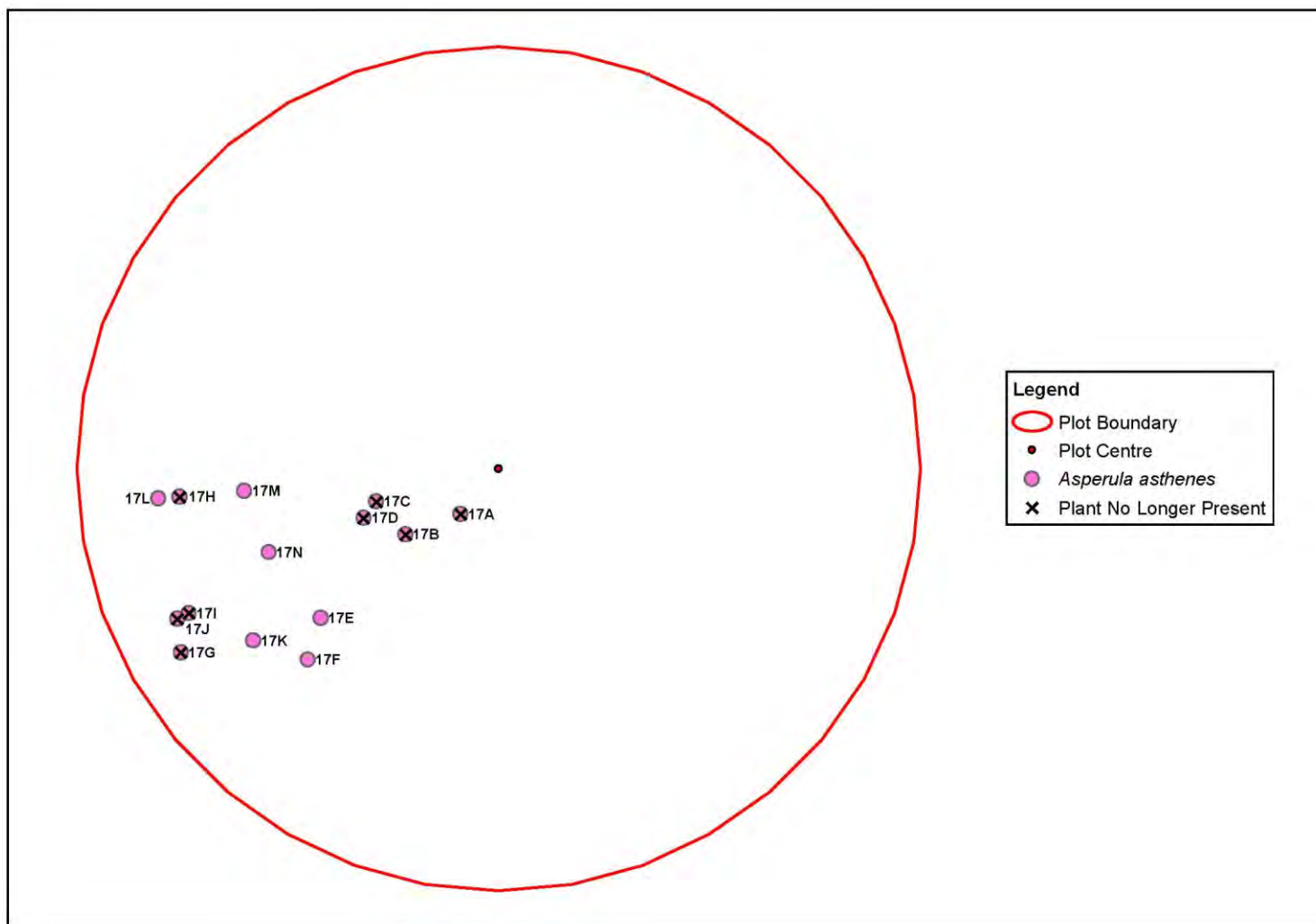


Figure A1-8: *Asperula asthenes* locations – monitoring point 17

Monitoring point 18 - *Asperula asthenes* monitoring results

Number	Distance (cm)	Bearing (degrees)	Clump Size (cm)				Flowers / fruit present (2018)	Comments
			2015	2016	2017	2018		
18A	610	220	40 x 30	40 x 30	-	-	-	Not found
18B	690	220	100 x 60	100 x 50	-	-	-	Not found
18C	670	225	30 x 20	30 x 20	-	-	-	Not found
18D	880	215	20 x 40	20 x 40	-	-	-	Not found
18E	900	220	100 x 90	90 x 90	10 x 5	-	-	Not found
18F	760	225	70 x 80	70 x 90	-	-	-	Not found
18G	820	235	70 x 30	70 x 40	10 x 5	-	-	Not found
18H	890	265	5 x 10	20 x 10	-	-	-	Not found
18I	820	280	30 x 40	30 x 30	-	-	-	Not found
18J	830	290	55 x 30	50 x 30	5 x 5	-	-	Not found
18K	960	235	50 x 10	40 x 15	-	-	-	Not found
18L	780	215	10 x 10	20 x 20	-	-	-	Not found
18M	980	225	30 x 10	20 x 10	-	-	-	Not found
18N	680	210	-	-	40 x 10	60x10	-	New growth
18O	700	215	-	-	-	70x15	-	New growth
18P	660	310	-	-	-	10x25	Flowers	Present on lower side of creek bank
18Q	770	315	-	-	-	60x20	-	Present within creek bed, new growth

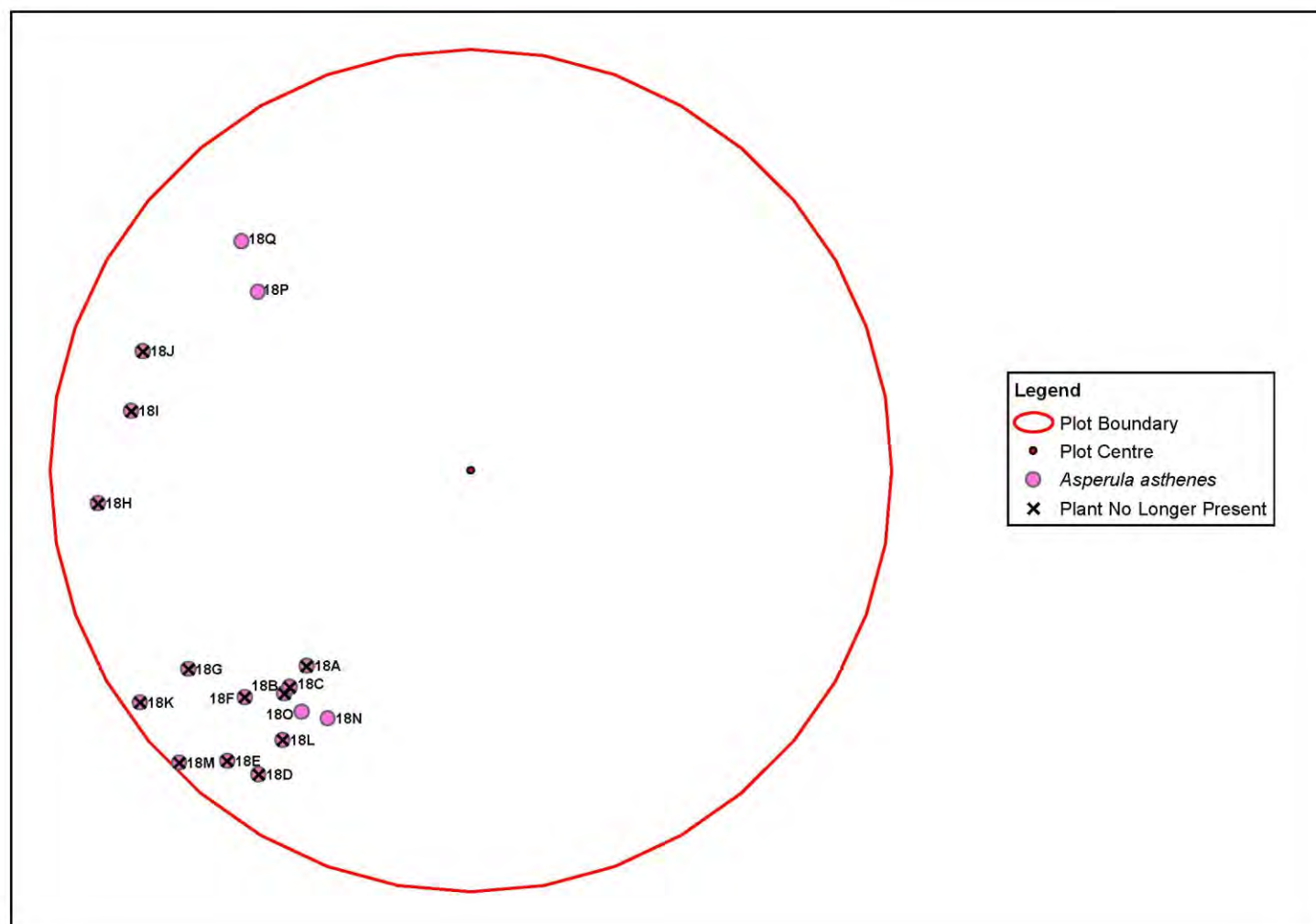


Figure A1-9: *Asperula asthenes* locations – monitoring point 18

APPENDIX 2. VEGETATION MONITORING DATA

Monitoring site	Dominant species in each stratum		Estimated % cover			
			2015	2016	2017	2018
MP1	Canopy	<i>Eucalyptus propinqua</i> (Small-fruited Grey Gum), <i>E. microcorys</i> (Tallowwood), <i>E. acmenoides</i> (White Mahogany) and <i>Corymbia maculata</i> (Spotted Gum)	50%	50%	50%	50%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak), <i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> (Cheese Tree) and <i>Breynia oblongifolia</i> (Coffee Bush)	40%	40%	40%	40%
	Shrub	<i>Leucopogon juniperinus</i> (Prickly Beard-heath), <i>Hibbertia aspera</i> (Rough Guinea Flower) and <i>Breynia oblongifolia</i> (Coffee Bush)	5%	5%	5%	5%
	Ground (grass)	<i>Imperata cylindrica</i> (Blady Grass), <i>Oplismenus aemulus</i> (Australian Basket Grass), <i>Poa labillardierei</i> (Tussock) and <i>Themeda triandra</i> (Kangaroo Grass)	60%	60%	60%	60%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Carex longibrachiata</i> and <i>Adiantum aethiopicum</i> (Common Maidenhair)	50%	50%	50%	50%
	Exotic	<i>Lantana camara</i> (Lantana)	30%	30%	25%	25%
MP2	Canopy	<i>Corymbia maculata</i> (Spotted Gum), <i>Eucalyptus microcorys</i> (Tallowwood), <i>E. canaliculata</i> (Grey Gum) and <i>E. paniculata</i> subsp. <i>paniculata</i> (Grey Ironbark)	40%	40%	40%	40%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak), <i>Bursaria spinosa</i> (Blackthorn) and <i>Exocarpos cupressiformis</i> (Cherry Ballart)	40%	35%	35%	35%
	Shrub	<i>Leucopogon juniperinus</i> (Prickly Beard-heath) and <i>Acacia ulicifolia</i> (Prickly Moses)	5%	5%	5%	5%
	Ground (grass)	<i>Themeda triandra</i> (Kangaroo Grass) and <i>Poa labillardierei</i> (Tussock)	50%	50%	50%	50%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Gonocarpus tetragynus</i> and <i>Eustrephus latifolius</i> (Wombat Berry)	20%	20%	20%	20%
	Exotic	<i>Lantana camara</i> (Lantana)	5%	5%	1%	1%
MP3	Canopy	<i>Lophostemon confertus</i> (Brush Box), <i>Syncarpia glomulifera</i> (Turpentine), <i>Eucalyptus propinqua</i> (Small-fruited Grey Gum) and <i>E. microcorys</i> (Tallowwood)	40%	40%	40%	40%
	Midstorey	<i>Melaleuca styphelioides</i> (Prickly-leaved Tea Tree), <i>Livistona australis</i> (Cabbage Palm), <i>Allocasuarina torulosa</i> (Forest Oak) and <i>Elaeocarpus obovatus</i> (Hard Quandong)	60%	60%	60%	60%
	Shrub	<i>Pittosporum multiflorum</i> (Orange Thorn) and <i>Diospyros australis</i> (Black Plum)	40%	40%	50%	50%
	Ground (grass)	<i>Oplismenus aemulus</i> (Australian Basket Grass)	<5%	<5%	<5%	<5%
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Carex longibrachiata</i> , <i>Adiantum hispidulum</i> (Rough Maidenhair Fern) and <i>Cissus antarctica</i> (Kangaroo Vine)	90%	90%	90%	90%
	Exotic	<i>Lantana camara</i> (Lantana)	50%	50%	50%	50%

Monitoring site	Dominant species in each stratum		Estimated % cover			
			2015	2016	2017	2018
MP4	Canopy	<i>Lophostemon confertus</i> (Brush Box), <i>Syncarpia glomulifera</i> (Turpentine), and <i>Eucalyptus propinqua</i> (Small-fruited Grey Gum)	30%	30%	30%	30%
	Midstorey	<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> (Cheese Tree), <i>Melaleuca styphelioides</i> (Prickly-leaved Tea Tree), <i>Acmena smithii</i> (Lilly Pilly) and <i>Elaeocarpus obovatus</i> (Hard Quandong)	60%	60%	60%	60%
	Shrub	<i>Pittosporum multiflorum</i> (Orange Thorn)	5%	5%	3%	3%
	Ground (grass)	<i>Oplismenus aemulus</i> (Australian Basket Grass)	5%	5%	5%	5%
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Morinda jasminoides</i> (Sweet Morinda) and <i>Carex longibrachiata</i>	90%	90%	90%	90%
	Exotic	<i>Lantana camara</i> (Lantana), <i>Asparagus aethiopicus</i> (Ground Asparagus) and <i>Tradescantia fluminensis</i> (Wandering Jew)	35%	35%	25%	30%
MP5	Canopy	<i>Eucalyptus pilularis</i> (Blackbutt), <i>E. microcorys</i> (Tallowwood), <i>Angophora costata</i> (Smooth-barked Apple) and <i>E. globoides</i> (White Stringybark)	40%	40%	40%	40%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak), <i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> (Cheese Tree), <i>Persoonia linearis</i> (Narrow-leaved Geebung) and <i>Melaleuca linariifolia</i> (Flax-leaved Paperbark)	60%	60%	60%	60%
	Shrub	<i>Leptospermum polygalifolium</i> (Tantoon), <i>Breynia oblongifolia</i> (Coffee Bush) and <i>Phyllanthus hirtellus</i> (Thyme Spurge)	5%	5%	10%	10%
	Ground (grass)	<i>Entolasia stricta</i> (Wiry Panic) and <i>Oplismenus imbecillis</i> (Creeping Beard Grass)	60%	60%	60%	60%
	Ground (other)	<i>Doryanthes excelsa</i> (Gynea Lily), <i>Pteridium esculentum</i> (Common Bracken) and <i>Lomandra longifolia</i> (Spiny-headed Mat-rush)	50%	50%	50%	50%
	Exotic	Nil	-	-	-	-
MP6	Canopy	<i>Eucalyptus microcorys</i> (Tallowwood), <i>E. propinqua</i> (Small-fruited Grey Gum), <i>Corymbia gummifera</i> (Red Bloodwood) and <i>Eucalyptus pilularis</i> (Blackbutt)	50%	50%	50%	50%
	Midstorey	<i>Callistemon salignus</i> (Willow Bottlebrush), <i>Melaleuca styphelioides</i> (Prickly-leaved Tea Tree), <i>Allocasuarina torulosa</i> (Forest Oak), <i>Acmena smithii</i> (Lilly Pilly), <i>Zieria smithii</i> (Sandfly Zieria) and <i>Backhousia myrtifolia</i> (Grey Myrtle)	60%	60%	50%	55%
	Shrub	<i>Hibbertia aspera</i> (Rough Guinea Flower)	<5%	<5%	<5%	5%
	Ground (grass)	<i>Imperata cylindrica</i> (Blady Grass), <i>Oplismenus imbecillis</i> (Creeping Beard Grass) and <i>Poa labillardierei</i> (Tussock)	20%	20%	20%	20%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Doryanthes excelsa</i> (Gynea Lily), <i>Adiantum aethiopicum</i> (Common Maidenhair) and <i>Morinda jasminoides</i> (Sweet Morinda)	30%	30%	30%	30%
	Exotic	Nil	-	-	-	-
MP7	Canopy	<i>Angophora costata</i> (Smooth-barked Apple), <i>Eucalyptus eugenioides</i> (Thin-leaved Stringybark) and <i>Corymbia gummifera</i> (Red Bloodwood)	35%	35%	35%	35%
	Midstorey	<i>Allocasuarina littoralis</i> (Black She-oak), <i>Leptospermum polygalifolium</i> (Tantoon) and <i>Allocasuarina torulosa</i> (Forest Oak)	40%	40%	40%	40%

Monitoring site	Dominant species in each stratum		Estimated % cover			
			2015	2016	2017	2018
	Shrub	<i>Pultenaea euchila</i> (Orange Pultenaea)	5%	5%	5%	5%
	Ground (grass)	<i>Themeda triandra</i> (Kangaroo Grass) and <i>Entolasia stricta</i> (Wiry Panic)	50%	50%	50%	50%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush) and <i>Gahnia radula</i>	70%	60%	60%	60%
	Exotic	<i>Setaria sphacelata</i> (South African Pigeon Grass)	5%	5%	5%	5%
MP8	Canopy	<i>Angophora costata</i> (Smooth-barked Apple), <i>Eucalyptus eugenioides</i> (Thin-leaved Stringybark) and <i>Corymbia gummifera</i> (Red Bloodwood)	30%	30%	30%	30%
	Midstorey	<i>Allocasuarina littoralis</i> (Black She-oak), <i>Leptospermum polygalifolium</i> (Tantoon) and <i>Acacia longifolia</i> (Sydney Golden Wattle)	50%	50%	50%	50%
	Shrub	<i>Pultenaea paleacea</i> (Chaffy Bush-pea), <i>Pultenaea euchila</i> (Orange Pultenaea), <i>Phyllanthus hirtellus</i> (Thyme Spurge), <i>Hibbertia riparia</i> (Erect Guinea-flower) and <i>Hibbertia aspera</i> (Rough Guinea Flower)	20%	20%	20%	20%
	Ground (grass)	<i>Entolasia stricta</i> (Wiry Panic) and <i>Themeda triandra</i> (Kangaroo Grass)	50%	50%	50%	50%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Ptilothrix deusta</i> , <i>Patersonia sericea</i> (Silky Purple-flag) and <i>Lomandra obliqua</i>	50%	50%	50%	50%
	Exotic	Nil	-	-	-	-
MP9	Canopy	<i>Angophora costata</i> (Smooth-barked Apple), <i>Corymbia gummifera</i> (Red Bloodwood), <i>Eucalyptus microcorys</i> (Tallowwood) and <i>E. eugenioides</i> (Thin-leaved Stringybark)	40%	40%	40%	40%
	Midstorey	<i>Allocasuarina littoralis</i> (Black She-oak), <i>Dodonaea triquetra</i> (Large-leaf Hop-bush) and <i>Persoonia linearis</i> (Narrow-leaved Geebung)	50%	50%	50%	50%
	Shrub	<i>Leptospermum polygalifolium</i> (Tantoon), <i>Pultenaea euchila</i> (Orange Pultenaea), <i>Logania albiflora</i> and <i>Polyscias sambucifolia</i> (Elderberry Panax)	10%	10%	10%	10%
	Ground (grass)	<i>Imperata cylindrica</i> (Blady Grass), <i>Entolasia stricta</i> (Wiry Panic) and <i>Themeda triandra</i> (Kangaroo Grass)	30%	30%	40%	40%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Pteridium esculentum</i> (Common Bracken) and <i>Ptilothrix deusta</i>	60%	60%	60%	50%
	Exotic	Nil	-	-	-	-
MP10	Canopy	<i>Eucalyptus piperita</i> (Sydney Peppermint), <i>Angophora costata</i> (Smooth-barked Apple), <i>Corymbia gummifera</i> (Red Bloodwood) and <i>Eucalyptus microcorys</i> (Tallowwood)	40%	40%	40%	35%
	Midstorey	<i>Allocasuarina littoralis</i> (Black She-oak), <i>Persoonia linearis</i> (Narrow-leaved Geebung) and <i>A. torulosa</i> (Forest Oak)	10%	10%	10%	10%
	Shrub	<i>Pultenaea euchila</i> (Orange Pultenaea), <i>Leptospermum polygalifolium</i> (Tantoon), <i>Pultenaea paleacea</i> (Chaffy Bush-pea) and <i>Acacia ulicifolia</i> (Prickly Moses)	5%	5%	5%	5%
	Ground (grass)	<i>Entolasia stricta</i> (Wiry Panic), <i>Themeda triandra</i> (Kangaroo Grass) and <i>Imperata cylindrica</i> (Blady Grass)	40%	40%	40%	40%
	Ground (other)	<i>Gahnia radula</i> , <i>Doryanthes excelsa</i> (Gymea Lily), <i>Lomandra longifolia</i> (Spiny-headed Mat-rush) and <i>Ptilothrix deusta</i>	60%	60%	60%	60%

Monitoring site	Dominant species in each stratum		Estimated % cover			
			2015	2016	2017	2018
	Exotic	Nil	-	-	-	-
MP11	Canopy	<i>Angophora costata</i> (Smooth-barked Apple), <i>Corymbia gummifera</i> (Red Bloodwood) and <i>Eucalyptus capitellata</i> (Brown Stringybark)	35%	35%	35%	35%
	Midstorey	<i>Allocasuarina littoralis</i> (Black She-oak), <i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> (Cheese Tree), <i>Leptospermum polygalifolium</i> (Tantoon) and <i>Banksia spinulosa</i> (Hairpin Banksia)	40%	40%	40%	40%
	Shrub	<i>Pultenaea paleacea</i> (Chaffy Bush-pea) and <i>Boronia pinnata</i>	5%	5%	5%	5%
	Ground (grass)	<i>Entolasia stricta</i> (Wiry Panic), <i>Imperata cylindrica</i> (Blady Grass) and <i>Themeda triandra</i> (Kangaroo Grass)	35%	35%	40%	40%
	Ground (other)	<i>Xanthorrhoea latifolia</i> , <i>Pteridium esculentum</i> (Common Bracken) and <i>Ptilothrix deusta</i>	60%	60%	60%	60%
	Exotic	Nil	-	-	-	-
MP12	Canopy	<i>Eucalyptus pilularis</i> (Blackbutt), <i>Angophora costata</i> (Smooth-barked Apple), <i>E. globoidea</i> (White Stringybark), <i>Corymbia gummifera</i> (Red Bloodwood), <i>E. microcorys</i> (Tallowwood) and <i>E. piperita</i> (Sydney Peppermint)	40%	40%	40%	40%
	Midstorey	<i>Leptospermum polygalifolium</i> (Tantoon), <i>Allocasuarina littoralis</i> (Black She-oak), <i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> (Cheese Tree) and <i>Exocarpos cupressiformis</i> (Cherry Ballart)	30%	30%	30%	30%
	Shrub	<i>Pultenaea euchila</i> (Orange Pultenaea), <i>Boronia pinnata</i> and <i>Banksia spinulosa</i> (Hairpin Banksia)	10%	10%	10%	5%
	Ground (grass)	<i>Themeda triandra</i> (Kangaroo Grass), <i>Entolasia stricta</i> (Wiry Panic), and <i>Austrostipa</i> sp.	40%	40%	40%	30%
	Ground (other)	<i>Xanthorrhoea latifolia</i> and <i>Ptilothrix deusta</i>	40%	40%	40%	30%
	Exotic	Nil	-	-	-	-
MP13	Canopy	<i>Eucalyptus sparsifolia</i> (Narrow-leaved Stringybark), <i>Corymbia maculata</i> (Spotted Gum), <i>E. paniculata</i> (Grey Ironbark) and <i>E. microcorys</i> (Tallowwood)	40%	40%	40%	40%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak), <i>Syncarpia glomulifera</i> (Turpentine) and <i>Callistemon salignus</i> (Willow Bottlebrush)	40%	40%	40%	40%
	Shrub	<i>Hibbertia aspera</i> (Rough Guinea Flower) and <i>Pultenaea euchila</i> (Orange Pultenaea)	5%	5%	5%	5%
	Ground (grass)	<i>Imperata cylindrica</i> (Blady Grass), <i>Poa labillardierei</i> (Tussock), <i>Themeda triandra</i> (Kangaroo Grass) and <i>Oplismenus imbecillis</i> (Creeping Beard Grass)	60%	60%	60%	70%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Doryanthes excelsa</i> (Gynea Lily), <i>Lepidosperma laterale</i> and <i>Patersonia sericea</i>	30%	30%	40%	40%
	Exotic	Nil	-	-	-	-
MP14	Canopy	<i>Angophora costata</i> (Smooth-barked Apple), <i>Eucalyptus eugenioides</i> (Thin-leaved Stringybark), <i>E. microcorys</i> (Tallowwood), and <i>E. paniculata</i> subsp. <i>paniculata</i> (Grey Ironbark)	35%	40%	40%	40%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak), <i>Callistemon salignus</i> (Willow Bottlebrush) and <i>Glochidion ferdinandi</i> (Cheese Tree)	25%	25%	25%	25%

Monitoring site	Dominant species in each stratum		Estimated % cover			
			2015	2016	2017	2018
	Shrub	<i>Leucopogon juniperinus</i> (Prickly Beard-heath), <i>Pultenaea villosa</i> (Hairy Bush-pea), <i>Leptospermum polygalifolium</i> (Tantoon) and <i>Hibbertia aspera</i> (Rough Guinea Flower)	10%	15%	15%	15%
	Ground (grass)	<i>Themeda triandra</i> (Kangaroo Grass), <i>Poa labillardierei</i> (Tussock) and <i>Entolasia stricta</i> (Wiry Panic)	80%	80%	80%	80%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Doryanthes excelsa</i> (Gynea Lily) and <i>Brunoniella pumilio</i> (Dwarf Blue Trumpet)	30%	30%	30%	30%
	Exotic	<i>Setaria sphacelata</i> (South African Pigeon Grass)	5%	5%	5%	5%
MP15	Canopy	<i>Eucalyptus pilularis</i> (Blackbutt), <i>Angophora costata</i> (Smooth-barked Apple), <i>Corymbia gummifera</i> (Red Bloodwood) and <i>E. microcorys</i> (Tallowwood)	45%	45%	45%	45%
	Midstorey	<i>Allocasuarina littoralis</i> (Black She-oak) and <i>Acacia irrorata</i> (Green Wattle)	20%	20%	15%	15%
	Shrub	<i>Hibbertia vestita</i> (Hairy Guinea Flower), <i>Breynia oblongifolia</i> (Coffee Bush) and <i>Phyllanthus gunnii</i> (Scrubby Spurge)	10%	10%	10%	10%
	Ground (grass)	<i>Themeda triandra</i> (Kangaroo Grass), <i>Entolasia stricta</i> (Wiry Panic) and <i>Imperata cylindrica</i> (Blady Grass)	30%	30%	30%	30%
	Ground (other)	<i>Doryanthes excelsa</i> (Gynea Lily), <i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Pteridium esculentum</i> (Common Bracken), <i>Lepidosperma laterale</i> and <i>Xanthorrhoea macronema</i>	60%	60%	60%	60%
	Exotic	<i>Lantana camara</i> (Lantana)	5%	5%	1%	1%
MP16	Canopy	<i>Eucalyptus pilularis</i> (Blackbutt), <i>E. propinqua</i> (Small-fruited Grey Gum), <i>E. microcorys</i> (Tallowwood) and <i>Angophora costata</i> (Smooth-barked Apple)	50%	50%	50%	50%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak), <i>Syncarpia glomulifera</i> (Turpentine) and <i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> (Cheese Tree)	30%	30%	30%	30%
	Shrub	<i>Leucopogon juniperinus</i> (Prickly Beard-heath) and <i>Acacia floribunda</i> (White Sally Wattle)	10%	10%	10%	10%
	Ground (grass)	<i>Poa labillardierei</i> (Tussock), <i>Imperata cylindrica</i> (Blady Grass), and <i>Oplismenus imbecillis</i> (Creeping Beard Grass)	50%	50%	40%	40%
	Ground (other)	<i>Carex appressa</i> (Tall Sedge), <i>Doodia aspera</i> (Prickly Rasp Fern), <i>Lomandra longifolia</i> (Spiny-headed Mat-rush) and <i>Calochlaena dubia</i> (Rainbow Fern)	30%	30%	40%	40%
	Exotic	<i>Lantana camara</i> (Lantana)	30%	30%	30%	40%
MP17	Canopy	<i>Eucalyptus pilularis</i> (Blackbutt), <i>E. microcorys</i> (Tallowwood), <i>Syncarpia glomulifera</i> (Turpentine), <i>E. acmenoides</i> (White Mahogany) and <i>E. propinqua</i> (Small-fruited Grey Gum)	40%	40%	40%	40%
	Midstorey	<i>Backhousia myrtifolia</i> (Grey Myrtle), <i>Lophostemon confertus</i> (Brush Box), <i>Livistona australis</i> (Cabbage Palm), <i>Acmena smithii</i> (Lilly Pilly) and <i>Allocasuarina torulosa</i> (Forest Oak)	50%	50%	50%	50%
	Shrub	<i>Wilkiea huegeliana</i> (Veiny Wilkiea), <i>Acacia maidenii</i> (Maiden's Wattle), <i>Eupomatia laurina</i> (Bolwarra) and <i>Pittosporum multiflorum</i> (Orange Thorn)	5%	5%	5%	5%
	Ground (grass)	<i>Poa labillardierei</i> (Tussock), <i>Themeda triandra</i> (Kangaroo Grass) and <i>Entolasia marginata</i> (Bordered Panic)	40%	40%	40%	40%

Monitoring site	Dominant species in each stratum		Estimated % cover			
			2015	2016	2017	2018
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Lomandra longifolia</i> (Spiny-headed Mat-rush) and <i>Gymnostachys anceps</i> (Settlers' Twine)	50%	50%	50%	50%
	Exotic	<i>Lantana camara</i> (Lantana)	10%	15%	15%	15%
MP18	Canopy	<i>Eucalyptus saligna</i> (Sydney Blue Gum), <i>E. microcorys</i> (Tallowwood), <i>Syncarpia glomulifera</i> (Turpentine), and <i>E. acmenoides</i> (White Mahogany)	45%	45%	45%	45%
	Midstorey	<i>Lophostemon confertus</i> (Brush Box), <i>Backhousia myrtifolia</i> (Grey Myrtle), <i>Cryptocarya glaucescens</i> (Jackwood), <i>Allocasuarina torulosa</i> (Forest Oak) and <i>Acacia irrorata</i> (Green Wattle)	25%	25%	25%	25%
	Shrub	<i>Acacia maidenii</i> (Maiden's Wattle) and <i>Denhamia silvestris</i> (Narrow-leaved Orangebark)	5%	5%	5%	5%
	Ground (grass)	<i>Poa labillardierei</i> (Tussock), <i>Imperata cylindrica</i> (Blady Grass), and <i>Oplismenus imbecillis</i> (Creeping Beard Grass)	50%	50%	50%	50%
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Lomandra longifolia</i> (Spiny-headed Mat-rush) and <i>Gymnostachys anceps</i> (Settlers' Twine)	50%	50%	50%	50%
	Exotic	<i>Lantana camara</i> (Lantana)	10%	15%	15%	15%

APPENDIX 3. PHOTO MONITORING POINTS

Appendix 3.1 – Biodiversity Offset Area Monitoring Sites

Monitoring Point 1 (MP1)



Monitoring point 1 (north) – 2015



Monitoring point 1 (north) – 2016



Monitoring point 1 (north) – 2017



Monitoring point 1 (north) – 2018

Monitoring Point 2 (MP2)



Monitoring point 2 (north) – 2015



Monitoring point 2 (north) – 2016



Monitoring point 2 (north) – 2017



Monitoring point 2 (north) – 2018

Monitoring Point 3 (MP3)



Monitoring point 3 (north) – 2015



Monitoring point 3 (north) – 2016



Monitoring point 3 (north) – 2017



Monitoring point 3 (north) – 2018

Monitoring Point 4 (MP4)



Monitoring point 4 (north) – 2015



Monitoring point 4 (north) – 2016



Monitoring point 4 (north) – 2017



Monitoring point 4 (north) – 2018

Monitoring Point 5 (MP5)



Monitoring point 5 (north) – 2015



Monitoring point 5 (north) – 2016



Monitoring point 5 (north) – 2017



Monitoring point 5 (north) – 2018

Monitoring Point 6 (MP6)



Monitoring point 6 (north) – 2015



Monitoring point 6 (north) – 2016



Monitoring point 6 (north) – 2017



Monitoring point 6 (north) – 2018

Monitoring Point 7 (MP7)



Monitoring point 7 (north) – 2015



Monitoring point 7 (north) – 2016



Monitoring point 7 (north) – 2017



Monitoring point 7 (north) – 2018

Monitoring Point 8 (MP8)



Monitoring point 8 (north) – 2015



Monitoring point 8 (north) – 2016



Monitoring point 8 (north) – 2017



Monitoring point 8 (north) – 2018

Monitoring Point 9 (MP9)



Monitoring point 9 (north) – 2015



Monitoring point 9 (north) – 2016



Monitoring point 9 (north) – 2017



Monitoring point 9 (north) – 2018

Monitoring Point 10 (MP10)



Monitoring point 10 (north) – 2015



Monitoring point 10 (north) – 2016



Monitoring point 10 (north) – 2017



Monitoring point 10 (north) – 2018

Monitoring Point 11 (MP11)



Monitoring point 11 (north) – 2015



Monitoring point 11 (north) – 2016



Monitoring point 11 (north) – 2017



Monitoring point 11 (north) – 2018

Monitoring Point 12 (MP12)



Monitoring point 12 (north) – 2015



Monitoring point 12 (north) – 2016



Monitoring point 12 (north) – 2017



Monitoring point 12 (north) – 2018

Monitoring Point 13 (MP13)



Monitoring point 13 (north) – 2015



Monitoring point 13 (north) – 2016



Monitoring point 13 (north) – 2017



Monitoring point 13 (north) – 2018

Appendix 1.2 – Lot 12 Monitoring Sites

Monitoring Point 14 (MP14)



Monitoring point 14 (north) – 2015



Monitoring point 14 (north) – 2016



Monitoring point 14 (north) – 2017



Monitoring point 14 (north) – 2018

Monitoring Point 15 (MP15)



Monitoring point 15 (north) – 2015



Monitoring point 15 (north) – 2016



Monitoring point 15 (north) – 2017



Monitoring point 15 (north) – 2018

Monitoring Point 16 (MP16)



Monitoring point 16 (north) – 2015



Monitoring point 16 (north) – 2016



Monitoring point 16 (north) – 2017



Monitoring point 16 (north) – 2018

Monitoring Point 17 (MP17)



Monitoring point 17 (north) – 2015



Monitoring point 17 (north) – 2016



Monitoring point 17 (north) – 2017



Monitoring point 17 (north) – 2018

Monitoring Point 18 (MP18)



Monitoring point 18 (north) – 2015



Monitoring point 18 (north) – 2016



Monitoring point 18 (north) – 2017



Monitoring point 18 (north) – 2018

APPENDIX 4. EXOTIC SPECIES RECORDED IN THE OFFSET AREA

Scientific Name	Common Name	Priority Weeds (Biosecurity Act 2015) in Mid Coast Council control area
<i>Ageratina riparia</i>	Creeping Crofton Weed	-
<i>Anagallis arvensis</i>	Scarlet Pimpernel	-
<i>Andropogon virginicus</i>	Whisky Grass	-
<i>Asparagus aethiopicus</i>	Ground Asparagus	Prohibition on dealings
<i>Axonopus fissifolius</i>	Narrow-leafed Carpet Grass	-
<i>Bidens pilosa</i>	Cobblers Pegs	-
<i>Briza maxima</i>	Quaking Grass	-
<i>Chloris gayana</i>	Rhodes Grass	-
<i>Hypochaeris radicata</i>	Catsear	-
<i>Lantana camara</i>	Lantana	Prohibition on dealings
<i>Lolium perenne</i>	Perennial Ryegrass	-
<i>Melinis repens</i>	Red Natal Grass	-
<i>Paspalum dilatatum</i>	Paspalum	-
<i>Paspalum mandiocanum</i>	Broadleaf Paspalum	-
<i>Pennisetum clandestinum</i>	Kikuyu	-
<i>Plantago lanceolata</i>	Lamb's Tongues	-
<i>Senecio madagascariensis</i>	Fireweed	Prohibition on dealings
<i>Senna pendula</i> var. <i>glabrata</i>	Cassia	-
<i>Setaria sphacelata</i>	South African Pigeon Grass	-
<i>Solanum nigrum</i>	Black-berry Nightshade	-
<i>Stellaria media</i>	Common Chickweed	-
<i>Trifolium repens</i>	White Clover	-
<i>Tradescantia fluminensis</i>	Wandering Jew	-
<i>Verbena bonariensis</i>	Purpletop	-
<i>Vulpia myuros</i>	Rat's Tail Fescue	-

APPENDIX 5. STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Ashley Owen	Dip Science	Ecologist	Field surveys
Yann Buissiere	BEnvMgt	Botanist	Field surveys and report writing
Samara Schulz	BEnv Sc & Mgt (Hons)	Senior Ecologist	Field surveys and report review
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS and figure preparation

APPENDIX 6. LICENSING

Kleinfelder employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act 1974* (License Number: SL100730, Expiry: 31 March 2019) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.

APPENDIX 6 – Water Monitoring Data

Surface Water - Dam 1 (2018)

	Criteria	Date												Min	Max	Average
		19-Jan-	16-02	20-03-	18-04-	18-05-	19-06-	20-07-	17-08-	14-09-	19-10-	15-11-	18-12-			
pH (pH unit)	6.5 - 8.5	7.3	7.7	6.9	6.4	5.9	7.3	6.5	6.7	7.1	6.8	7.4	7.2	5.9	7.7	6.9
TSS (mg/L)	40	9	9	19	5	12	76	12	12	33	81	76	98	5	98	36
TDS (mg/L)	-	399	438	355	330	321	471	350	365	377	412	514	430	32	514	396.8
Turbidity (NTU)	-	49	44	18	19	70	276	32	43	83	136	84	184	18	276	86.5
EC (µS/cm)	125-2200	665	662	574	529	555	496	600	553	508	593	1035	543	496	1035	609
Nitrogen (Nitrate) (mg/L)	0.35	5.400	5.500	4.500	5.000	7.100	10.600	12.000	11.400	11.300	12.200	11.000	9.160	4.5	12.2	8.8
Total Nitrogen (mg/L)		6.20	6.10	7.40		7.90	11.60		11.00	12.60	12.80	12.20	10.30	6.1	12.8	9.8
Total Phosphorous (mg/L)	0.025	0.02	0.02	0.02	<0.05	<0.05	0.05	<0.05	<0.05	0.03	0.03	0.01	<0.01	0.01	0.05	0.02
Ammonia (mg/L)	0.02	0.150	0.130	0.250	0.010	0.100	0.050	0.010	0.070	0.020	0.030	0.150	0.060	0.01	0.25	0.08
Oil and Grease (mg/L)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5	5	5
Calcium (mg/L)	-	6.0	5.5	10.0	4.2	2.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0	2	10	3.5
Magnesium (mg/L)	-	5.4	5.1	5.9	5.5	5.0	4.0	4.5	5.0	5.0	5.0	6.0	3.0	3	6	4.
Sodium (mg/L)	-	110	110	90	91	98	94	99	104	110	103	108	93	90	110	100.8
Potassium (mg/L)	-	2.4	2.3	3.0	1.7	2.0	2.0	1.5	2.0	3.0	1.0	2.0	2.0	1	3	2
Total Hardness (as CaCO ₃)	-	37	35	49	33	26	21	23	21	21	26	21	17	17	49	27.5
Arsenic (mg/L)	0.024	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.004	0.001	0.004	0.001
Cadmium (mg/L)	0.0002	0.0001	0.0001	0.0001	<0.0002	0.0001	0.0001	<0.0002	0.0001	0.0001	0.0001	0.0001	0.0060	0.0001	0.006	0.0006
Chromium (mg/L)	0.001	0.001	0.002	0.001		0.001	0.002		0.001	0.001	0.001	0.003	0.002	0.001	0.003	0.001
Copper (mg/L)	0.0014	0.002	0.001	0.008	0.001	0.002	0.002	0.001	0.001	0.001	0.002	0.005	0.120	0.001	0.1	0.01
Nickel (mg/L)	0.011	0.001	0.001	0.005	0.001	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.034	0.001	0.03	0.004
Lead (mg/L)	0.0034	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.003	0.001	0.003	0.001

	Criteria	Date												Min	Max	Average
		19-Jan-	16-02	20-03-	18-04-	18-05-	19-06-	20-07-	17-08-	14-09-	19-10-	15-11-	18-12-			
Manganese (mg/L)	1.9	0.058	0.013	0.110	0.150	0.137	0.261	0.210	0.167	0.156	0.122	0.054	0.010	0.01	0.3	0.1
Vanadium (mg/L)	-	0.003	0.003	0.001	<0.005	<0.010	<0.010	<0.005	<0.010	<0.010	<0.010	<0.010	0.004	0.001	0.01	0.007
Zinc (mg/L)	0.0213	0.0290	0.0140	0.2500	0.0070	0.0170	0.0110	0.0060	0.0060	0.0190	0.0130	0.0330	0.0060	0.006	0.25	0.03

Surface Water - Dam 2 (2018)

	Criteria	Date												Min	Max	Average
		19-Jan-	16-02-	20-03-	18-04-	18-05-	19-06-	20-07-	17-08-	14-09-	19-10-	15-11-	18-12-			
pH (pH unit)	6.5 - 8.5	7.29	6.48	6.81	7.70	5.80	7.51	6.80	6.64	6.37	6.77	6.76	4.62	4.6	7.7	6.6
TSS (mg/L)	40	37	22	6	17	4	828	5	5	7	191	14	162	4	828	108
TDS (mg/L)	-	354	428	344	300	177	360	300	357	230	182	272	167	167	428	289
Turbidity (NTU)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EC (µS/cm)	125-2200	434	548	535	490	345	171	540	604	405	268	470	193	171	604	416
Nitrogen (Nitrate) (mg/L)	0.35	0.34	0.03	1.60	1.50	1.80	0.94	0.82	0.62	0.95	0.57	0.29	0.84	0.032	1.8	0.858
Total Nitrogen (mg/L)		1.30	0.53	2.70		1.90	1.40		0.60	1.60	1.00	0.30	1.00	0.3	2.7	1.2
Total Phosphorous (mg/L)	0.025	0.03	0.04	0.02	<0.05	<0.05	0.18	<0.05	<0.05	0.01	0.05	<0.01	<0.01	0.01	0.18	0.045
Ammonia (mg/L)	0.02	0.110	0.039	0.170	0.010	0.180	0.020	0.010	0.070	0.010	0.010	0.020	0.020	0.0	0.18	0.055
Oil and Grease (mg/L)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5	5	5
Calcium (mg/L)	-	2.6	5.4	26.0	22.0	6.0	2.0	30.0	46.0	12.0	6.0	37.0	3.0	2	46	16.5
Magnesium (mg/L)	-	3.7	4.2	5.3	5.4	5.0	2.0	7.5	10.0	6.0	3.0	5.0	3.0	2	10	5
Sodium (mg/L)	-	79	89	49	66	52	34	46	53	49	35	35	26	26	89	51
Potassium (mg/L)	-	2.4	2.7	2.0	2.3	1.0	1.0	0.8	1.0	<1.0	<1.0	<1.0	1.0	0.8	2.7	1.4
Total Hardness (as CaCO3)	0.024	22	31	88	77	36	13	110	135	50	27	108	20	13	135	59.7
Arsenic (mg/L)	0.0002	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.004	0.001	0.004	0.001
Cadmium (mg/L)	0.001	0.0001	0.0001	0.0001	<0.0002	0.0001	0.0001	<0.0002	0.0001	0.0001	0.0001	0.0001	0.0070	0.0001	0.007	0.0007
Chromium (mg/L)	0.0014	0.003	0.002	0.001		0.001	0.021		0.001	0.001	0.003	0.001	0.003	0.001	0.02	0.004
Copper (mg/L)	0.011	0.004	0.003	0.008	0.002	0.017	0.016	0.001	0.001	0.001	0.003	0.001	0.124	0.001	0.1	0.01
Nickel (mg/L)	0.0034	0.002	0.002	0.001	0.001	0.001	0.012	0.001	0.001	0.001	0.003	0.001	0.024	0.001	0.02	0.004
Lead (mg/L)	1.9	0.003	0.002	0.001	0.001	0.001	0.014	0.001	0.001	0.001	0.002	0.001	0.003	0.001	0.01	0.003

	Criteria	Date												Min	Max	Average
		19-Jan-	16-02-	20-03-	18-04-	18-05-	19-06-	20-07-	17-08-	14-09-	19-10-	15-11-	18-12-			
Manganese (mg/L)	-	0.087	0.063	0.030	0.025	0.128	0.369	0.160	0.126	0.128	0.072	0.092	0.020	0.02	0.4	0.1
Vanadium (mg/L)	0.0213	0.001	0.008	0.001	0.007	<0.010	0.070	<0.005	<0.010	<0.010	<0.010	<0.010	0.004	0.00	0.07	0.01
Zinc (mg/L)		0.064	0.025	0.160	0.005	0.024	0.079	0.005	0.005	0.019	0.018	0.006	0.007	0.005	0.16	0.03

Surface Water – Dam 3 (2018)

	Criteria	Date										Min	Max	Average
		20-03-	18-04-	18-05-	19-06-	20-07-	17-08-	14-09-	19-10-	15-11-	18-12-			
pH (pH unit)	6.5 - 8.5	7.37	7.10	6.48	7.28	7.40	7.16	6.94	8.07	8.01	7.57	6.5	8.1	7.3
TSS (mg/L)	40	27	17	21	418	63	14	6	38	23	341	6	418	96.8
TDS (mg/L)	-	567	430	380	299	520	424	388	375	495	439	299	567	431.7
Turbidity (NTU)	-	87	59	107	669	310	69	31	45	44	358	31	669	177.9
EC (µS/cm)	125-2200	788	830	654	347	570	622	520	688	833	758	347	833	661
Nitrogen (Nitrate) (mg/L)	0.35	5.100	3.900	3.500	2.830	4.400	4.800	4.770	3.620	3.620	2.430	2.4	5.1	3.9
Total Nitrogen (mg/L)		5.60		4.00	3.90		4.80	5.50	4.20	4.50	3.50	3.5	5.6	4.5
Total Phosphorous (mg/L)	0.025	0.02	0.06	0.18	0.18	0.10	<0.05	0.01	0.01	0.01	0.11	0.01	0.18	0.07
Ammonia (mg/L)	0.02	0.170	0.010	0.090	0.200	0.010	0.050	0.030	0.060	0.080	0.060	0.01	0.2	0.08
Oil and Grease (mg/L)	5	7	<5	<5	<5	<5	<5	<5	<5	<5	<5	5	7	5
Calcium (mg/L)	-	15	15	19	5	12	22	27	17	22	16	5	27	17
Magnesium (mg/L)	-	12.0	9.9	8.0	4.0	9.7	10.0	10.0	8.0	11.0	10.0	4	12	9.3
Sodium (mg/L)	-	140	110	102	58	85	96	99	93	121	109	58	140	101.3
Potassium (mg/L)	-	2.5	1.7	2.0	1.0	1.3	2.0	1.0	1.0	2.0	2.0	1	2	1.6
Total Hardness (as CaCO3)	-	86	78	80	29	70	78	97	93	91	81	29	97	78.3
Arsenic (mg/L)	0.024	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.001
Cadmium (mg/L)	0.0002	<0.000 1	<0.0002	<0.000 1	<0.000 1	<0.0002	<0.000 1	<0.000 1	<0.000 1	<0.000 1	<0.000 1	<0.0001	<0.000 2	<0.0001
Chromium (mg/L)	0.001	0.001		0.002	0.014		0.001	0.001	0.001	0.001	0.006	0.001	0.01	0.01
Copper (mg/L)	0.0014	0.025	0.002	0.006	0.011	0.08	0.001	0.002	0.002	0.002	0.011	0.001	0.08	0.01
Nickel (mg/L)	0.011	0.002	0.002	0.002	0.01	0.007	0.001	0.001	0.001	0.001	0.005	0.001	0.01	0.003
Lead (mg/L)	0.0034	0.0020	0.0010	0.0010	0.0010	0.0060	0.0010	0.0010	0.0010	0.0030	0.005	0.001	0.01	0.002
Manganese (mg/L)	1.9	0.0740	0.1000	0.1300	0.3920	0.3500	0.0400	0.0810	0.0220	0.0180	0.258	0.018	0.39	0.15
Vanadium (mg/L)	-	0.005	0.006	<0.010	0.050	0.027	<0.010	<0.010	<0.010	<0.010	0.030	0.005	0.05	0.02
Zinc (mg/L)	0.0213	0.0640	0.0100	0.0250	0.0620	0.0410	0.1090	0.0170	0.0070	0.0140	0.0330	0.007	0.11	0.04

Surface Water - SW2 (2018)

	Criteria	Date									Min	Max	Average
		18 Apr	18 May	19 Jun	20 Jul	17 Aug	14 Sep 2018	19 Oct 2018	15 Nov 2018	18 Dec 2018			
pH (pH unit)	6.5 - 8.5	6.60	5.75	7.10	6.50	6.52	6.72	6.34	6.57	6.45	5.7	7.1	6.5
TSS (mg/L)	40	9	5	72	14	16	10	20	19	63	5	72	25.3
TDS (mg/L)	-	340	387	243	330	341	273	456	426	448	243	456	360.4
Turbidity			56	124	59	58	47	106	62	145	47	145	82
EC (µS/cm)	125-2200	550	536	255	410	385	304	533	568	520	255	568	451.2
Nitrogen (Nitrate) (mg/L)	0.35	0.030	4.300	2.400	1.100	<0.100	<0.100	8.250	0.830	6.540	0.03	8.25	2.63
Total Nitrogen			4.40	3.10		0.70	1.00	9.00	1.70	7.90	0.7	9	3.9
Total Phosphorous (mg/L)	0.025	0.18	0.09	0.02	<0.05	<0.05	0.03	<0.01	0.03	0.04	0.01	0.18	0.05
Ammonia (mg/L)	0.02	0.001	0.070	<0.01	<0.01	0.080	0.040	0.030	0.130	0.050	0.001	0.13	0.05
Oil and Grease (mg/L)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5	5	5
Calcium (mg/L)	-	4.8	4.0	3.0	3.3	4.0	4.0	2.0	3.0	2.0	2	4.8	3.3
Magnesium (mg/L)	-	5.9	5.0	4.0	4.7	5.0	5.0	4.0	4.0	3.0	3	5.9	4.5
Sodium (mg/L)	-	77	95	43	63	69	61	93	94	88	43	95	75.8
Potassium (mg/L)	-	3.0	2.0	2.0	1.7	2.0	2.0	2.0	2.0	2.0	1.7	3	2.1
Total Hardness (as CaCO3)	-	36	30	24	28	24	24	21	24	17	17	3	25.3
Arsenic (mg/L)	0.024	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.001
Cadmium (mg/L)	0.0002	<0.0002	<0.0001	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001
Chromium (mg/L)	0.001		0.001	0.003		0.002	0.002	0.002	0.001	0.005	0.001	0.005	0.002
Copper (mg/L)	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.007	0.001	0.007	0.002
Nickel (mg/L)	0.011	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.003	0.0013
Lead (mg/L)	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.002	0.001
Manganese (mg/L)	1.9	0.160	0.028	0.046	0.019	0.054	0.149	0.033	0.052	0.042	0.02	0.16	0.06
Vanadium (mg/L)	-	0.005	<0.010	<0.010	0.005	<0.010	<0.010	<0.010	<0.010	<0.010	0.005	0.01	0.01
Zinc (mg/L)	0.021	0.009	0.015	0.010	0.006	0.007	0.014	0.016	0.024	0.028	0.006	0.03	0.01

Surface Water – SW3 (2018)

	Criteria	Date				Min	Max	Average
		18 May	19 Jun	19 Oct	18 Dec			
pH (pH unit)	6.5 - 8.5	5.55	7.00	6.16	3.29	3.3	7	5.5
TSS (mg/L)	40	12	270	248	216	12	270	186.5
TDS (mg/L)	-	382	370	453	816	370	81	505.2
Turbidity		81	488	281	386	81	488	309
EC (µS/cm)	125-2200	331	112	243	412	112	412	274.5
Nitrogen (Nitrate) (mg/L)	0.35	0.460	0.280	<0.010	0.050	0.01	0.46	0.2
Total Nitrogen		0.80	0.90	1.20	1.40	0.8	1.4	1.07
Total Phosphorous (mg/L)	0.025	0.120	0.080	0.120	0.170	0.08	0.17	0.1
Ammonia (mg/L)	0.02	0.090	0.010	0.010	0.080	0.01	0.09	0.05
Oil and Grease (mg/L)	5	<5	<5	<5	<5	5	5	5
Calcium (mg/L)	-	3.0	2.0	3.0	2.0	2	3	2.5
Magnesium (mg/L)	-	5.0	1.0	3.0	2.0	1	5	2.7
Sodium (mg/L)	-	54	25	38	34	25	54	37.7
Potassium (mg/L)	-	2.0	1.0	1.0	1.0	1	2	1.2
Total Hardness (as CaCO ₃)	-	30	9	20	13	9	30	18
Arsenic (mg/L)	0.024	0.001	0.002	0.001	0.002	0.001	0.002	0.001
Cadmium (mg/L)	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium (mg/L)	0.001	0.001	0.012	0.009	0.017	0.001	0.017	0.01
Copper (mg/L)	0.001	0.002	0.010	0.011	0.019	0.011	0.019	0.01
Nickel (mg/L)	0.011	0.001	0.006	0.006	0.009	0.001	0.009	0.005
Lead (mg/L)	0.003	0.001	0.007	0.008	0.011	0.001	0.01	0.007
Manganese (mg/L)	1.9	0.028	0.139	0.123	0.178	0.03	0.2	0.1
Vanadium (mg/L)	-	<0.010	0.040	0.030	0.060	0.01	0.06	0.03
Zinc (mg/L)	0.021	0.015	0.052	0.057	0.092	0.02	0.09	0.05

Surface Water – SW4 (2018)

	Criteria	Date				Min	Max	Average
		18 May	19 Jun	19 Oct	18 Dec			
pH (pH unit)	6.5 - 8.5	5.55	7.00	6.16	3.29	3.29	7	5.5
TSS (mg/L)	40	12	270	248	216	12.00	270	186.5
TDS (mg/L)	-	382	370	453	816	370	816	505.2
Turbidity		81	488	281	386	81	488	309
EC (µS/cm)	125-2200	331	112	243	412	112	412	274.5
Nitrogen (Nitrate) (mg/L)	0.35	0.460	0.280	<0.010	0.050	0.01	0.46	0.2
Total Nitrogen		0.80	0.90	1.20	1.40	0.80	1.4	1.075
Total Phosphorous (mg/L)	0.025	0.120	0.080	0.120	0.170	0.08	0.17	0.1
Ammonia (mg/L)	0.02	0.090	0.010	0.010	0.080	0.01	0.1	0.05
Oil and Grease (mg/L)	5	<5	<5	<5	<5	5	5	5
Calcium (mg/L)	-	3.0	2.0	3.0	2.0	2	3	2.5
Magnesium (mg/L)	-	5.0	1.0	3.0	2.0	1	5	2.7
Sodium (mg/L)	-	54	25	38	34	25	54	37.7
Potassium (mg/L)	-	2.0	1.0	1.0	1.0	1	2	1.25
Total Hardness (as CaCO ₃)	-	30	9	20	13	9	30	18
Arsenic (mg/L)	0.024	0.001	0.002	0.001	0.002	0.001	0.002	0.001
Cadmium (mg/L)	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium (mg/L)	0.001	0.001	0.012	0.009	0.017	0.001	0.02	0.01
Copper (mg/L)	0.001	0.002	0.010	0.011	0.019	0.002	0.02	0.01
Nickel (mg/L)	0.011	0.001	0.006	0.006	0.009	0.001	0.009	0.005
Lead (mg/L)	0.003	0.001	0.0070	0.0080	0.0110	0.001	0.01	0.007
Manganese (mg/L)	1.9	0.028	0.139	0.123	0.178	0.03	0.18	0.1
Vanadium (mg/L)	-	<0.010	0.040	0.030	0.060	0.01	0.06	0.03
Zinc (mg/L)	0.021	0.015	0.052	0.057	0.092	0.02	0.09	0.05

Groundwater - BH 205 and BH 207 *(2018)

	BH 205					BH 207				
	Date		Min	Max	Average	Date		Min	Max	Average
	18 Apr 18	30 Oct 18				18 Apr 18	30 Oct 18			
Chloride (mg/L)	870	420	420.000	870.00	645	1100	140	140	1100	620
Conductivity (at 25Â°C) (µS/cm)	2400	2600	2400	2600	2500	3300	580	580	3300	1940
Nitrate & Nitrite (as N) (mg/L)	0.09	0.07	0.07	0.09	0.08	<0.05	<0.05	0.05	0.05	0.05
pH	7.8	9.8	7.8	9.8	8.8	7.3	7.0	7	7.3	7.15
Phosphate total (as P)	0.40	0.17	0.17	0.40	0.28	0.52	0.34	0.34	0.52	0.43
Sulphate (as S) (mg/L)	59	41	41	59	50	74	22	22	74	48
Total Dissolved Solids (mg/L)	1200	1100	1100	1200	1150	1700	340	340	1700	1020
Total Kjeldahl Nitrogen (as N) (mg/L)	2.7	0.4	0.4	2.7	1.5	0.3	0.5	0.3	0.5	0.4
Total Nitrogen (as N) (mg/L)	2.8	0.5	0.5	2.8	1.65	0.3	0.5	0.3	0.5	0.4
Calcium (mg/L)	46	180	46	180	113	37	6	6	37	21
Magnesium (mg/L)	22	<0.5	0.5	22	11.2	47	8	7.6	47	27.3
Potassium (mg/L)	3.2	9.1	3.2	9.1	6.1	2.5	0.9	0.9	2.5	1.7
Sodium (mg/L)	370	220	220	370	295	490	97	97	490	293.5
Bicarbonate Alkalinity (as CaCO3)	280	<20	20	280	150	200	40	40	200	120
Carbonate Alkalinity (as CaCO3)	<10	94	10	94	52	<10	<10	10	10	10
Total Alkalinity (as CaCO3)	280	420	280	420	350	200	40	40	200	120
Benzene (µg/L)	<0.001	<0.001	-	-	-	<0.001	<0.001	-	-	-
Ethylbenzene (µg/L)	<0.001	<0.001	-	-	-	<0.001	<0.001	-	-	-
m&p-Xylenes (µg/L)	<0.002	<0.002	-	-	-	<0.002	<0.002	-	-	-
o-Xylene (µg/L)	<0.001	<0.001	-	-	-	<0.001	<0.001	-	-	-
Toluene (µg/L)	<0.001	<0.001	-	-	-	<0.001	<0.001	-	-	-
Xylenes - Total (µg/L)	<0.003	<0.003	-	-	-	<0.003	<0.003	-	-	-
4-Bromofluorobenzene (surr)	101	82	82	101	91.5	99	93	93	99	96
TRH C10-36 (Total)	<0.1	<0.1	-	-	-	<0.1	<0.1	-	-	-

	BH 205					BH 207				
	Date		Min	Max	Average	Date		Min	Max	Average
	18 Apr 18	30 Oct 18				18 Apr 18	30 Oct 18			
TRH C10-C14 (µg/L)	<0.05	<0.05	-	-	-	<0.05	<0.05	-	-	-
TRH C15-C28 (µg/L)	<0.1	<0.1	-	-	-	<0.1	<0.1	-	-	-
TRH C29-C36 (µg/L)	<0.1	<0.1	-	-	-	<0.1	<0.1	-	-	-
TRH C6-C9 (µg/L)	<0.02	<0.02	-	-	-	<0.02	<0.02	-	-	-
Naphthalene	<0.01	<0.01	-	-	-	<0.01	<0.01	-	-	-
TRH >C10-C16	<0.05	<0.05	-	-	-	<0.05	<0.05	-	-	-
TRH >C10-C16 less Naphthalene (F2)	<0.05	<0.05	-	-	-	<0.05	<0.05	-	-	-
TRH >C16-C34	<0.1	<0.1	-	-	-	<0.1	<0.1	-	-	-
TRH >C34-C40	<0.1	<0.1	-	-	-	<0.1	<0.1	-	-	-
TRH C6-C10	<0.02	<0.02	-	-	-	<0.02	<0.02	-	-	-
TRH C6-C10 less BTEX (F1)	<0.02	<0.02	-	-	-	<0.02	<0.02	-	-	-

Groundwater – BH 208 and BH 303 (2018)

	BH 208					BH 303				
	Date		Min	Max	Average	Date		Min	Max	Average
	18 Apr 18	30 Oct 18				18 Apr 18	30 Oct 18			
Chloride (mg/L)	1000	-	1000	1000	1000	1000	520	520	1000	760
Conductivity (at 25°C) (µS/cm)	3000	-	3000	3000	3000	3200	1900	1900	3200	2550
Nitrate & Nitrite (as N) (mg/L)	3.6	-	3.6	3.6	3.6	<0.05	0.16	-	-	-
pH	7.10	-	7.10	7.10	7.10	6.8	8.2	6.8	8.2	7.5
Phosphate total (as P)	1.0	-	1.0	1.0	1.0	0.58	0.10	0.1	0.58	0.34
Sulphate (as S) (mg/L)	240	-	240	240	240	27	34	27	34	30.5
Total Dissolved Solids (mg/L)	3000	-	3000	3000	3000	1400	1100	1100	1400	1250
Total Kjeldahl Nitrogen (as N) (mg/L)	1.0	-	1.0	1.0	1.0	<0.2	1.0	0.2	1	0.6
Total Nitrogen (as N) (mg/L)	4.6	-	4.6	4.6	4.6	<0.2	1.2	0.2	1.2	0.7
Calcium (mg/L)	35	-	35	35	35	33	22	22	33	27.5
Magnesium (mg/L)	38	-	38	38	38	38	31	31	38	34.5
Potassium (mg/L)	3.0	-	3.0	3.0	3.0	5.4	7.0	5.4	7	6.2
Sodium (mg/L)	480	-	480	480	480	350	300	300	350	325
Bicarbonate Alkalinity (as CaCO ₃)	81	-	81	81	81	120	75	75	120	97
Carbonate Alkalinity (as CaCO ₃)	<10	-	<10	<10	<10	<10	<10	10	10	10
Total Alkalinity (as CaCO ₃)	81	-	81	81	81	120	75	75	120	97.5
Benzene (µg/L)	<0.001	-	-	-	-	<0.001	<0.001	-	-	-
Ethylbenzene (µg/L)	<0.001	-	-	-	-	<0.001	<0.001	-	-	-
m&p-Xylenes (µg/L)	<0.002	-	-	-	-	<0.002	<0.002	-	-	-
o-Xylene (µg/L)	<0.001	-	-	-	-	<0.001	<0.001	-	-	-
Toluene (µg/L)	<0.001	-	-	-	-	<0.001	<0.001	-	-	-
Xylenes - Total (µg/L)	<0.003	-	-	-	-	<0.003	<0.003	-	-	-
4-Bromofluorobenzene (surr)	102	-	102	102	102	99	94	94	99	96.5
TRH C10-36 (Total)	1.81	-	-	-	-	0.2	0.2	-	-	-

	BH 208					BH 303				
	Date		Min	Max	Average	Date		Min	Max	Average
	18 Apr 18	30 Oct 18				18 Apr 18	30 Oct 18			
TRH C10-C14 (µg/L)	0.41	-	-	-	-	<0.05	<0.05	-	-	-
TRH C15-C28 (µg/L)	1.0	-	-	-	-	0.2	0.2	-	-	-
TRH C29-C36 (µg/L)	0.4	-	-	-	-	<0.1	<0.1	-	-	-
TRH C6-C9 (µg/L)	<0.02	-	-	-	-	<0.02	<0.02	-	-	-
Naphthalene	<0.01	-	-	-	-	<0.01	<0.01	-	-	-
TRH >C10-C16	0.53	-	-	-	-	<0.05	0.27	-	-	-
TRH >C10-C16 less Naphthalene (F2)	0.53	-	-	-	-	<0.05	0.27	-	0.27	0.16
TRH >C16-C34	1.1	-	-	-	-	0.2	<0.1	-	0.2	0.15
TRH >C34-C40	<0.1	-	-	-	-	<0.1	<0.1	-	-	-
TRH C6-C10	<0.02	-	-	-	-	<0.02	<0.02	-	-	-
TRH C6-C10 less BTEX (F1)	<0.02	-	-	-	-	<0.02	<0.02	-	-	-

APPENDIX 7 – *Tetratheca juncea* Monitoring



TETRATHECA JUNCEA
MONITORING REPORT
FOR THE
KARUAH EAST QUARRY SITE
(PROJECT APPROVAL 09-0175)

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Reference No.	<i>Tetratheca juncea</i> Translocation - Karuah East
Document Status & Date:	September 2018



ABBREVIATIONS

DA	<i>Development Application</i>
EPA Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GPS	<i>Global Positioning System</i>
OEH	<i>NSW Office of Environment and Heritage</i>
PA	<i>Project Approval</i>
PPR	<i>Preferred Project Plan</i>
RMS	<i>NSW Roads and Maritime Service</i>
TJMP	<i>Tetratheca juncea Management Plan</i>



CONTENTS

1	INTRODUCTION	4
2	TRANSLOCATION PREPARATION	5
2.1	Marking Plants	5
3	MONITORING RESULTS	7
4	CONCLUSION	13
5	BIBLIOGRAPHY	1
APPENDIX A	PHOTOS	A-1



I INTRODUCTION

Firebird ecoSultants has been engaged by Karuah East Pty Ltd to monitor the success of the translocation of the *Tetratheca juncea* in accordance with the Translocation Plan for *Tetratheca juncea* at Kaurah East Quarry prepared by Firebird ecoSultants (July 2015) to satisfy the requirements of the Project Approval (PA 09_0175) granted on 17 June 2014 for the Karuah East Quarry Project (Karuah East).

The new of the Karuah East Quarry Project required a translocation program to be implemented for threatened species *Tetratheca juncea*. The approved quarry expansion includes a biodiversity offset conservation area adjacent to the existing quarry. This area has been investigated during the approval process and found 6324 clumps of *Tetratheca juncea*. At the time of the original survey it was found that the approved impact area was found to have 243 clumps of *Tetratheca juncea*. However, at the time of translocation 367 individuals were recorded in the May 2016 surveys. It is acknowledged that translocation is not a mitigation measure and is considered as a supplementary action due to low certainty of success. However, in this instance, translocation is being proposed as an additional measure to gain a better biodiversity outcome. Translocation of the individuals to be impacted from within the impact area to the offset site will assist in protecting the genetic diversity of the population. Translocation has been successfully undertaken for *Tetratheca juncea* previously at other sites with a moderate survival rate of 27% after 5 years (Lake Macquarie City Council, 2013).

Alex Picton (Firebird, ecologist) and Nicolas Alexander (Firebird, ecologist) aided in the removal of 367 *T.juncea* individuals during their excavation from the impact site on the 11 May 2016 till the 23rd May 2016. The 367 individuals were translocated into pre-prepared areas within the proposed offset site now referred to as the Translocation Site within this report. An area of 2,500m² to 3,000m² has been identified in Lot 14 as the Translocation Site. Refer to Figure 3-3 showing location of Translocation Site. The Translocation Site has been selected to ensure that an appropriate vegetation community and aspect would be provided. The *Tetratheca juncea* removed from the impact area (being 367 clumps) were placed within this identified Translocation Site to ensure that translocation success is as high as possible, and replicates the source environment as much as practicable.



2 TRANSLOCATION PREPARATION

2.1 Marking Plants

Three hundred and sixtyseven clumps of *Tetralthea juncea* were removed from the impact site that were translocated as part of the development approval. The collection method entailed digging within the Translocation Site before collecting a translocation section from the impact area and placing the section into the hole within the Translocation Site. Site preparation included the removal of threatening processes that may impact upon the success of plant survival. These include weed control, protection from herbivory and management of fire risks. An irrigation system was installed to ensure moisture levels remain adequate for plant survival.

Removal of the plants were undertaken in patches that included numerous clumps. Each of these patches are referred to as a translocation section with Rows A1-A30 and B1-B14 the number of individuals were recorded for each row. Refer to Table 2-1 for results of number of individuals plants in each row.

Table 2-1 Number of *T. juncea* translocated

Row	Count of <i>Tetralthea juncea</i>
A1	6
A2	5
A3	5
A4	4
A5	6
A6	8
A7	4
A8	7
A9	5
A10	5
A11	8
A12	7
A13	4
A14	6
A15	6
A16	6
A17	10
A18	11
A19	10
A20	10
A21	8
A22	9



Row	Count of <i>Tetratheca juncea</i>
A23	8
A24	8
A25	12
A26	16
A27	13
A28	11
A29	10
A30	11
B1	11
B2	9
B3	11
B4	7
B5	6
B6	11
B7	9
B8	10
B9	9
B10	11
B11	10
B12	9
B13	12
B14	3
Total	367

The following methods were employed for the translocation program:

- An excavator was used to dig the plants out of the ground in large scoops. This ensured the plant would be removed with large root balls and soil from the source area.
- The excavator operator would carefully slide the plants with the clump of soil from the excavator's bucket onto the bucket of a front end loader.
- Once the front end loader was filled with approximately 6 excavator scoops, the driver would carefully transport the plants to the translocation area. The plants and soil from source area were carefully slid from the loader bucket by a labourer into the prepared holes.
- The area was watered immediately. The translocation sections received follow up watering to ensure establishment.



3 MONITORING RESULTS

Monitoring of the *T. juncea* individuals in accordance with the Translocation Plan for *T. juncea* (Firebird, 2015) has been undertaken by Firebird consultants in October 2016, October 2017 and September 2018. Monitoring involved the following:

- Flower Counts
- Observe general plant health
- Identify all plants within each Section
- Photo points

The results displayed in Table 3-1 show that of the 367 individuals translocated 135 have survived as of September 2018 and were showing signs of regrowth &/ or in flower. This presents an approximate survival rate of **37%**. Refer to Appendix A for Photos.

Table 3-1 Monitoring results of *T.juncea* plants recorded during the September 2018 survey

Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Flower Count
A1	6	6	5	2	Plant 1: 3 flowers & budding, Plant 2: Budding
A2	5	0	0	1	Plant 1: Green, no flowers
A3	5	5	1	1	Plant 1: 8 flowers & budding
A4	4	5	2	1	Plant 1: 50+ flowers
A5	6	3	3	2	Plant 1: 2 flowers & budding, Plant 2: 7 flowers & budding
A6	8	8	4	5	Plant 1: 3 flowers & budding, Plant 2: 14 flowers & budding, Plant 3: 2 flowers,



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Flower Count
					Plant 4: 11 flowers & budding, Plant 5: 8 flowers & budding
A7	4	4	2	3	Plant 1: 12 flowers & budding, Plant 2: 3 flowers, Plant 3: O/br,
A8	7	9	9	5	Plant 1: 2 flowers & budding, Plant 2: 14 flowers & budding, Plant 3: 29 flowers & budding, Plant 4: 28 flowers & budding, Plant 5: 2 flowers & budding
A9	5	5	3	2	Plant 1: 1 flower, Plant 2: budding
A10	5	3	1	1	Plant 1: O/br
A11	8	7	1	2	Plant 1: O/br, Plant 2: budding
A12	7	8	4	1	Plant 1: D
A13	4	4	1	2	Plant 1: 24 flowers & budding, Plant 2: O/br
A14	6	6	0	2	Plants 1-2: O/br
A15	6	6	5	5	Plants 1-5: D
A16	6	4	4	4	Plants 1-4: D
A17	10	4	10	2	Plant 1: 24 flowers & budding, Plant 2: 42 flowers &



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Flower Count
					budding
A18	11	11	8	4	Plant 1: 6 flowers, Plant 2: 18 flowers & budding, Plant 3: 7 flowers, Plant 4: 50 + flowers
A19	10	8	5	4	Plant 1: 50 + flowers, Plant 2: 18 flowers & budding, Plant 3: 50 + flowers, Plant 4: 7 flowers
A20	10	9	5	2	Plant 1: 15 flowers, Plant 2: 24 flowers
A21	8	8	2	3	Plants 1-2: O/br, Plant 3: 24 flowers
A22	9	8	7	5	Plant 1: 50 + flowers, Plant 2: 16 flowers & budding, Plant 3: 5 flowers, Plant 4: 20 flowers & budding, Plant 5: 19 flowers
A23	8	13	5	6	Plant 1: 3 flowers, Plant 2: 50+ flowers, Plant 3: 8 flowers, Plant 4: 10 flowers, Plant 5: 5 flowers, Plant 6: 50+ flowers



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Flower Count
A24	8	7	4	7	Plant 1: 2 flowers, Plant 2: 2 flowers, Plant 3: 2 flowers, Plant 4: 10 flowers, Plant 5: 29 flowers, Plant 6: 50+ flowers, Plant 7: 3 flowers
A25	12	6	4	4	Plant 1: 7 flowers, Plant 2: 13 flowers & budding, Plant 3: 6 flowers, Plant 4: 1 flower
A26	16	18	7	4	Plant 1: 7 flowers, Plant 2: 12 flowers, Plant 3: 24 flowers, Plant 4: 19 flowers & budding
A27	13	7	6	3	Plant 1: 6 flowers, Plant 2: 10 flowers, Plant 3: 11 flowers
A28	11	2	2	2	Plant 1: 2 flowers, Plant 2: 3 flowers
A29	10	7	5	5	Plants 1-5: D
A30	11	10	6	3	Plant 1: 3 flowers, Plant 2: 28 flowers, Plant 3: 8 flowers
B1	11	12	4	4	Plant 1: 50+ flowers, Plant 2:



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Flower Count
					50+ flowers, Plant 3: 17 flowers, Plant 4: 9 flowers & budding
B2	9	8	4	3	Plant 1: 26 flowers, Plant 2: 12 flowers, Plant 3: 50+ flowers
B3	11	9	6	3	Plant 1: 50+ flowers, Plant 2: 10 flowers & budding, Plant 3: 13 flowers
B4	7	5	5	3	Plant 1: 4 flowers, Plant 2: 24 flowers, Plant 3: 20 flowers
B5	6	6	5	3	Plant 1: 7 flowers, Plant 2: 25 flowers, Plant 3: 8 flowers
B6	11	7	4	1	Plant 1: 7 flowers
B7	9	8	7	3	Plants 1-3: O/br
B8	10	7	4	5	Plant: 16 flowers, Plant 2: O/br, Plant 3: 11 flowers, Plant 4: 6 flowers, Plant 5: 10 flowers
B9	9	6	5	2	Plant 1: 11 flowers, Plant 2: 3 flowers
B10	11	11	5	2	Plant 1: 13 flowers, Plant 2:



Row #	No Translocated in May 2016	Monitoring Results October 2016	Monitoring Results October 2017	Monitoring Results September 2018	Flower Count
					14 flowers
B11	10	10	6	3	Plants 1-3: O/br
B12	9	10	5	3	Plant 1: 2 flowers, Plant 2: 7 flowers, Plant 3: O/br
B13	12	10	5	3	Plant 1: 11 flowers, Plant 2-3: D
B14	3	9	1	4	Plants 1-4: D
Total	367	319	187	135	

O/BR = Plant has no flowers and is browned off
however there is fresh regrowth
D = Dead



4 CONCLUSION

The monitoring of the *T. juncea* translocation, as of September 2018, has shown a survival rate of 37% for the third year of monitoring. Kleinfelder (2018) have also observed a decline in the *T. juncea* numbers within the Biodiversity Offset for the past three years. It is noted that the yearly rainfall totals as recorded by the Bureau of Meteorology's official weather station at Nelson Bay has been below the long-term average in 2016, 2017 and 2018. This suggests that the natural decline in *T. juncea* population is potentially related to the drier than normal conditions.

However, it should also be noted that the translocation site is considerably more overgrown with native vegetation than the previous years. *T. juncea* are quite difficult to find when they are not in flower, particularly in heavily vegetated areas. Thus, it is considered that there was a chance of potentially missing individual *T. juncea* during the survey effort which would result in a lower predicted rate of survival.

A further two (2) years of monitoring will be able to show more certainty of the success of translocation of *T. juncea*.



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APPENDIX A PHOTOS

Photo 1: *T.juncea* in flower in September 2018



Photo 2: Unhealthy/browning *T.juncea*



Photo 3: Considerable regrowth of native vegetation in translocation rows



APPENDIX 8 – Audit Action Plan



RESPONSE TO AUDIT RECOMMENDATIONS – Independent Environmental Audit (EMM, July 2017)

Update: 19 March 2019

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
Project Approval PA 09_0175			
Schedule 3 - Environmental Performance Conditions			
19	The Proponent shall comply with the discharge limits in any EPL, or with Section 120 of the POEO Act	<p>Non-compliant</p> <p>It is recommended that monitoring at SW5 is included in the routine monitoring program.</p> <p>It is recommend that oil and grease concentrations downstream and upstream of the quarry (and potentially in adjacent catchments) are investigated to determine the source of elevated oil and grease concentrations, and whether the quarry is contributing to downstream concentrations.</p> <p>It is recommended that any exceedances of water quality criteria during dam water discharges are reported, in accordance with the project approval conditions and the quarry's EPL.</p>	<p>TSS exceedances during discharge have been reported during 2018.</p> <p>Oil & grease has been closely monitored. There has been no elevated oil and grease concentrations during 2018.</p>

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
21	<p>The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must:</p> <p>(c) include:</p> <p>..</p> <p>(iii) a Groundwater Monitoring Program that includes:</p> <ul style="list-style-type: none"> • baseline data of groundwater levels surrounding the site; • groundwater impact assessment criteria, to be developed following analysis of baseline data, including trigger levels for investigating any potentially adverse groundwater impacts; and • a program to monitor and/or validate the impacts of the project on groundwater resources. <p>..</p>	<p>Administrative non-compliance</p> <p>It is recommended that groundwater levels are monitored quarterly or that the monitoring frequency is modified in the WMP.</p>	<p>Action completed.</p> <p>Groundwater levels have been monitored every quarter and will continue in the future as per the approved Water MP.</p>
27	<p>The Proponent shall develop and implement a translocation program for <i>Tetratheca juncea</i> to the satisfaction of the Secretary. This program must:</p> <p>..</p> <p>(e) include short and long-term goals and performance criteria to measure the effectiveness of the program; and</p> <p>..</p>	<p>Administrative non-compliance</p> <p>It is recommended that the plan is updated to include performance criteria to ensure the effectiveness of the program can be reviewed and to identify ways to improve the success of future translocation programs.</p>	<p>Action completed.</p> <p>The TJTMP was updated in 2018, which received approval on 14 March 2019.</p>

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
29	The Proponent shall, within 12 months of the finalisation of the Biodiversity Offset Strategy, make suitable arrangements to provide appropriate long-term security for the offset area, in consultation with OEH and Council, and to the satisfaction of the Secretary. ..	Administrative non-compliance It is recommended that the conservation agreement is finalised in consultation with OEH and DPE.	Pending. A conservation agreement under Part 4 Division 12 of the National Parks & Wildlife Act 1974 was drafted in November 2016. In July 2017, KEQ lodged a Section 75(W) modification (Mod 1) with the DPE. In February 2018, another Section 75(W) modification (Mod 2) was lodged. Both these modifications were approved in 2018. The conservation agreement will be reviewed and modified accordingly.
32	The Proponent shall prepare and implement a Landscape and Rehabilitation Management Plan for the project to the satisfaction of the Secretary. This Plan would relate to the area of the quarry and all perimeter lands. This plan must: .. d. describe the short, medium and long-term measures that would be implemented to: • manage remnant vegetation and habitat on the site; and • ensure compliance with the rehabilitation objectives and progressive rehabilitation obligations of this approval. ..	Non-compliant It is recommended that soil is not stockpiled within the quarrying area or that it is stored within discrete stockpiles as opposed to forming parts of benches. This would allow the soil thickness to be verified to be less than 3 m and to ensure that it is easily recovered for use in rehabilitation.	Pending. Further topsoil from the extraction area has been stripped and temporarily stockpiled in the southern area of the extraction area. Topsoil stockpiles will be relocated once more room becomes available.

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
34	The Proponent shall lodge a Conservation and Rehabilitation Bond with P&I within 6 months of the approval of the Landscape and Rehabilitation Management Plan, to ensure that the Biodiversity Offset Strategy and the rehabilitation of the site is implemented in accordance with the performance and completion criteria set out in the Landscape and Rehabilitation Management Plan. ..	Administrative non-compliance The Conservation and Rehabilitation Bond was lodged outside of 6 months of the approval of the Landscape and Rehabilitation Management Plan (14 December 2015).	The Conservation and Rehabilitation Bond was lodged with the DPE in July 2016. No further action is required to comply with this condition.
Schedule 5 - Environmental Management, Reporting and Auditing			
3	The Proponent shall ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include: ... (f) a program to investigate and implement ways to improve the environmental performance of the project over time; (g) a protocol for managing and reporting any: <ul style="list-style-type: none"> incidents; complaints; non-compliances with statutory requirements; and exceedances of the impact assessment criteria and/or 	Compliant As noted within the EMS, the quarry's management team will discuss and review the status of all management plans on an annual basis, but unless required, all site environmental management plans (including the Environmental Management Strategy) will be reviewed and updated every three years. The EMS does not include a adequately detail the program to improve the environmental performance of the project, the reporting protocol or review protocol. It is recommended that a copy of the quarry's Environmental Incident Reporting Form be appended to each of the quarry's management	All management plans are currently under review and will be updated during Q2 2019. Consideration will be given to include a copy of the Environmental Incident Form in the Appendices of each MP's.



Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
	<ul style="list-style-type: none"> performance criteria; and a protocol for periodic review of the plan. 	plans and the protocol for managing and reporting all environmental incidents be referenced in the text.	
7	The Proponent shall immediately notify the Secretary and any other relevant agencies of any incident that has caused, or threatens to cause, material harm to the environment. For any other incident associated with the project, the Proponent shall notify the Secretary and any other relevant agencies as soon as practicable after the Proponent becomes aware of the incident. Within 7 days of the date of the incident, the Proponent shall provide the Secretary any relevant agencies with a detailed report on the incident, and such further reports as may be requested.	<p>Non-compliant</p> <p>It is recommended that any exceedances of water quality criteria during dam water discharges are reported, in accordance with the project approval conditions and the quarry's EPL.</p>	Exceedances of water quality that occurred in October 2018 was reported to the EPA and DPE.

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
EPL 20611			
2 Discharge to Air and Water and Applications to Land			
P1.3	The following points referred to in the table (refer to Appendix C) are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.	<p>Compliant</p> <p>As noted within the Annual Review and the environmental monitoring reports, there were no discharge events at Karuah East Quarry during the reporting period for these documents. The discharge points listed in the Water Management Plan are consistent with the licensed discharge points listed as part of this condition (refer to Figure 4 of the Water Management Plan). As noted regarding Schedule 2, Condition 2 of PA 09_0175, Dam 1 has been constructed about 100 m further south than shown on the plan.</p> <p>It is recommended that the proposed surface water management layout in the Water Management Plan (Figure 4) is updated accordingly and the plan is submitted to the EPA with a request to vary the EPL.</p>	<p>Water MP will be revised. Figure 4 of the Water MP will be updated to reflect location changes of the Dams.</p> <p>It is anticipated that the Water MP will be updated by the end of Q2 2019.</p>
3 Limit Conditions			
L1.1	Except as may be expressly provided in any other condition of this licence, the licensee must comply with Section 120 of the Protection of the Environment Operations Act 1997.	<p>Non-compliant</p> <p>It is recommended that any exceedances of water quality criteria during dam water discharges are reported, in accordance with the project approval conditions and the quarry's EPL.</p>	<p>Exceedances of water quality that occurred in October 2018 was reported to the EPA and DPE.</p> <p>All controlled and uncontrolled discharge events will be reported in the annual returns as required under EPL 20611.</p>

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
L2.1	For each monitoring/discharge point or utilisation area specified in the table/s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.	<p>Non-compliant</p> <p>It is recommended that any exceedances of water quality criteria during dam water discharges are reported, in accordance with the project approval conditions and the quarry's EPL.</p>	<p>Exceedances of water quality that occurred in October 2018 was reported to the EPA and DPE.</p> <p>All controlled and uncontrolled discharge events will be reported in the annual returns as required under EPL 20611.</p>
L2.2	Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.	<p>Non-compliant</p> <p>It is noted that the baseline pH of the area was 5.58–6.20 (refer to Table 4 in the Water Management Plan), while the EPL specifies a discharge range of pH 6.5–8.5. So any discharge is expected to be out of compliance unless it is treated to increase the pH above the natural range. The environmental benefit of such treatment is questionable given that it may result in a perturbation from the natural conditions of the receiving waters.</p>	<p>Though this has been non-compliant, previous monitoring results shows that the pH levels across the KEQ site is naturally lower than the EPL limits. At this time, KEQ believes there will be no environmental benefits in treating the discharge water to raise the pH. Monitoring results of discharge events will be reported in the EPL annual returns. Monthly and discharge monitoring will also be reported in the Annual Reviews.</p> <p>The surface water monitoring results of 2018 has shown that the pH in the dams have risen since 2016/2017. The pH levels have been more consistently in the 6.5-8.5 range.</p>

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
L4.4	<p>To determine compliance:</p> <p>a) with the Leq(15 minute) noise limits in the Noise Limits table, the noise measurement equipment must be located:</p> <p>i) approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or</p> <p>ii) within 30 metres of a dwelling façade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or, where applicable;</p> <p>iii) within approximately 50 metres of the boundary of a National Park or a Nature Reserve.</p> <p>b) with the LA1(1 minute) noise limits in the Noise Limits table, the noise measurement equipment must be located within 1 metre of a dwelling façade.</p> <p>c) with the noise limits in the Noise Limits table, the noise measurement equipment must be located:</p> <p>i) at the most affected point at a location where there is no dwelling at the location; or</p> <p>ii) at the most affected point within an area at a location prescribed by part (a) or part (b) of this condition.</p> <p>Note: A non-compliance of the Noise Limits table will still occur where noise generated from the premises in excess of the appropriate limit is measured:</p>	<p>Compliant</p> <p>The Noise Management Plan specifies that all noise measurement procedures employed throughout the monitoring programme will be guided by the requirements of AS 1055 1997 Acoustics - Description and Measurement of Environmental Noise (refer to Section 8). In addition, all acoustic instrumentation employed throughout the monitoring programme will be designed to comply with the requirements of AS IEC 61672.1 2004 Electroacoustics Sound level meters - Specifications. As noted within the Noise Management Plan and the Annual Review, the noise monitoring locations are consistent with the locations listed as part of this EPL. The monitoring requirements specified as part of this condition are not explicitly addressed within the Noise Management Plan.</p> <p>It is recommended that the Noise Management Plan be revised to include reference to the specific measures listed in this condition.</p>	<p>KEQ will review the Noise MP in consultation with an acoustic specialist. Amendments will be made to the Noise MP if required.</p> <p>It is anticipated that the Noise MP will be updated during Q2 2019.</p>

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
	i) at a location other than an area prescribed in part (a) and part (b); and/or ii) at a point other than the most affected point at a location.		
5 Monitoring and Recording Conditions			
M3.1	... Note: The Protection of the Environment Operations (Clean Air) Regulation 2010 requires testing for certain purposes to be conducted in accordance with test methods contained in the publication " <i>Approved Methods for the Sampling and Analysis of Air Pollutants in NSW</i> ".	Compliant The general requirements of the air quality monitoring program are established in Section 8.1.1 of the Air Quality and Greenhouse Gas Management Plan. As noted within Section 8.1.1, all monitoring must be conducted in accordance with the Approved Methods for the Sampling and Analysis of Air Pollutants in NSW. It is recommended that a statement be included within the quarry's monthly environmental monitoring reports and future annual reviews that monitoring has been conducted in accordance with the <i>Approved Methods for the Sampling and Analysis of Air Pollutants in NSW</i>.	Action completed.



Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
M6.1	The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.	<p>Administrative non-compliance</p> <p>It is recommended that the Hunter Quarries website is updated to specify a number to call with complaints - this may be the same number as the general number provided.</p>	<p>Action completed.</p> <p>The Hunter Quarries website was updated on 14 July 2017. An environmental complaints contact phone number is now listed.</p>
M6.2	The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.	<p>Administrative non-compliance</p> <p>It is recommended that the Hunter Quarries website is updated to specify a number to call with complaints - this may be the same number as the general number provided.</p>	<p>Action completed.</p> <p>The Hunter Quarries website was updated on 14 July 2017. An environmental complaints contact phone number was added.</p>

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
Statement of Commitments – Appendix 6, Project Approval 09_0175			
Schedule 3 - Environmental Performance Conditions			

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
2.0 SUMMARY OF MANAGEMET PLANS	... The following management plans will be prepared prior to commencement of construction works: ... - Waste Management Plan. ...	Administrative non-compliant The quarry's EMS and management plans have been approved by DPE. However, a waste management plan has not been prepared to meet this commitment. It is recommended that a waste management plan is prepared, in accordance with the summary of environmental monitoring provided in Table 6 of the EMS.	Waste management is partially covered in the EMS. A separate Waste MP will be considered and developed if necessary before the end of Q2 2019.
3.0 SOIL AND WATER / 3.2 Groundwater Management	Refuelling will be undertaken in a designated non-permeable (compacted clay or concrete) area.	Administrative non-compliant The site is under construction and re-fuelling areas have not been constructed. Refuelling in the quarry and infrastructure area is currently performed by a mobile tanker. These are temporary arrangements during the project's construction period and will be addressed prior to the commencement of quarrying operations. Obviously, some earthworks need to be completed before a non-permeable refuelling area can be established. It would have been better to recognise this when writing this commitment. It is recommended that a non-permeable refuelling area (or areas) is constructed as soon as practicable.	Action completed. A permanent refuelling area was constructed at the end of 2017. A self bunded "bladder" diesel tank was installed. Refuelling has been constructed in concrete and includes an oil/fuel catchment sump.
3.0 SOIL AND WATER / 3.2 Groundwater Management	Groundwater samples will be collected for laboratory analysis on a 6-monthly basis. The groundwater quality results will be laboratory analysed for the parameters below and compared to background water	Administrative non-compliant There is no evidence that the groundwater sampling was carried out by an experienced professional or environmental scientist in	Action completed. Groundwater monitoring reports are provided to KEQ by the groundwater specialists for every monitoring event.

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
	quality results. The groundwater sampling will be carried out by an experienced groundwater professional or environmental scientist in accordance with Australian sampling standards. The basic analyte and parameter suite applies to all samples. The additional extended analytic suite should apply annually together with the basic suite.	<p>accordance with the Australian sampling standards.</p> <p>It is recommended that the qualifications and experience of the professional undertaking groundwater sampling are provided in monitoring reports.</p> <p>The laboratory results for March 2016 and April 2017 confirmed that the suite of analytes listed as part of this commitment were assessed (with the exception of total iron, which was not assessed as part of the April 2017 monitoring event).</p> <p>It is recommended that total iron concentrations be assessed as part of the 12 monthly suite of analytes or that the Water Management Plan is amended to remove this requirement.</p>	All analytes are now included in the laboratory reports.
3.0 SOIL AND WATER / 3.2 Groundwater Management	Additional Analysis – 12 monthly (every second sample only): Nutrient suite: total nitrogen, nitrate, total Kjeldahl nitrogen, total phosphorus, phosphate; Metals (arsenic, cadmium, chromium, copper, lead, zinc, nickel, manganese, mercury, total iron, filterable iron); Polycyclic Aromatic Hydrocarbon (PAH); and Organophosphorus pesticides, phenoxy acid herbicides.	<p>Administrative non-compliant</p> <p>The laboratory results for March 2016 and April 2017 confirmed that the suite of analytes listed as part of this commitment were assessed (with the exception of total iron, which was not assessed as part of the April 2017 monitoring event).</p> <p>It is recommended that total iron concentrations be assessed as part of the 12 monthly suite of analytes or that the Water Management Plan is amended to remove this requirement.</p>	Action completed. All analytes are now included in the laboratory reports.
3.0 SOIL AND WATER / 3.3 Surface Water – Proposed Water	In the event that water is required to be discharged offsite, the water will be tested prior to discharge to ensure appropriate discharge criteria are met, such as Total Suspended Solids (TSS) below a	<p>Non-compliant</p> <p>As described above (refer to Schedule 3, Condition 19 of PA 09_0175), the results of the TSS monitoring during the discharge events from Dam</p>	Action completed. TSS during discharge has been below the criterion in 2018 except for three days of discharge from LDP001 that occurred during October 2018.

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
Management Systemt	concentration of 50 mg/L. Where this is not the case, water will be treated, for example through the use of chemical flocculation, to achieve a suitable water quality.	3 in March and April 2017 exceeded the concentration limits (40 mg/L) defined by Condition L2.4 of the quarry's EPL and 50 mg/L. It is recommended that water be treated during all future dam water discharges to achieve a suitable water quality.	KEQ will continue to monitor and treat the dam water in the future when required.
3.0 SOIL AND WATER / 3.3 Surface Water – Proposed Water Management Systemt	In the event that an exceedance in surface water quality criteria is identified, the exceedance will need to be reported to the relevant agencies in accordance with the requirements of the EPL.	Non-compliant As described above (refer to Schedule 3, Condition 19 of PA 09_0175), the results of the water quality monitoring for pH, TSS and oil and grease during the discharge events from Dam 3 in March and April 2017 exceeded the concentration limits defined by Condition L2.4 of the quarry's EPL. These discharge events should have been reported due to the degraded water quality recorded. It is recommended that any exceedances of water quality criteria during dam water discharges are reported, in accordance with the project approval conditions and the quarry's EPL.	Noted. Exceedance in water quality during three days of discharge in October 2018 was reported to the EPA and DPE.
3.0 SOIL AND WATER / 3.3 Surface Water – Proposed Water Management Systemt	That controlled discharge of treated (e.g. flocculated) water be undertaken when total site storage levels are above 4.3 ML, which would provide the capacity to contain more rainfall events and reduce wet weather discharges (this assumes the dams are built to the capacities presented in Table 2 – refer to Appendix C).	<i>Not verified</i> It is noted that there was little free-board on Dam 1 and 3 during the site inspection. No water level gauges were observed. It is recommended that water level gauges are installed in the dams and the relationship between water levels and total volume stored is established.	KEQ is investigating options for water level gauges. It is likely that KEQ will install a water level gauge at Dam 1, Dam 2 and Dam 3 for long term monitoring.

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
4. BIODIVERSITY & CONSERVATION OFFSET / 4.1 Flora and Fauna	A report detailing the methods and results of the pre-clearing surveys will be prepared and submitted to OEH immediately prior to the commencement of the clearing operations.	Administrative non-compliant Correspondence with T. Grugeon on 30 May 2017 confirmed that the pre-clearing surveys were undertaken as per Section 6.2 of the landscape and rehabilitation management plan, which was approved by DPE in accordance with Condition 32 of Schedule 3 of PA 09_0175. However, specific correspondence with OEH to address this commitment did not occur. It is recommended that the report detailing the methods and results of the pre-clearing surveys is submitted to OEH.	Action completed. Reports submitted to OEH in 2017.
4. BIODIVERSITY & CONSERVATION OFFSET / 4.1 Flora and Fauna	<u>Site Survey and Exclusion Fencing</u> The extraction area/forest interface will be delineated to protect retained bushland areas on Lot 12 and 13. To achieve this, the quarry footprint boundary will be surveyed and pegged by a Registered Surveyor prior to the conduct of clearing operations. Plastic mesh fencing or star pickets and flagging tape will be installed along the extraction boundary for use as exclusion fencing. The fencing will function as a clearly marked 'exclusion' boundary for the machinery operations.	Compliant During the site inspection, evidence of appropriate signage delineating the conservation offset areas from the extraction area/project area was observed. In addition, it was noted that boundary tape and plastic mesh fencing was used during the clearing process. Fencing has not yet been erected to the extent identified in this commitment, which is unclear as to whether it applies to construction as well as to operations. It was noted that long-term exclusion fencing cannot be erected until after construction has been completed. It is recommended that exclusion fencing be installed as soon as practicable after the completion of construction to meet this commitment.	Noted. Partially completed. Exclusion chain wire fencing has been erected except along the boundary of the extraction area. The exclusion fencing will be installed as soon as it is practical in this area.

Condition Number	Condition	Compliance Status and Recommendations	KEQ Comment (March 2019)
4. BIODIVERSITY & CONSERVATION OFFSET / 4.1 Flora and Fauna	Where possible, vegetation clearing activity will be timed so as to avoid the following breeding periods for hollow dependent fauna: i) October – February (microbats); and ii) June – August (large forest owls and microbats in torpor).	Compliant Vegetation clearing for the project commenced in April 2016 and the majority of the project area was cleared between April and June 2016, with some clearing also occurring in July and November 2016. However, it is noted that the commitment is to avoid these periods "where possible" and that there will be ongoing clearing as part of the project. It is recommended that future clearing is scheduled well in advance to avoid breeding periods for hollow-dependent fauna.	Noted. KEQ has made all efforts to avoid clearing during these periods and will continue to do so in the future. Clearing and felling of identified habitat trees are supervised by ecologists.
4. BIODIVERSITY & CONSERVATION OFFSET / 4.2 Biodiversity Offset Strategy	Seasonal flora and fauna survey of the offset site will be undertaken in accordance with relevant OEH guidelines. In particular, seasonal survey for <i>Tetratheca juncea</i> and <i>Grevillea parviflora</i> ssp <i>parviflora</i> will be undertaken and reported to the NSW OEH.	Compliant No reduction in threatened flora populations was recorded at the monitoring sites in 2016. It is recommended that the results of all future seasonal surveys for <i>Tetratheca juncea</i> and <i>Grevillea parviflora</i> ssp <i>parviflora</i> be reported to OEH in accordance with this condition.	Noted. The 2018 BOA Annual Monitoring report will be submitted to the OEH.
11.0 QUARRY CLOSURE & REHABILITATION / 11.1 Rehabilitation Management Plan	Stockpiles will be protected with sediment fencing and planted with a sterile cover crop (annual species) to ensure stabilisation. Surface drainage in the vicinity of the stockpiles will be configured so as to direct any runoff around the stockpile.	Non-compliant Stockpiles are generally protected by sediment fences. A sterile cover crop has not been planted. It is recommended that a sterile cover crop is planted on soil stockpiles in accordance with the Landscape and Rehabilitation Management Plan.	Noted. Partially completed. KEQ have seeded topsoil stockpiles with sterile crops (annual rye, millet and oats). All new topsoil stockpiles will continue to be seeded with sterile crops.