



ANNUAL REVIEW

KARUAH EAST QUARRY

KARUAH, NSW

Review Period: 1 January 2021 – 31 December 2021

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ABBREVIATIONS

CCC	Community Consultative Committee
DA	Development Application
DDG	Dust Deposition Gauge
DPE	Department of Planning and Environment (Formerly DPIE)
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management Strategy
EPA	NSW Environmental Protection Authority
EPL	Environment Protection Licence
Ha	Hectare
km	Kilometre
L	Litre
LDP	Licensed Discharge Point
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
NPWS	NSW National Parks and Wildlife Service, now part of Environment, Energy and Science
RFS	NSW Rural Fire Service
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 2021 to 31 December 2021**.

This report provides specific detail on the project including a summary of environmental monitoring data and environmental performance during the reporting period.

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 2021
Annual Review end date	31 December 2021
I, Michael Todd, 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 2021 to 31 December 2021 and that I am authorised to make this statement on behalf of Karuah East Quarry Pty Ltd. <i>Note.</i> <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> <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>	
Name of authorised reporting officer	Michael Todd
Title of authorised reporting officer	Quarry Manager
Signature of authorised reporting officer	
Date	31/10/2022

1.0 STATEMENT OF COMPLIANCE

Table 1, Table 2, and Table 3 outline the compliance status of the quarry operations at the end of the 2021 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: - 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: - 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-Compliances

Relevant Approval	Condition #	Condition Description (Summary)	Compliance Status	Site Comment	Where Addressed in Annual Review
PA 09_0175	Schedule 3 Condition 19	Surface Water Discharges	Non-compliance relating to exceedance of concentration limits	Exceedances in TSS during an uncontrolled discharge in March 2021, over 6 days. Refer to Section 6.8 for further detail.	Section 6.8 and Section 10
EPL 20611	Condition L1 and 2	Surface Water Discharges	Non-compliance relating to exceedance of concentration limits	As per Schedule 3 Condition 19. Refer to Section 6.8 for further detail.	Section 6.8 and Section 10
EPL 20611	Condition M2	Depositional Dust Monitoring Frequency	Non-compliant	A result for depositional dust from DDG 5 for June 2021 could not be retrieved due to the gauge being found broken upon collection.	Section 6.4.3

Relevant Approval	Condition #	Condition Description (Summary)	Compliance Status	Site Comment	Where Addressed in Annual Review
EPL 20611	Condition M2	TSP Monitoring Frequency	Non-compliant	Non-compliance for failure to sample TSP every 6 days due to equipment failure. The TSP HVAS unit was found broken in March 2021, causing the machine to cease collection of TSP results for 3 consecutive sampling events.	Section 6.4.3

2.0 INTRODUCTION

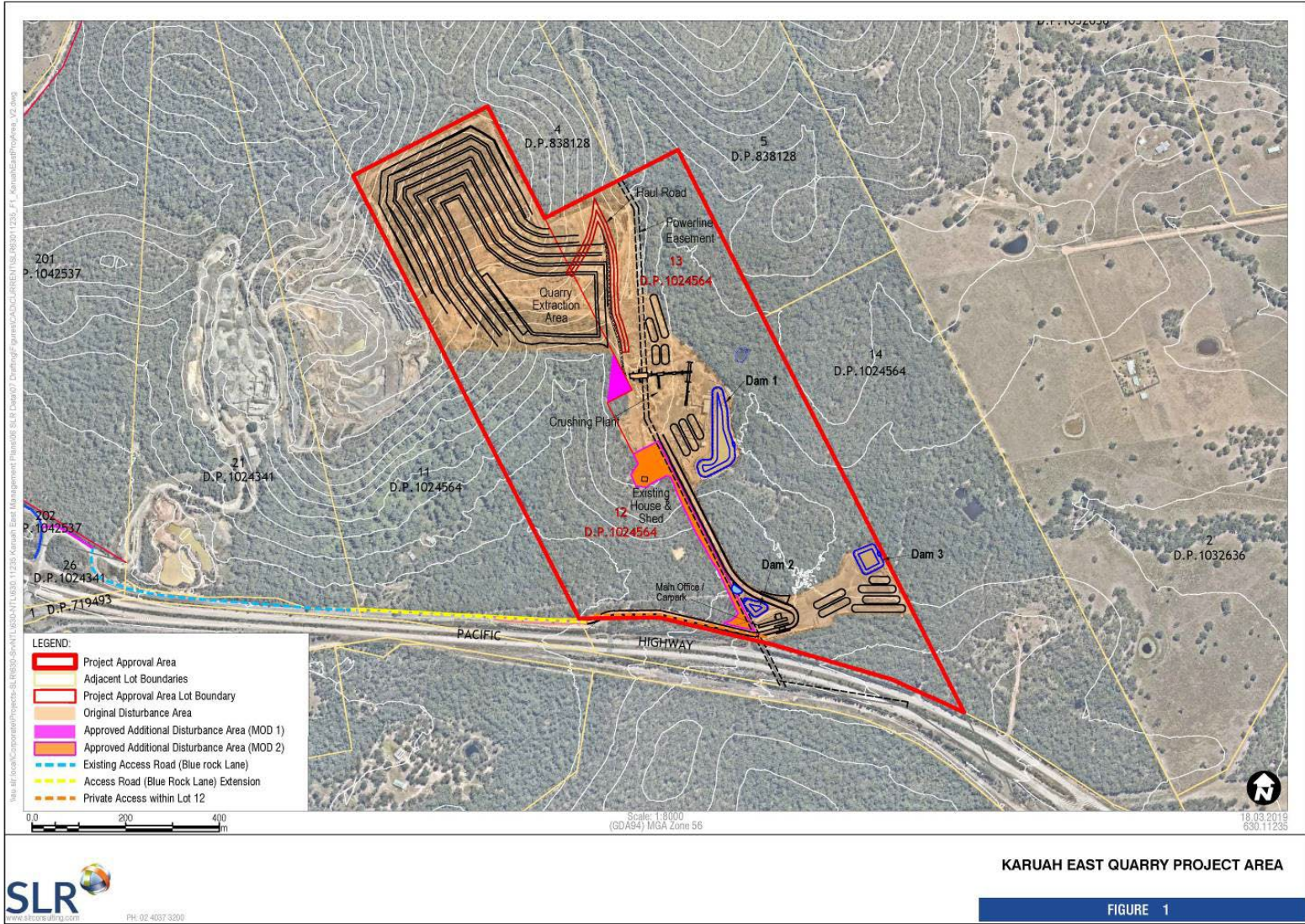
This Annual Review covers the reporting period from the **1 January 2021** to **31 December 2021** for the Karuah East Quarry. **Figure 1** presents the Karuah East Quarry site plan and layout.

2.1 Project Overview

Karuah East Quarry is a hard rock quarry which contributes materials to construction industries in the Hunter, New England, and Sydney Regions. The site is located on Blue Rock Close, off the Pacific Highway, approximately 3 km north-east of Karuah, NSW. The Karuah East Quarry site covers approximately 33 hectares within Lots 12 and 13 of DP 1024564. 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;
- Drilling and blasting activities;
- Loading and hauling of extracted material;
- Crushing and screening of extracted material;
- Stockpiling of material onsite; and
- Location of plant on Lot 13 comprised of office buildings, workshops, parking areas, crushing plant, wash plant, weigh bridge and product storage areas.

Figure 1 - Karuah East Quarry – Site Plan



3.0 APPROVALS

The Karuah East Quarry is required to hold relevant approvals for the quarrying operations. These approvals are summarised in **Table 4**.

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>

3.1 PA 09_0175

PA 09_0175 has been modified four times, Modification 1, Modification 2, Modification 8 and Modification 9. A copy of the consolidated consent is attached as **Appendix 1**. Note that Modifications 3 to 7 were not progressed and have been withdrawn.

3.1.1 Modification 1

Modification 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.

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**.

3.1.2 Modification 2

Modification 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. 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**.

3.1.3 Modification 8

Following the commencement of quarrying activity in 2018, it was identified that improved targeted acoustic mitigation measures were necessary and would be beneficial to all stakeholders. Modification 8 (MOD 8) was submitted to DPE on 20 June 2019 to implement improved acoustic mitigation measures and to modify the operational noise criteria of the Project Approval (Condition 3 of Schedule 3) in accordance with the NSW Noise Policy for Industry (2017).

Approval for MOD 8 was received on 22 December 2020. Further details around the changes to noise criteria and additional acoustic measures are included in **Section 6.2**. There was no change to surface disturbance as part of this modification.

3.1.4 Modification 9

Modification 9 (MOD 9) was submitted to DPE on 26 April 2021 with the aim of more efficiently supplying product to local customers by aligning operational hours with those local building and infrastructure projects. Under MOD 9, the defined activity “Product loading and dispatch” was added under the hours of operation outlined in Condition 7 of Schedule 2 of the Project Approval. Additionally, operating hours under Quarrying Operations were extended on weekdays and Saturdays.

MOD 9 was approved 2 December 2021. For the majority of this 2021 Annual Review period, Karuah East Quarry operated under the hours of operation defined under MOD 8. Karuah East Quarry began to operate as per the hours of operation outlined in MOD 9 from December 2021. There was no change to surface disturbance as part of this modification.

3.2 EPBC 2014/7278

Federal Approval (EPBC 2014/7282) for the Karuah East Quarry was granted on 20 March 2015. A copy of this approval is attached in **Appendix 1**.

An Annual Compliance Report for EPBC Approval 2014/7282 is prepared each year and is available on the Hunter Quarries website <https://hunterquarries.com.au/reports/>

3.3 EPL 20611

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

No variations were made to EPL 20611 in 2021. In 2022, Karuah East will apply to the EPA for a variation of the EPL based on the changes from MOD 8 and 9. A copy of the EPL is attached in **Appendix 2**.

3.4 Management Plans

The site operates under a series of approved environmental management plans, which are listed in **Table 6**.

Table 6 – Karuah East Quarry Management Plan Status

Management Plan	Status
Environmental Management Strategy	Originally approved in 2015. Updated in 2019 for MOD 2. Reviewed in 2020 and 2021 following recent approvals of MOD 8 and MOD 9. Revision will continue into 2022 to ensure suitable expert consultation.
Air Quality and Greenhouse Gas Management Plan	Originally approved in 2015. Updated in 2019 for MOD 2.

Management Plan	Status
Biodiversity Offset Management Plan	Originally approved in March 2016. Latest update in October 2018.
Blast Management Plan	Originally approved in 2015. Updated in 2019 for MOD 2.
Heritage Management Plan	Originally approved in 2015.
Landscape and Rehabilitation Management Plan	Originally approved in 2015. Approved in March 2020.
Noise Management Plan	Originally approved in 2015. Updated in 2019 for MOD 2. Updated for MOD 8 and MOD 9 (EMM, April 2022).
Traffic Management Plan	Originally approved in 2015.
Waste Management Plan	Original dated 2017. Updated in 2019 for MOD 2.
Water Management Plan	Originally approved in 2015. Updated in 2019 for MOD 2.
<i>Tetratheca juncea</i> Translocation Plan	Originally approved in 2015. Revised in 2019 for MOD 2.

3.5 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 former Department of Planning and Environment's (DPE) *Annual Review Guidelines* (2015).

Table 7 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 7 - 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 Applicant must review the environmental performance of the development 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

Condition Number	Condition Requirement for Annual Review	Document Section
Schedule 5, Condition 4(b)	<i>(b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, which includes a comparison of these results against:</i> <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 documents referred to in condition 2(d) of Schedule 2 of this consent;</i>	Section 6
Schedule 5, Condition 4(c)	<i>(c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;</i>	Section 1, 10 and 11
Schedule 5, Condition 4(d)	<i>(d) identify any trends in the monitoring data over the life of the development;</i>	Section 6
Schedule 5, Condition 4(e)	<i>(e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and</i>	Section 6
Schedule 5, Condition 4(f)	<i>(f) describe the measures that would be implemented over the current calendar year to improve the environmental performance of the development.</i>	Section 11

4.0 OPERATIONS SUMMARY

The following section briefly describes the general operation and environmental performance of Karuah East Quarry during this 2021 reporting period.

4.1 Land Preparation

During the reporting period there was approximately 3.39 ha land clearing. Further minor land clearing within the quarry footprint is scheduled for 2022.

4.2 Construction Activities

No construction activities were completed at Karuah East Quarry during the 2021 reporting period.

4.3 Quarry Operations

Operations during 2021 involved progressive drilling and blasting, followed by crushing and screening to produce the required materials.

The monthly production summary during the reporting period is included in **Table 8**.

Table 8 - Monthly Production Summary (tonnes)

Month	Monthly total (tonnes)
Jan	58,607
Feb	71,119
Mar	39,690
Apr	59,405
May	73,354
Jun	85,996
Jul	84,345
Aug	81,847
Sep	59,109
Oct	72,865
Nov	85,736
Dec	64,702
Total:	836,775
Forecast 2022:	900,000

Project Approval 09_0175 permits the extraction of up to 1.5 million tonnes per annum from Karuah East Quarry. The annual production was consistent with the 2020 production total.



Photo 1 – Crushing Plant (January 2021)



Photo 2 – Dam 1 (27 October 2021)



Photo 3 – Dam 2 (2 September 2021)



Photo 4 – Dam 3 (3 August 2021)

4.4 Operating Hours

From 1 January 2021 to 1 December 2021 and in accordance with Schedule 2, Condition 7 of MOD 8, Karuah East Quarry operated during the approved operating hours listed in **Table 9**:

Table 9 - Approved Operating Hours (1 January 2021 – 1 December 2021)

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 40 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.

The hours of operation were changed under MOD 9. **Table 10** defines the approved hours of operations which came into effect from 2 December 2021.

Table 10 - Approved Operating Hours (2 December 2021 – 31 December 2021)

Activity	Operating Hours
Quarrying Operations	7.00 am to 9.00 pm, Monday to Friday; 7:00 am to 10:00 pm Monday to Friday on 50 calendar days per year; and 7:00 am to 6:00 pm, Saturday. No drilling 6:00 pm to 10:00 pm Monday to Friday or 1:00 pm to 6:00 pm Saturday No quarrying operations on Sundays or Public Holidays
Product loading and dispatch	5:00 am to 9:00 pm Monday to Friday 5:00 am to 10:00 pm Monday to Friday on 50 calendar days per year 6:00 am to 6:00 pm Saturday No product loading and dispatch 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 40 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.

4.5 Operating Equipment

When operational during the 2021 reporting period the following equipment was used:

- Excavator x 3;
- Bulldozer x 1;
- Mobile crusher (screening and crushing equipment);
- Trommel x 1;
- Front end loader x 6;
- 25,000 L water tanker; x 1 and
- Onsite Haul trucks x 6.

4.6 Next Reporting Period

Table 11 outlines forecast operations for the next reporting period.

Table 11 - Forecast Operations for Next Reporting Period

Aspect	Forecast for Next Reporting Period
Construction	None proposed.
Quarrying	Continuation of quarrying during 2022.

5.0 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The actions required as an outcome of the previous Annual Review are provided in **Table 12**.

Table 12 - Actions Required from Previous Annual Review

Action Required from Previous Annual Review	Action taken by Operator	Where Discussed in Annual Review
Karuah East Commitments from 2020 Annual Review		
Update Noise Management Plan (and other management plans if necessary) to reflect approval of MOD 8	KEQ continued to update the Noise Management Plan in 2021, including to incorporate MOD 9 changes.	Section 6.2
Continue environmental monitoring in accordance with management plans and approval requirements	KEQ continued to conduct environmental monitoring. Instances of equipment error caused unavoidable monitoring frequency non-compliances.	Section 1.0, Section 3.4 and Section 6.0
Continue CCC and community support	KEQ continued to facilitate CCC meetings in 2021.	Section 8.0
Continue to update the website with monitoring data and key environment and community information	Monthly monitoring data uploaded to the Hunter Quarries environmental reporting page during 2021.	Results discussed in Section 6.0.
Complete Independent Environmental Audit recommendations listed in Audit Action Plan	Karuah East continued to work to close out the actions in the Audit Action Plan.	Section 9.0
Continue to undertake pest and weed management as required	Pest and weed monitoring and management continued.	Section 6.5

KEQ received a letter from DPE on 15 June 2021 in response to the submission of the 2020 Annual Review. The DPE stated the Annual Review satisfied reporting requirements of Project Approval 09_0175. DPE made additional comments which are presented in **Table 13** below.

Table 13 – DPE Comments on 2020 Annual Review

Comments from DPE Letter dated 15/06/2021		Where addressed in this Annual Review
For future Annual Reviews, under the provisions of Schedule 2 condition 4 of the approval, please include the following information:	1. Section 6.2 Noise – to evaluate noise impacts from Karuah East Quarry and quarrying related noise sources in the area against the noise criteria in the approval, the noise monitoring reports must include the following – - The noise criteria for Karuah East Quarry which are prescribed in the approval, rather than a reference to the Noise Management Plan for the project. - Details of noise monitoring undertaken (including unattended monitoring) during the reporting period including the date, time, location, duration of logging, and the instrumentation used.	Addressed in Section 6.2 – Noise and Appendix 4 – Noise Monitoring Reports. - Section 6.2.2 presents the noise criteria prescribed in the Project Approval 09_0175. - Noise Monitoring Reports in Appendix 4 provide descriptions of the monitoring undertaken, including times, dates, meteorological conditions, duration, and instruments used. Unattended noise monitoring results are

Comments from DPE Letter dated 15/06/2021		Where addressed in this Annual Review
	- Instrument details and a copy of the current instrument calibration certificates. - Meteorological conditions under which all noise monitoring was conducted. - For unattended noise monitoring, noise logger data must be presented graphically together with weather data on a daily basis. - A summary of operational noise monitoring results for all receivers listed in Schedule 3 condition 3 Table 2 including locations A to E, a description of how noise levels were measured (i.e. direct measurement or calculation), and an assessment of compliance with the noise criteria prescribed in the approval.	included in the summarised results of Section 6.2.3. - Calibration certificates are appended to the EMM Noise Monitoring Reports and equipment details are provided in Section 5 of Thearle Reports. - Weather data was recorded during monitoring and sourced from the site meteorological station. - Noise specialist reports assess the compliance with the noise criteria of the consolidated consent.
	2. Section 9 Complaints – please include a review of complaints records for the project over the reporting period, including a comparison of these results against complaints recorded in reporting periods.	Addressed in Section 8.0 Community. Section 8 provides a summary of the complaints in 2021. A comparison of complaints received since operations commenced is also presented in Table 39.

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 development, the Applicant 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.

A 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**.

Table 14 presents a summary of the meteorological data collected by the meteorological station during the Annual Review reporting period.

Table 14 - 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-21	22.9	10.8	39.7	241.8	59.8	5	40.2
Feb-21	21.8	13.2	33.1	200.4	29.8	17	46.1
Mar-21	20.1	12.5	34.3	606.6	106.2	13	55.6
Apr-21	16.2	4.5	29.4	35.0	15	4	48.5
May-21	14.0	3.7	26.1	75.2	25.4	9	46.1
Jun-21	11.1	1.6	22.1	158.4	80.6	10	46.1
Jul-21	10.9	0.6	26.6	59.4	26.6	6	61.5
Aug-21	12.5	2.2	28.1	45.4	23.0	4	55.6
Sep-21	15.3	4.4	31.1	128.0	44.6	9	58.0
Oct-21	18.1	6.8	35.2	80.4	24.8	8	61.5
Nov-21	19.3	7.0	31.5	247.2	51.8	14	56.8
Dec-21	21.6	11.9	37.9	115.6	36.4	12	46.1

Average monthly temperatures during the reporting period ranged from 10.9 degrees Celsius (°C) to 22.9 °C, with a maximum temperature 39.7°C recorded in January 2021. Total monthly rainfall ranged from 35 mm (April) to 606.6 mm (March) per month, with the maximum daily rainfall recorded at 106.2 mm in March 2021. The maximum wind gusts were recorded in July and October 2021 with a result of 61.5 km per hour.

The total rainfall for 2021 was 1993.4mm which can be compared to 1537.0 mm in 2020. The nearest Australian Bureau of Meteorology (BOM) weather station 61339 is located at Clarencetown and recorded a total of 857.2 mm in 2021 and 730.2 mm in 2020.

6.2 Noise

6.2.1 EIS / Preferred Project Report Predictions

The *Noise and Blasting Impact Assessment (SLR, 2012)* was developed for the initial project approval. predicted noise levels were below the project specific noise criteria.

For MOD 8, a Noise Impact Assessment was undertaken by Thearle Acoustics (Thearle, 2019) in accordance with the NSW Noise Policy for industry (2017). This report found operational noise levels of the Karuah East Quarry were predicted to meet project specific noise target at all nearest, non-project related residential locations surrounding the site with the exception of Lot 10 DP 1032636. The predicted noise levels from the 2019 report are presented in the table below.

Table 15 – MOD 8 EIS Predicted Noise Levels – Daytime

Location	Period	Project specific Noise Criteria LAeq (15 minute)	
		Predicted Noise Impact	Predicted Intrusiveness Criteria
A	Day	42 dBA	49 dBA
B	Day	36 dBA	49 dBA
C	Day	37 dBA	49 dBA
D	Day	34 dBA	49 dBA
E	Day	39 dBA	49 dBA
F	Day	26 dBA	40 dBA
G	Day	43 dBA	44 dBA
H	Day	45 dBA	43 dBA
I	Day	40 dBA	40 dBA
J	Day	<35 dBA	40 dBA

6.2.2 Noise Criteria

PA 09_0175

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

*The Applicant must ensure that the operational noise generated by the development does not exceed the criteria in **Table 15** at any residence on privately owned land. Noise generated by the development must be monitored and measured in accordance with the relevant procedures and modifications (including certain meteorological conditions) of the NSW Noise Policy for Industry 2017.*

From 22 December 2020, the criteria in **Table 16** applies to noise monitoring at Karuah East following the approval of MOD 8.

Table 16 - Operational Noise Criteria (dBA LAeq(15minute) MOD 8

Location	Criteria (day)
A	42
G	43
H	45
All other residences	40

Note 1: Day period defined as Monday to Saturday 7am to 6pm, Sunday and Public Holidays 8am to 6pm.

The noise criteria in **Table 16** does not apply if the Proponent has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and the Applicant has advised the Department in writing of the terms of this agreement.

EPL Condition L4

The noise limits set out in Condition L4.1 of the EPL 20611 are reproduced in **Table 17** are generally consistent with the criteria detailed in PA 09_0175.

Table 17 - 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

EPL 20611 will be varied in 2022 to reflect the changes to noise criteria as a result of the approval of MOD 8. The criteria in **Table 17** continue to apply for the 2021 reporting period.

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*”.

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

Both attended and unattended noise monitoring has been conducted at the nearest residential receivers to the quarry during Q1 and Q2 of the 2021 reporting period by Thearle Acoustics. A summary of the results are provided in **Table 18, Table 19, Table 22, and Table 23**, with full copies of the noise monitoring reports (Thearle Acoustics) appended to this Annual Review (**Appendix 4**).

Attended noise monitoring was also conducted at the nearest residential receivers to the quarry during Q3 and Q4 of the 2021 reporting period by EMM. A summary of the results are provided in **Table 20** and **Table 21**, with copies of the noise monitoring reports also in **Appendix 4**.

The approved *Noise Management Plan* includes a noise monitoring program as required by Schedule 3, Condition 7 of PA 09_0175.

6.2.3.1 Attended Noise Monitoring

February 2021 Operational Noise Monitoring

Table 18 - Operator Attended Noise Survey Results (23 February 2021)

Date/Start Time Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels L _{Amax} – dBA
	L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
Location A 23/02/2021 10:23 AM Calm	85	60	57	52	55	Birds 50-55 Pacific Highway 55 Karuah East Quarry Inaudible
Location B 23/02/2020 10:53 PM Calm	86	71	67	59	64	Pacific Highway 60-65 Karuah East Quarry Inaudible
Location F 23/02/2021 11:28 AM Calm	88	53	57	53	56	Birds and Insects 40 Local Traffic 65 Pacific Highway 55 Karuah East Quarry Inaudible
Location G 23/02/2021 12:07 PM Calm	75	57	56	50	54	Birds and Insects 40-55 Pacific Highway 50 Karuah East Quarry Inaudible

Note 1: Weather data was obtained from the automatic weather station located at Karuah East Quarry.

Karuah East operational activities were found to be inaudible at Location A, B, F and G, therefore results were found to be within the relevant consent condition criteria during February 2021 noise monitoring.

April 2021 Operational Noise Monitoring

Table 19 - Operator Attended Noise Survey Results (May 2021)

Date/Start Time Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels L _{Amax} – dBA
	L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
Location A 06/05/2021 14:00 PM W = 20 kph	85	60	59	56	58	Wind Noise 50-60 Motorbike 50-55 Pacific Highway 45-55 Karuah East Quarry Inaudible

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 B 06/05/2021 15:05 PM W = 20 kph	87	71	67	60	64	Pacific Highway 55-65 Birds 40-45 Karuah East Quarry Inaudible
Location F 06/05/2021 13:20 PM W = 20 kph	85	59	57	54	56	Wind Noise 50-55 Insects 40-45 Karuah East Quarry Inaudible
Location G 06/05/2021 09:50 AM W = 20 kph	68	49	47	46	47	Wind Noise 40-45 Insects 40-45 Birds 35-40 Karuah East Project Inaudible

Karuah East operational activities were found to be inaudible at Location A, B, F and G, therefore, results were found to be within the relevant consent condition criteria during May 2021 noise monitoring.

August 2021 Operational Noise Monitoring

Table 20 - Operator Attended Noise Survey Results (August 2021)

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 A 31/08/2021 10:36 AM	62	55	53	45	50	Karuah East Quarry inaudible. Traffic on the Pacific Highway and bird noise consistently audible.
Location B 31/08/2021 10:55 AM	74	69	66	52	61	Karuah East Quarry inaudible. Traffic on the Pacific Highway and bird noise consistently audible. Karuah Quarry occasionally audible (37dB LAeq, 15 minute).
Location F 31/08/2021 11:13 AM	70	54	49	41	47	Karuah East Quarry inaudible. Distant traffic on the Pacific Highway and bird noise consistently audible. Wind in foliage occasionally audible.
Location G 31/08/2021 11:37 AM	60	54	46	35	43	Karuah East Quarry Engine revs and processing plant consistently audible with alarms and bangs on occasion. Within criteria. Distant traffic on the Pacific Highway

Karuah East operational activities were found to be inaudible at Location A and G, occasionally audible at Location B, and consistently audible at Location G. Results from all locations were found to be within the relevant consent condition criteria during August 2021 noise monitoring.

November 2021 Operational Noise Monitoring**Table 21 - Operator Attended Noise Survey Results (November 2021)**

Date/Start Time Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels L _{Amax} – dBA
	L _{Amax}	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}	
Location A 19/11/2021 10:44 AM	96	81	53	48	66	Karuah East Quarry inaudible. Traffic on the Pacific Highway. Insects, frogs and bird noise consistently audible. Resident noise and a dog barking frequently audible.
Location B 19/11/2021 11:19 AM	69	68	65	59	63	Karuah East Quarry inaudible. Traffic on the Pacific Highway and bird noise consistently audible.
Location F 19/11/2021 10:10 AM	89	68	49	44	59	Karuah East Quarry inaudible. Distant traffic on the Pacific Highway, insects and bird noise consistently audible. Car passbys occasionally audible.
Location G 19/11/2021 11:48 AM	60	53	45	39	43	Karuah East Quarry engine revs and processing plant consistently audible with bangs on occasion. Within Criteria. Distant traffic on the Pacific Highway, insects, frogs and bird noise consistently audible. Aircraft noise, resident noise and livestock noise occasionally audible.

Karuah East operational activities were found to be inaudible at Location A, B and F, and consistently audible at Location G. However, the results of all locations were found to be within the relevant consent condition criteria during August 2021 noise monitoring.

6.2.3.2 Unattended Noise Monitoring

Unattended noise monitoring was conducted at location G during the reporting period. **Table 22** and **Table 23** outline unattended noise monitoring results for Quarter 1 and 2 of 2021.

Table 22 - Unattended Continuous Monitoring Ambient Noise Levels (February 2021)

INP Period	L _{A1}	L _{A10}	L _{A90}	L _{Aeq}
Location G				
Daytime	59	54	48	53
Evening	62	59	52	57
Night	58	56	50	54

Table 23 - Unattended Continuous Monitoring Ambient Noise Levels (April 2021)

INP Period	LA1	LA10	LA90	LA _{eq}
Location G				
Daytime	63	57	52	58
Evening	65	63	55	57
Night	57	55	51	50

Thearle Acoustics concluded that Karuah East was compliant during Quarter 1 and Quarter 2 of the 2021 reporting period.

Unattended Noise Monitoring 2021 Review

In 2021 EMM conducted a review of unattended noise monitoring results for the life of the project. Section 8.4 of the approved *Noise Management Plan* states:

Unattended noise monitoring will be conducted initially on a quarterly basis. The frequency of monitoring will be reviewed after the first 12 months of operations in order to determine future requirements.

A review of the historical unattended noise monitoring data by EMM found no evident trends associated with Karuah East Quarry operations. Given that the evening period LA₉₀ noise levels (when Karuah East Quarry was not operational) were measured to be at or above the day period LA₉₀ noise levels during all of the monitoring events, it is likely that road traffic noise from the Pacific Highway is the main contributor to measured ambient noise levels at the unattended noise monitoring location. As a result of this review, the Karuah East Quarry has decided to cease the unattended noise monitoring component of the quarterly compliance noise monitoring program.

6.2.3.3 Noise Summary 2021

Attended and unattended noise levels were within the consent condition criteria outlined in **Table 16** at all locations during the 2021 monitoring period.

Unattended noise monitoring ceased from Quarter 3 of 2021 as per the advice of noise monitoring specialists (EMM, 2021) (**Appendix 4**).

6.2.4 Management Measures

The *Noise Management Plan* was updated in 2021 to reflect the approval of MOD 8.

The following best practice noise control measures were implemented in 2021:

- 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

The *Noise Management Plan* is under revision to reflect the approval of MOD 9 and the 2021 unattended noise monitoring review.

The updated *Noise Management Plan* will be published on the Karuah East Quarry website once approved by DPE.

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 24**.

Table 24 - 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 L5.1 to 5.7 of EPL 20611 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 25 blasts during the reporting period at Karuah East Quarry. The results of the blast monitoring undertaken are contained in **Table 25**.

Table 25 - Blast Results 2021

Date	Location		Time	Overpressure dB(L)	Vibration
22 January 2021	32°37'29.61"S, 152° 0'26.68"E	R.L 128.0	12:32:00 PM	n/t	n/t
4 February 2021	32°37'29.14"S, 152° 0'24.76"E	R.L 128.0	1:29:00 PM	n/t	n/t
18 February 2021	32°37'30.03"S, 152° 0'26.70"E	R.L 128.0	12:57:00 PM	n/t	n/t
5 March 2021	32°37'28.21"S, 152° 0'25.23"E	R.L 128.0	11:00:00 AM	n/t	n/t
26 March 2021	32°37'32.12"S, 152° 0'26.75"E	R.L 128.0	12:27:00 PM	n/t	n/t
12 April 2021	32°37'28.37"S, 152° 0'25.30"E	R.L 128.0	12:28:00 PM	n/t	n/t
5 May 2021	32°37'29.14"S, 152° 00'25.91"E	R.L 128.0	11:25:00 AM	n/t	n/t
21 May 2021	32°37'32.13"S, 152° 0'23.60"E	R.L 128.0	12:53:00 PM	n/t	n/t
4 June 2021	32°37'32.20"S, 152° 0'23.99"E	R.L 128.0	1:01:00 PM	n/t	n/t
10 June 2021	32°37'32.17"S, 152° 0'26.54"E	R.L 120.0	1:56:00 PM	n/t	n/t
18 June 2021	32°37'31.33"S, 152° 00'26.04"E	R.L 120.0	1:59:00 PM	n/t	n/t
25 June 2021	32°37'28.92"S, 152° 00'26.15"E	R.L 120.0	1:29:00 PM	n/t	n/t
2 July 2021	32°37'32.30"S, 152° 0'28.27"E	R.L 105	12:28:00 PM	n/t	n/t
16 July 2021	32°37'29.25"S, 152° 0'27.39"E	R.L 128	12:56:00 PM	n/t	n/t
23 July 2021	32°37'32.42"S, 152° 0'27.39"E	R.L 105	12:26:00 PM	n/t	n/t
4 August 2021	32°37'28.58"S, 152° 0'26.47"E	R.L 128	1:32:00 PM	n/t	n/t
13 August 2021	E- 406849, N - 6389766	R.L 105	12:56:00 PM	n/t	n/t
16 August 2021	E- 406802, N - 6389990	R.L 130	2:22:00 PM	n/t	n/t
8 September 2021	E- 406827, N - 6389761	R.L 105	2:47:00 PM	n/t	n/t

Date	Location		Time	Overpressure dB(L)	Vibration
23 September 2021	E- 406800, N - 6389761	R.L 105	3:52:00 PM	n/t	n/t
15 October 2021	32°37'34.65" S, 152°00'28.42"	R.L 90	11:58:00 AM	n/t	n/t
26 October 2021	32°37'34.65" S, 152°00'26.92"	R.L 105	12:30PM	n/t	n/t
17 November 2021	32°37'34.65" S, 152°00'26.92"	RL 105	12:30PM	n/t	n/t
24 November 2021	32°37'29.60" S, 152°00'26.09"	R.L 105	11:28AM	n/t	n/t
17 December 2021	32° 37' 30.90055" S 152° 0' 24.07379" E	R.L 105	1:45PM	n/t	n/t

n/t = Not triggered

During the 2021 Annual Review reporting period:

- No blasts exceeded 120 dBL;
- All blasts were below detectable limits at the nearest residential dwelling or privately-owned land, and hence well below the criteria; and
- All blasts were below the detectable limits for vibration, and were therefore well below the 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 Location 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 7 to 9 of PA 09_0175 and have been reproduced in **Table 26, and Table 27, and Table 28**. 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 development do not exceed the criteria in **Table 26 to Table 28** at any residence on privately owned land.

Table 26 - 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 27 - 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 28 - 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 26 to Table 28 above:

- a) Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).
- b) Incremental impacts (i.e. incremental increase in concentrations due to the development 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.

No specific limit conditions are specified for air quality emissions in EPL 20611.

6.4.3 Key Environmental Performance or Management Issues

The main 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 29**. The location of the depositional dust gauges is shown in **Appendix 3**.

Table 29 - Depositional Dust Monitoring Summary (g/m²/month)

Date	DDG1	DDG2	DDG3	DDG4	DDG5
January	1.5	0.9	0.7	0.3	1.2
February	0.4	0.4	0.7	0.2	1.6
March	0.8	1.3	0.5	0.7	0.7
April	0.7	1.4	2.2	3.7	1.9
May	0.3	0.3	0.3	0.4	0.6
June	0.2	0.4	0.2	0.2	*Broken gauge
July	0.5	0.4	0.5	1.0	0.2
August	2.3	0.8	1.4	0.6	1.2
September	0.7	0.4	0.5	0.4	0.4
October	3.6	0.1	0.5	0.1	0.5
November	0.5	0.2	0.4	0.2	0.5
December	1.3	0.3	0.2	1.0	0.5
Annual Average	1.1	0.6	0.7	0.7	0.8
Minimum	0.3	0.1	<0.1	0.1	0.2
Maximum	3.6	1.4	2.2	3.7	1.9

* Broken dust gauge/sample resulting in missing result.

The 2021 monitoring results indicated that the maximum deposited dust levels measured at DDG 1 to DDG 5 were all less than the long-term impact assessment criteria for depositional dust (maximum deposited dust level of 4 g/m²/month) over the reporting period.

A sample for DDG5 June 2021 could not be retrieved due to the depositional dust gauge being broken when collection of the sample was attempted. DDG5 was replaced to ensure a July sample could be collected. As monthly monitoring is required by EPL 20611, this missed result is recorded as a non-compliance in this Annual Review.

High Volume Air Sampler

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. **Table 30** outlines the High Volume Air Sampler (HVAS) results during the 2021 reporting period.

Table 30 - High Volume Air Sampler Results ($\mu\text{g}/\text{m}^3$)

Date	TSP ($\mu\text{g}/\text{m}^3$)	PM ₁₀ ($\mu\text{g}/\text{m}^3$)	Compliance Status/Comments
3 January 2021	10	10	Compliant with 24-hour criteria.
9 January 2021	8	8	Compliant with 24-hour criteria.
15 January 2021	35	23	Compliant with 24-hour criteria.
21 January 2021	22	11	Compliant with 24-hour criteria.
27 January 2021	16	10	Compliant with 24-hour criteria.
2 February 2021	17	11	Compliant with 24-hour criteria.
8 February 2021	26	16	Compliant with 24-hour criteria.
14 February 2021	26	15	Compliant with 24-hour criteria.
20 February 2021	10	10	Compliant with 24-hour criteria.
26 February 2021	31	20	Compliant with 24-hour criteria.
4 March 2021	15	9	Compliant with 24-hour criteria.
10 March 2021	18	14	Compliant with 24-hour criteria.
16 March 2021	10	6	Compliant with 24-hour criteria.
22 March 2021	9	13	Compliant with 24-hour criteria. HVAS found damaged on 23/03/21 due to recent extreme rainstorms. TSP make up run dated 6/04/21.
28 March 2021	9	9	Compliant with 24-hour criteria. TSP make up run dated 7/04/21
3 April 2021	13	4	Compliant with 24-hour criteria. TSP make up run dated 12/04/21
9 April 2021	20	12	Compliant with 24-hour criteria.
15 April 2021	28	16	Compliant with 24-hour criteria.
21 April 2021	16	8	Compliant with 24-hour criteria.
27 April 2021	19	12	Compliant with 24-hour criteria.
3 May 2021	16	10	Compliant with 24-hour criteria. Nearby hazard reduction burning.
9 May 2021	14	10	Compliant with 24-hour criteria.
15 May 2021	12	6	Compliant with 24-hour criteria.
21 May 2021	11	7	Compliant with 24-hour criteria.
27 May 2021	26	14	Compliant with 24-hour criteria.
2 June 2021	17	10	Compliant with 24-hour criteria.
8 June 2021	30	11	Compliant with 24-hour criteria.
14 June 2021	10	8	Compliant with 24-hour criteria.
20 June 2021	10	5	Compliant with 24-hour criteria.
26 June 2021	6	3	Compliant with 24-hour criteria.
2 July 2021	24	15	Compliant with 24-hour criteria.
8 July 2021	26	13	Compliant with 24-hour criteria.
14 July 2021	10	6	Compliant with 24-hour criteria.
20 July 2021	11	5	Compliant with 24-hour criteria.
26 July 2021	15	8	Compliant with 24-hour criteria.
1 August 2021	15	8	Compliant with 24-hour criteria.
7 August 2021	9	4	Compliant with 24-hour criteria.
13 August 2021	15	9	Compliant with 24-hour criteria.
19 August 2021	25	12	Compliant with 24-hour criteria.
25 August 2021	6	2	Compliant with 24-hour criteria.
31 August 2021	40	24	Compliant with 24-hour criteria.

Date	TSP ($\mu\text{g}/\text{m}^3$)	PM ₁₀ ($\mu\text{g}/\text{m}^3$)	Compliance Status/Comments
6 September 2021	25	13	Compliant with 24-hour criteria.
12 September 2021	30	17	Compliant with 24-hour criteria.
18 September 2021	14	9	Compliant with 24-hour criteria.
24 September 2021	17	8	Compliant with 24-hour criteria.
30 September 2021	10	5	Compliant with 24-hour criteria.
6 October 2021	23	14	Compliant with 24-hour criteria.
12 October 2021	13	5	Compliant with 24-hour criteria.
18 October 2021	18	9	Compliant with 24-hour criteria.
24 October 2021	20	12	Compliant with 24-hour criteria.
30 October 2021	37	19	Compliant with 24-hour criteria.
5 November 2021	25	9	Compliant with 24-hour criteria.
11 November 2021	13	8	Compliant with 24-hour criteria.
17 November 2021	15	9	Compliant with 24-hour criteria.
23 November 2021	12	6	Compliant with 24-hour criteria.
29 November 2021	24	15	Compliant with 24-hour criteria.
5 December 2021	25	14	Compliant with 24-hour criteria.
11 December 2021	18	11	Compliant with 24-hour criteria.
17 December 2021	24	14	Compliant with 24-hour criteria.
23 December 2021	19	11	Compliant with 24-hour criteria.
29 December 2021	12	8	Compliant with 24-hour criteria.
Annual Average	18.0	10.5	Compliant
Minimum	6.0	2.0	
Maximum	40.0	24.0	Compliant

Notes: 1= Maximum criteria as specified in PA 09_0175

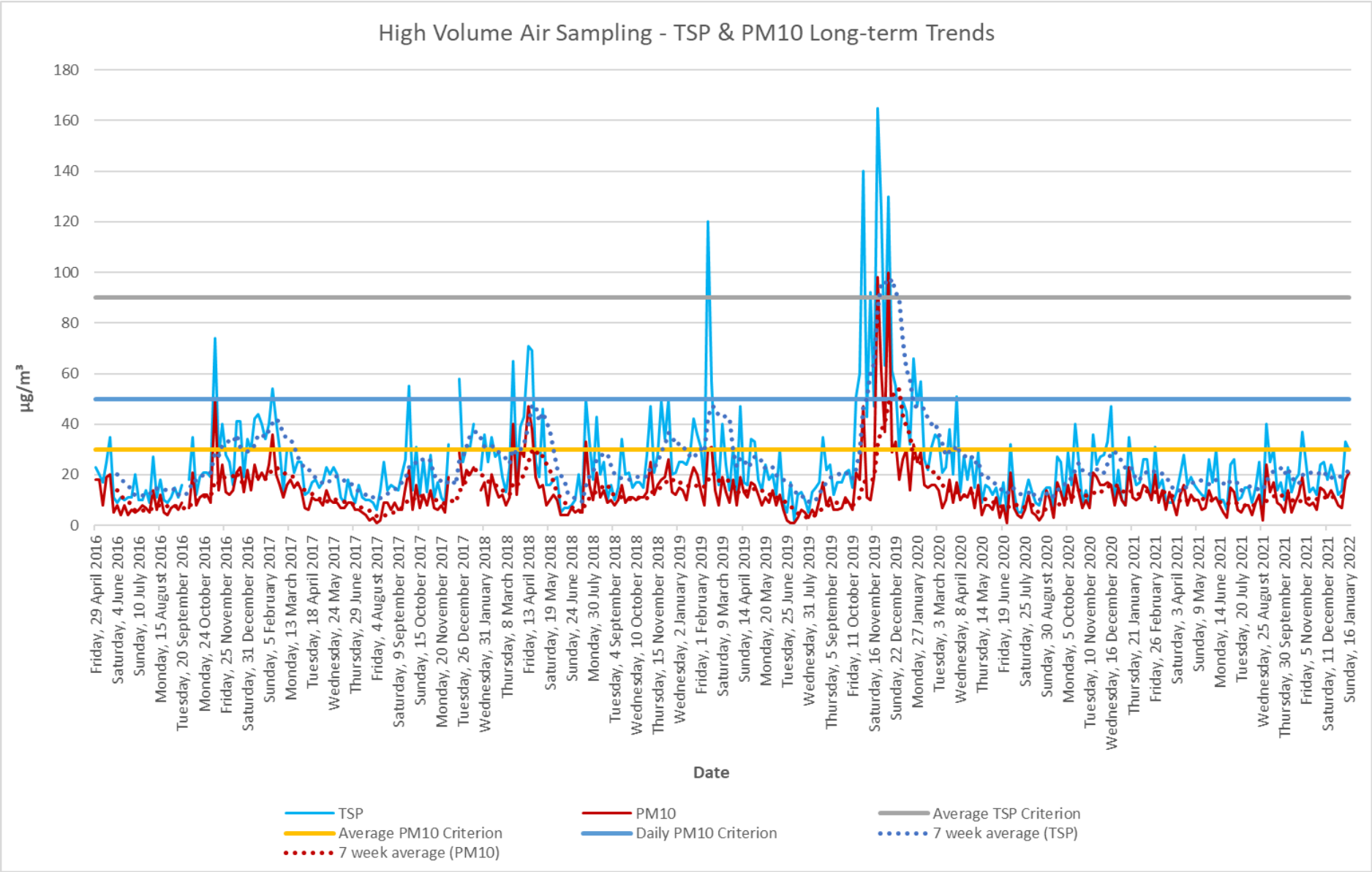
The TSP annual average for 2021 was $18 \mu\text{g}/\text{m}^3$, which is below the annual average criteria of $90 \mu\text{g}/\text{m}^3$. There was an increase in the TSP annual average from 2020 ($12.7 \mu\text{g}/\text{m}^3$) to 2021 ($18.0 \mu\text{g}/\text{m}^3$). The site is still well below the annual average for TSP despite the increase. The highest short-term TSP result for the reporting period was $40 \mu\text{g}/\text{m}^3$ which occurred in the 31 August 2021 sample. The highest TSP reading decreased in 2021 from a maximum reading of $66 \mu\text{g}/\text{m}^3$ in December 2020.

The annual average for PM₁₀ was $10.5 \mu\text{g}/\text{m}^3$, below the long-term impact assessment criteria of $30 \mu\text{g}/\text{m}^3$. This was a decrease from the average PM₁₀ result of $12 \mu\text{g}/\text{m}^3$ in 2020. The maximum PM₁₀ result recorded during 2021 was $24 \mu\text{g}/\text{m}^3$ slightly less than the $32 \mu\text{g}/\text{m}^3$ recorded during 2020.

On 23 March 2021, Karuah East Quarry discovered the TSP HVAS unit was not working properly. The equipment had failed during the period of extreme rainstorms under which the NSW Government declared a natural disaster. The manufacturer of the equipment (Lear Siegler) advised mechanical issues may occur during periods of wet weather. Karuah East Quarry reported the incident in a non-compliance notification to the EPA and DPE in March 2021.

The short-term impact assessment criteria of $50 \mu\text{g}/\text{m}^3$ was not exceeded during 2021. Long term trends are shown on **Figure 3**. The elevated results for PM₁₀ and TSP seen in late 2019 resulted from the 2019 NSW bushfires which were classified as an extraordinary event. Exceedances experienced in early 2019 were attributed to a dust storm, and similarly higher results seen in 2016 were the result of bushfires.

Figure 2 - High Volume Air Sampling – Long-term Trends



6.4.4 Management Measures

The following best practice air quality control measures continued to be implemented in 2021:

- 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.

6.5 Biodiversity

6.5.1 EIS Predictions

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

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* (BOAMP) 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 November and December 2021. A copy of the Ecological Monitoring Report (Kleinfelder, 2022) 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 have been surveyed annually in October since 2016, 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 2021 monitoring indicate that vegetation condition across monitoring sites remain relatively stable since the previous monitoring event in 2020, with almost all monitoring sites recording signs of regeneration across both canopy and mid-storey species.

Nest box monitoring was not required to be undertaken in 2021. Nest box monitoring was undertaken for boxes 1 – 125 in 2020. As per the approved *Flora and Fauna Management Plan*, the next round of nest box monitoring is required in 2022.

Key results from the 2021 monitoring programme include:

- *Asperula asthenes*, *Tetratheca juncea* and *Grevillea parviflora subsp. parviflora* populations are in good condition and have increased in size since annual monitoring in 2019 and 2020, likely due to recent favourable weather conditions;
- Minor sedimentation due to overtopping of a small number of sediment fences was observed, and the occurrence of dust on foliage within close proximity to quarry operations was noted;
- Weed coverage in the BOA and Lot 12 has increased – continued management is required to reduce Lantana cover, especially within the northern portion of the site;
- Despite no feral pigs or evidence thereof observed during monitoring, it is likely this species persists in the BOA and vertebrate pest monitoring and control programs should continue to be carried out; and
- A total of 318 nest boxes have been installed to date across the BOA. Annual monitoring of nest boxes continued in 2021 and will continue in 2022.

Tetratheca juncea Translocation

In accordance with the Translocation Plan for *Tetratheca juncea* (*T.juncea*), monitoring of *T.juncea* was undertaken by Firebird ecoSultants in 2020 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.

Only six of the translocation rows were observed to have *T. juncea* that were in flower, otherwise the *T. juncea* within the translocation site were predominantly not in flower or have browned or died off completely. The translocation site was found to be extensively overgrown in some areas, particularly rows B1 to B7 which were covered in dense grass growing around 2 m in height. *T. juncea* are extremely difficult to find when not in flower, particularly in densely vegetated areas. Due to the extremely low number of *T. juncea* that were observed to be in flower at this time (seven individuals total), combined with the dense overgrown rows, it was decided that it was not viable to undertake the complete survey for 2020. It is possible that *T. juncea* may have begun flowering earlier in the year and subsequently stopped flowering earlier in the year which may explain the lack of flowering individuals observed in October 2020. However, it is more likely that the chosen translocation site is just not suitable habitat for *T. juncea*.

Firebird ecoSultants (2021) believe that the translocation project for *T. juncea* at the Karuah East Quarry has had a low level of success, with the survival rate steadily reducing each year. The low rate of success is primarily attributed to the selection of the translocation site, which does not adequately represent the habitat in which *T. juncea* are typically found. *T. juncea* are typically found on southern facing slopes with sufficient canopy cover. The chosen translocation site is located near the top of a hill with little to no canopy cover which has exposed the translocated *T. juncea* to too much direct sunlight. However, it should be noted that there may have been other contributing factors to the low success rate, such as the lack of rainfall in past years and the increase in average temperature attributed to climate change.

A copy of the 2021 *T. juncea* Monitoring Report is attached to the previous 2020 Annual Review.

2021 Monitoring

Monitoring of *T. juncea* was undertaken in 2021 to satisfy the requirements of the 2019 *Tetratheca Juncea Translocation Management Plan*. Monitoring was undertaken at four monitoring sites MP 7, MP 8, MP 11 and MP 15. Overall, the abundance of *T. juncea* individuals within monitoring plots was stable in 2021 compared to previous years. A comprehensive summary of the 2021 monitoring results is presented in **Appendix 5**.

6.5.4 Management Measures

During 2021, the following management measures were undertaken:

- Repair of erosion and sediment controls as required;
- Fence repair (as required);
- Monitoring of nest boxes;
- Installation and maintenance of fauna crossing as required; and
- Weed and pest control, in particular Lantana as well as invasive wildlife.

As committed to in the previous Annual Review, KEQ commenced a review of the BOAMP as per the recommendations of the Karuah East 2020 IEA.

As recommended by Kleinfelder (2022), KEQ will continue to undertake biodiversity monitoring, biennial pest management, and, in particular, weed control activities.

Long Term Security of the Conservation Offset Area

Condition 29 of Project Approval 09_0175 requires long term security of the Biodiversity Offset Area. The offset area (comprised of part Lot 13 DP 1024564, Lot 14 DP 1024564 and Lot 5 DP 838128) is managed as a Biodiversity Offset Area in line with the approved Biodiversity Offset Area Management Plan (BOAMP).

Karuah East Quarry Pty Ltd previously provided a draft Conservation Agreement to the NSW Biodiversity Conservation Trust (BCT). Comments were received from the BCT requesting that the Conservation Agreement to be split into two separate agreements (to cover the differing land ownerships of Lot 13 DP 1024564 and Lot 5 DP 838128/ Lot 14 DP 1024564 (same ownership). Meetings have been held with the NSW BCT (November 2020) and NSW DPE (February 2021) and the status of the KEQ Biodiversity Offset Area was discussed. The following is noted:

- Both agencies note that the offset land is managed in line with the BOAMP; and
- BCT staff noted that as new offsets will be required as a result of the proposed MOD 10 application to modify the Project Approval (proposed increase to disturbance area primarily to facilitate additional stockpiling area), these additional offset lands will need to be integrated into Conservation Agreements relevant to individual land ownerships. It is BCT's strong preference that the long term arrangements are finalised after MOD 10 has been determined. DPE confirmed support of this approach. MOD 10 was lodged in July 2021 and is currently under assessment by the NSW DPE.

6.5.5 Proposed Improvements to Management Measures

The Karuah East Quarry will implement monitoring requirements outlined in the TJMP by completing monitoring of *T. juncea* individuals at Site 2 in October 2022. The 2022 monitoring will be the final monitoring event for the translocated individuals and will complete the approved *T. juncea* monitoring program.

The Karuah East Quarry will continue to implement the BOAMP and LRMP during 2022. As recommended by Kleinfelder (2022), the following actions will be undertaken in accordance with the relevant sections of the BOAMP:

- Ongoing weed management (targeting Lantana in the northern portion of the site);
- Installation of an additional 22 nest boxes to replace hollows removed in March, June, October, and November 2021 clearing as per the clearing reports in **Appendix 5**;
- Investigation of the use of cameras to monitor the effectiveness of aerial fauna crossings installed in 2020; and
- Ongoing vertebrate pest management to control destructive invasive wildlife (including wild dogs, feral pigs and foxes).

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 or additional measures taken relating to Aboriginal cultural heritage during the reporting period.

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 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 Heritage NSW 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 Heritage NSW and Heritage NSW 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 Heritage NSW confirms the remains are Aboriginal, Heritage NSW 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)*.

6.7 General Waste Management

6.7.1 Environmental Management

Karuah East Quarry uses a licensed contractor for waste removal at the site.

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

6.7.2 Environmental Performance

JR Richards, a waste contractor, removes waste from a 3 m³ waste bin at the site. Over the year, approximately 70 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 Water Management

Summary of Water Management at Site

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 20611 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 as 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.

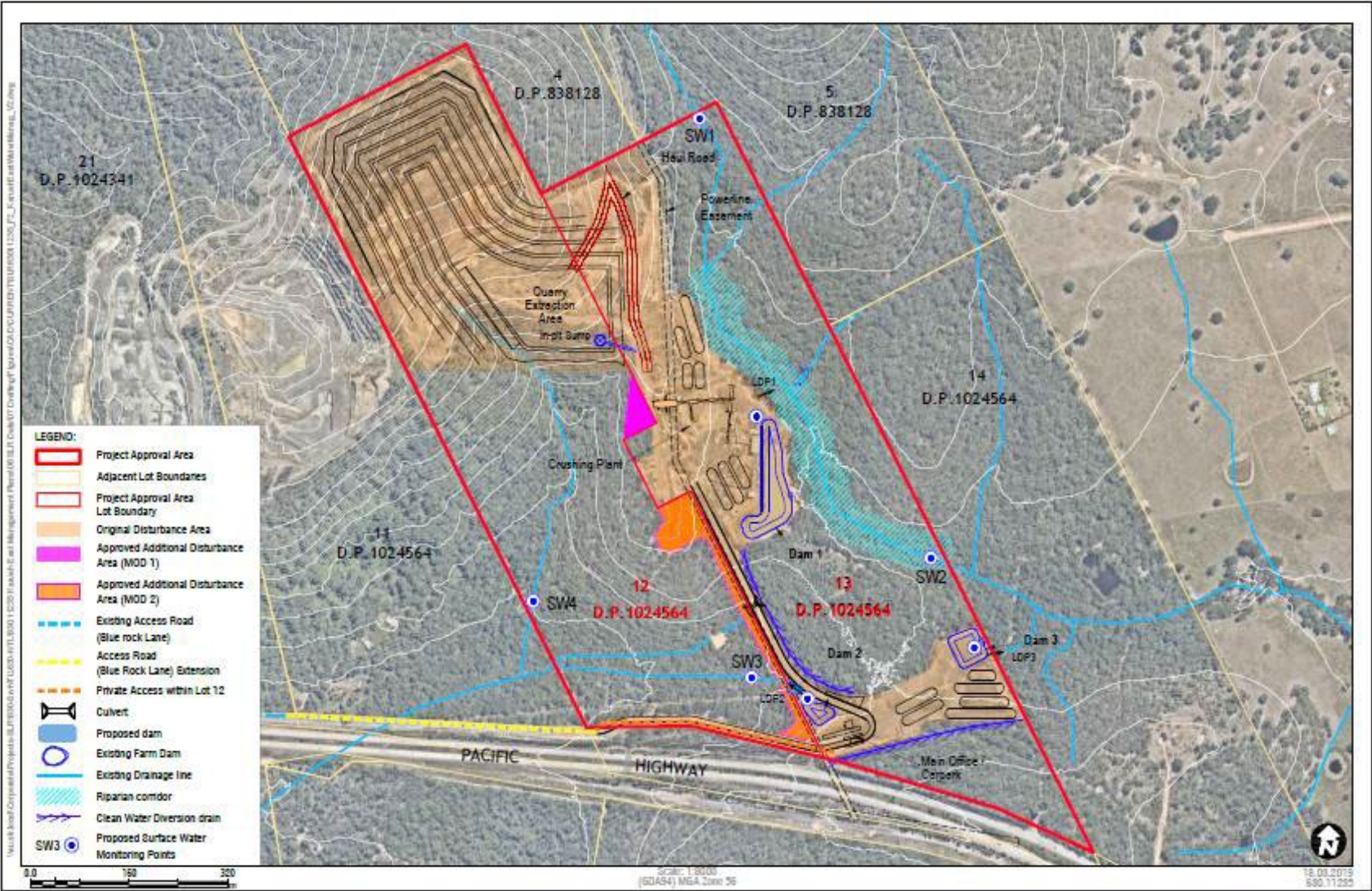
Water Storage and Use

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).

The current water management system and location of dams are shown in **Figure 3**.

Figure 3 - Current Water Management System (Prepared by SLR)



6.8.1 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 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).

6.8.2 Surface Water Monitoring

6.8.2.1 Approved Criteria

Discharge criteria for the Karuah East Quarry is provided in Condition L2.4 of EPL 20611 and outlined in Error! Reference source not found.. These pollutants will be tested during discharge events from LDP001, LDP002 and LDP003. Discharge events are discussed in **Section 7.3.3**.

Table 31 - Discharge Surface Water Criteria (LDP001, LDP002, LDP003)

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

As detailed in Section 8.1.3 of the WMP, surface water monitoring is undertaken at the following locations:

- Dam 1, Dam 2, and 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.

As per Section 8.1.3 of the WMP, 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 as per Section 3 of the Statement of Commitments.

Karuah East Quarry began revising and updating the WMP in 2021. Karuah East Quarry will submit the updated WMP for approval and publish the approved version on the website.

6.8.2.2 Discharge Results

Controlled and uncontrolled discharges from each licenced discharge point are listed in **Table 32**.

There were 25 discharges from LDP001 during the 2021 reporting period, 6 of which were uncontrolled. The monitoring results show that all pH results were within criteria. Oil and Grease was within criteria during all discharge events. TSS results exceeded criteria during the six uncontrolled discharges dates in March 2021. All controlled discharges were within EPL criteria and therefore compliant.

During 2021 there were 15 discharge events from LDP002, six of which were uncontrolled. The monitoring results show that both pH and Oil and Grease were within criteria during all controlled and uncontrolled discharges. TSS exceeded criteria during the six uncontrolled discharges.

There were 24 discharges from LDP003 in 2021, 18 of which were controlled and six uncontrolled. The monitoring results show that both pH and Oil and Grease were within criteria during all controlled and uncontrolled discharges. TSS exceeded criteria during the six uncontrolled discharges.

There were zero pH exceedances in the controlled discharges from LDP001, LDP002 and LDP003. There were a total of 18 exceedances recorded in TSS from the March 2021 uncontrolled discharge combined from LDP001, LDP002 and LDP003.

All 18 TSS exceedances occurred during the uncontrolled discharge in March 2021 with the largest exceedance recording 1260 mg/L on the 18 March 2021 from LDP001. The uncontrolled discharge was related to a period of extreme rainfall in the Karuah region, which resulted in submerged roads and damaged access tracks. This uncontrolled discharge was reported as an incident to relevant authorities in accordance with the *Pollution Incident Response Management Plan*, with an incident report dated March 2021 sent to the EPA and DPE. The discharge ceased after 23 March 2021. Further details of this incident can be found in **Section 10**.

Compared to 2020, there were fewer number of discharges in 2021 but a higher number of TSS exceedances (11 in 2020, compared to 18 in 2021). In 2020, there was also one pH exceedance. There were zero pH exceedances in 2021. The TSS ranged <5 to 1260 mg/L in 2021, and 8 to 5380 mg/L in 2020.

Table 32 - Discharge Monitoring Results 2021

Discharge Point	Date	pH	EC (µS/cm)	Turbidity (NTU)	TSS (mg/L)	Oil and Grease (mg/L)	Discharging	Comment
	EPL Criteria	6.5 - 8.5	-	-	40	5		
LDP001	Tuesday, 2 March 2021	6.9	706	27	33	NV	Yes	Controlled discharge
	Wednesday, 3 March 2021	6.9	703	25	29	NV	Yes	Controlled discharge
	Thursday, 4 March 2021	6.7	738	17	21	NV	Yes	Controlled discharge
	Friday, 5 March 2021	6.7	727	23	29	NV	Yes	Controlled discharge
	Monday, 8 March 2021	6.8	752	29	37	NV	Yes	Controlled discharge
	Tuesday, 9 March 2021	6.8	737	10	11	NV	Yes	Controlled discharge
	Thursday, 11 March 2021	6.7	738	27	32	NV	Yes	Controlled discharge
	Friday, 12 March 2021	7.0	742	65	32	NV	Yes	Controlled discharge
	Monday, 15 March 2021	7.0	642	2.3	<5	NV	Yes	Controlled discharge
	Tuesday, 16 March 2021	6.8	661	2.2	4	NV	Yes	Controlled discharge
	Wednesday, 17 March 2021	6.8	656	1.6	<5	NV	Yes	Controlled discharge
	Thursday, 18 March 2021	6.9	522	16	18	NV	Yes	Controlled discharge
	Thursday, 18 March 2021	6.8	493	1630	1260	NV	Yes	Uncontrolled discharge
	Friday, 19 March 2021	6.9	195	1200	868	NV	Yes	Uncontrolled discharge
	Saturday, 20 March 2021	7.0	140	985	576	NV	Yes	Uncontrolled discharge
	Sunday, 21 March 2021	7.2	120	1500	816	NV	Yes	Uncontrolled discharge
	Monday, 22 March 2021	7.0	183	950	404	NV	Yes	Uncontrolled discharge
	Tuesday, 23 March 2021	6.9	242	995	385	NV	Yes	Uncontrolled discharge
	Wednesday, 27 October 2021	7.5	671	26	15	NV	Yes	Controlled discharge
	Thursday, 28 October 2021	7.5	677	14	7	NV	Yes	Controlled discharge

Discharge Point	Date	pH	EC (µS/cm)	Turbidity (NTU)	TSS (mg/L)	Oil and Grease (mg/L)	Discharging	Comment
	Friday, 29 October 2021	7.4	683	15	8	NV	Yes	Controlled discharge
	Monday, 1 November 2021	7.4	701	23	14	NV	Yes	Controlled discharge
	Tuesday, 2 November 2021	7.4	735	31	19	NV	Yes	Controlled discharge
	Thursday, 4 March 2021	6.6	950	31	29	NV	Yes	Controlled discharge
	Friday, 5 March 2021	6.7	2090	20	20	NV	Yes	Controlled discharge
LDP002	Monday, 8 March 2021	6.9	3830	33	24	NV	Yes	Controlled discharge
	Monday, 15 March 2021	6.7	667	18	11	NV	Yes	Controlled discharge
	Tuesday, 16 March 2021	6.6	660	19	11	NV	Yes	Controlled discharge
	Thursday, 18 March 2021	7.1	121	935	636	NV	Yes	Controlled discharge
	Friday, 19 March 2021	6.9	136	835	532	NV	Yes	Controlled discharge
	Saturday, 20 March 2021	7.0	96.9	500	311	NV	Yes	Controlled discharge
	Sunday, 21 March 2021	7.0	87.2	455	294	NV	Yes	Controlled discharge
	Monday, 22 March 2021	7.0	123	280	92	NV	Yes	Controlled discharge
	Tuesday, 23 March 2021	7.0	169	410	236	NV	Yes	Controlled discharge
	Tuesday, 25 May 2021	7.3	474	23	12	NV	Yes	Controlled discharge
	Wednesday, 26 May 2021	6.7	510	37	23	NV	Yes	Controlled discharge
	Monday, 28 June 2021	7.0	366	39	32	NV	Yes	Controlled discharge
	Tuesday, 26 October 2021	7.1	389	93	32	NV	Yes	Controlled discharge
	Wednesday, 24 November 2021	7.9	713	15	<5	NV	Yes	Controlled discharge
	Wednesday, 8 December 2021	6.6	562	26	9	NV	Yes	Controlled discharge
LDP003	Thursday, 18 March 2021	7.5	455	625	406	NV	Yes	Uncontrolled discharge
	Friday, 19 March 2021	7.1	186	915	592	NV	Yes	Uncontrolled discharge

Discharge Point	Date	pH	EC (µS/cm)	Turbidity (NTU)	TSS (mg/L)	Oil and Grease (mg/L)	Discharging	Comment
	Saturday, 20 March 2021	7.0	145	720	340	NV	Yes	Uncontrolled discharge
	Sunday, 21 March 2021	7.0	118	620	336	NV	Yes	Uncontrolled discharge
	Monday, 22 March 2021	7.2	124	405	184	NV	Yes	Uncontrolled discharge
	Tuesday, 23 March 2021	7.1	140	405	237	NV	Yes	Uncontrolled discharge
	Tuesday, 25 May 2021	7.7	543	65	18	NV	Yes	Controlled discharge
	Wednesday, 26 May 2021	7.7	547	55	15	NV	Yes	Controlled discharge
	Thursday, 27 May 2021	7.6	571	45	10	NV	Yes	Controlled discharge
	Tuesday, 29 June 2021	7.7	489	80	39	NV	Yes	Controlled discharge
	Wednesday, 30 June 2021	7.9	494	70	33	NV	Yes	Controlled discharge
	Thursday, 1 July 2021	7.7	449	70	37	NV	Yes	Controlled discharge
	Friday, 2 July 2021	7.7	523	60	34	NV	Yes	Controlled discharge
	Monday, 5 July 2021	6.66	462	23	<5	<5	Yes	Controlled discharge
	Tuesday, 6 July 2021	7.4	599	18	12	NV	Yes	Controlled discharge
	Wednesday, 7 July 2021	7.4	547	14	14	NV	Yes	Controlled discharge
	Wednesday, 4 August 2021	7.7	630	18	9	NV	Yes	Controlled discharge
	Tuesday, 10 August 2021	7.8	636	9	<5	NV	Yes	Controlled discharge
	Thursday, 12 August 2021	7.7	648	6.9	<5	NV	Yes	Controlled discharge
	Monday, 16 August 2021	7.7	659	18	8	NV	Yes	Controlled discharge
	Wednesday, 18 August 2021	7.7	634	32	12	NV	Yes	Controlled discharge
	Friday, 20 August 2021	7.7	647	40	17	NV	Yes	Controlled discharge
	Friday, 3 September 2021	7.6	673	80	34	NV	Yes	Controlled discharge
	Thursday, 25 November 2021	7.9	701	59	23	NV	Yes	Controlled discharge

6.8.3 Groundwater Monitoring Results

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 Dol Water.

Groundwater Level

Table 33 shows a comparison of groundwater levels since 2017. All groundwater locations were monitored four times during 2021 with a requirement for quarterly monitoring of groundwater levels as per the WMP. As evident, water levels have remained relatively consistent at BH208 and BH303, with BH205 showing a consistent increase in water level in recent years. Water levels at BH207 were relatively consistent and saw a slight increase in 2021. These increases may be attributed to the higher-than-average rainfall received at site in 2020 and 2021.

Table 33 - Groundwater Level since 2017

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
January 2019	20.1	9.2	20.4	31.0
April 2019	20.3	9.2	20.5	30.6
July 2019	19.7	9.1	20.6	31.1
October 2019	18.6	8.2	20.6	30.7
January 2020	19.95	9.3	20.7	31.2
April 2020	18.4	8.3	20.6	30.4
July 2020	18.2	8.3	20.8	31.2
October 2020	16.7	7.7	20.7	30.8
January 2021	18.1	8.5	20.8	31.4
April 2021	17.5	7.4	20.7	30.9
June 2021	18.2	8.3	20.7	31.2
October 2021	16.7	7.4	20.5	30.7

Groundwater Quality

Sampling of groundwater monitoring locations occurred on 14 April 2021 and 1 October 2021 in accordance with the six-monthly requirement to monitor groundwater quality data as per the WMP. Note: BH 208 was unable to be sampled in 2020 and 2021 due to insufficient water levels at both monitoring events. Results have been compared against data sampled from 2010 (pre-Karuah East Quarry) in **Table 34**.

Table 34 - 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
BH 207	7.4	1540	Not sampled	1
BH 303	6.3	600	Not sampled	1
Average Results 2016				
BH 205	7.3	1182	2015	2
BH 207	6.9	1578	2780	2

Monitoring Location	pH	TDS (mg/L)	EC (µS/cm)	Number of Samples
BH 208	6.4	2000	3010	2
BH 303	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
BH 303	6.9	1175	2350	2
Average Results 2018				
BH 205	8.8	1150	2500	2
BH 207	7.2	1020	1940	2
BH 208	7.10	3000	3000	1
BH 303	7.5	1250	2550	2
Average Results 2019				
BH 205	8.3	1734	2432	2
BH 207	6.9	1579	2527	2
BH 208	6.9	*	2505	1
BH 303	6.2	1557	2404	2
Average Results 2020				
BH 205	7.1	1460	2735	2
BH 207	7.0	1548	2865	2
BH 208	*	*	*	0
BH 303	5.9	1625	2985	2
Average Results 2021				
BH 205	6.76	1869	3350	2
BH 207	6.45	1663	3070	2
BH 208	*	*	*	0
BH 303	5.82	1674	2910	2

* No data recorded due to insufficient water levels.

2021 results are comparable to results from previous years and pre-Karuah East averages. The pH at BH 205, BH 303 and BH 207 in 2021 is more acidic than 2020 results but consistent with levels seen in 2019. TDS levels continued to be highly variable across the years. Average EC was higher at locations BH 205 and BH 207 in 2021 compared to 2020.

EC was not sampled during 2010 monitoring.

Karuah East Quarry will continue to monitor groundwater quality during 2022.

6.8.4 Water Take

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

6.8.5 Salinity Trading Scheme Credit Use

Not applicable to Karuah East Quarry.

6.8.6 Compensatory Water to Other Users

Not applicable to Karuah East Quarry.

6.9 Summary of Environmental Performance

Table 35 provides a summary of the environmental performance at the site for the reporting period.

Table 35 - 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	Compliant	Within criteria.	Continued monitoring
Blasting	See Section 6.3.1	Compliant	Within criteria.	Continued monitoring
Air Quality	See Section 6.4.1	Generally compliant. Non-compliances with monitoring frequency requirements on two occasions due to equipment failures.	Within criteria.	Continued monitoring
Biodiversity	See Section 6.5.1	Compliant.	Within criteria for BOAMP and LRMP.	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
Water	See Section 6.8.1	Non-compliances with discharge criteria. Uncontrolled discharge exceedances in March 2021.	Discharge criteria non-compliances have been reported to EPA and DPE. Six uncontrolled discharges at LP001, LP002, and LP003 occurred in March 2021.	Continued monitoring

7.0 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.

7.1 Rehabilitation Performance During Reporting Period

A summary of rehabilitation at Karuah East Quarry is outlined in **Table 36**.

Table 36 - 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: • Exploration activities; • Infrastructure; • Dams; and • The installation or maintenance of fences, bunds and any other works.	No Rehabilitation. Clearance of approximately 1.5 ha within the quarry footprint undertaken at the north-western region of the site across March and June 2021.
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 37 - 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)	25.07 ha	28.46	31.5
Total Active Disturbance	25.07 ha	28.46	31.5
Land Being Prepared for Rehabilitation	0	0	0
Land Under Active Rehabilitation	0	0	0
Completed Rehabilitation	0	0	0

7.2 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 38**.

Table 38 - 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. Karuah East Quarry continues to assess opportunities for progressive rehabilitation throughout quarry planning.

8.0 COMMUNITY

8.1 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:

- 29 March 2021;
- 9 June 2021 (extraordinary meeting held to discuss MOD 9); and
- 6 December 2021.

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

Key aspects discussed include:

- Site inspection;
- Discussion about MOD 9 (hours of operation) in the 9 June 2021 meeting;
- Presentation of the Company Report;
- Monitoring and environmental performance, including non-compliances;
- Community complaints and response to complaints; and
- Discussion around future modifications that may be sought.

8.2 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.

8.3 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.

8.3.1 Complaints

In 2021 there was one complaint received.

Karuah East Quarry received a complaint by email on 18 May 2021 regarding noise. The complaint detailed unacceptable noise levels to the east of Karuah East Quarry. An investigation was undertaken immediately after the complaint was received, however site personnel could not find evidence of the noise originating from the site. Karuah East Quarry noted major road works were being undertaken at a nearby location on the Pacific Highway which may have been the source of the noise. There were no further actions required.

Table 39 summarises the number of complaints made to Karuah East Quarry since operations at the site commenced.

Table 39 – Comparison of Complaints for Karuah East Quarry

Year	Complaint Type					
	Noise	Air Quality	Blasting	Traffic	Water	Other
2016	0	0	0	1	0	0
2017	1	0	0	0	1	1 (combined noise and dust complaint)
2018	1	0	1	0	0	0
2019	0	0	0	0	0	2 (access and vibration)
2020	0	0	0	0	0	1 (vibration)
2021	1	0	0	0	0	0

9.0 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.

In October 2020, Hansen Bailey completed the second Independent Environmental Audit of Karuah East Quarry. A copy of the Independent Environmental Audit is available on the website <https://hunterquarries.com.au/>.

The following key documents reviewed during the audit included:

- PA 09_0175 and Statement of Commitments (as modified);
- EPL 20611; and
- Karuah East Quarry environmental management plans and procedures.

The non-compliances identified in the 2020 Independent Environmental Audit were generally minor in nature, however there were some additional controls recommended by Hansen Bailey to ensure that the environmental management plans approved under PA 09_0175 are consistently implemented.

The Audit Action Plan and current progress against the recommendations is contained in **Appendix 7**.

10.0 INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

10.1 Summary of Incidents

Uncontrolled Discharge

With an active La Niña influencing climate along the east coast of Australia since September 2021, KEQ has experienced greater than average rainfall since October 2020; during which month a 1 in 200 year rainfall event was experienced resulting in 355.2mm received over the whole month. Successively, KEQ has received 241.8mm in January, 200.4mm in February, and 606.6mm in March.

To assist in managing the extreme rainfall received, a chemically enhanced primary treatment (CEPT) unit was hired to increase treatment and compliant discharge of water from site water storages. Heavy rainfall was received on 15 March 2021; however, this was only the start of an extreme rainfall event that severely increased in intensity on 18 March 2021 and persisted for seven days.

All three of the KEQ dams eventually reached storage capacity and uncontrolled discharge commenced from 18 March 2021. KEQ enacted the PIRMP to minimise risks of pollution and notified the EPA and DPE. KEQ also provided an incident report and non-compliance notification to the EPA and DPE following the event. Water quality monitoring was undertaken (see **Section 6.8** for the results).

In addition to the EPA Hotline being contacted to self-report the incident, DPE Compliance Officer (Jennifer Sage) and EPA Operations Officer (Rebecca Akhurst) were both contacted and provided a summary of the extreme weather event and environmental incident that had occurred. A communication strategy was prepared in consultation with the DPE and implemented as soon as practically possible, to notify nearby residents.

At the morning toolbox talk, all site workers and contractors were briefed that the PIRMP had been enacted and were advised to notify their supervisor if they noticed anything that may cause environmental concern.

Broken Depositional Dust Gauge

Prior to the sample being analysed, DDG 5 sample for June 2021 broke in the laboratory. This resulted in no depositional dust result for DDG 5 for June 2021. As outlined in a non-compliance report provided to DPE and EPA, the DDG 5 sample was collected from site, however at the laboratory the sampling apparatus shattered, losing the sample. As monthly monitoring is required by EPL 20611, Karuah East reported the missing result to the DPE. DPE did not require any further action. All other depositional dust gauges recorded a compliant result for June 2021.

Broken TSP HVAS Unit

The KEQ TSP and HVAS Unit was found damaged in March 2021, believed to be caused by NSW rainstorms affecting the site. Because monitoring is required every 6 days to collect results for TSP and PM₁₀ levels, KEQ reported the missing results to DPE and the EPA. KEQ undertook make-up sampling events to supplement the missed sampling events in March 2021.

10.2 Summary of Non-compliance

A summary of non-compliances is outlined in **Table 3** in **Section 1**.

10.3 Environmental Training

Training of Karuah East Quarry employees and contractors was undertaken monthly through the year with a focus on environmental awareness and incidents. This training includes PIRMP testing at least once a year. Other training includes environmental awareness for the following areas:

- Biodiversity conservation;
- Air quality;
- Fuel and spill containment and control;
- Noise and vibration;
- Pest vertebrate management; and
- Waste management.

11.0 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Table 40 outlines the proposed actions in the next reporting period.

Table 40 - Proposed Actions in the Next Reporting Period

Proposed Action	Timeline	Management Plan Requires Revision
Update of multiple Management Plans to incorporate MOD 9.	Revision and approval process is expected to occur in 2022 and into 2023.	Yes
Continue environmental monitoring in accordance with management plans and approval requirements	On-going	Yes, with Management Plans being updated in 2022.
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
Continue to undertake pest and weed management as required	Ongoing	No

12.0 REFERENCES

The following documents and reports have been used to assist in writing this Annual Review:

Management Plans

- Air Quality and Greenhouse Gas Management Plan (SLR 2019);
- Biodiversity Offset Area Management Plan (Kleinfelder 2018);
- Blast Management Plan (SLR 2019);
- Environmental Management Strategy (SLR 2019);
- Heritage Management Plan (RPS 2019);
- Landscape and Rehabilitation Management Plan (Kleinfelder and SLR 2019);
- Noise Management Plan (EMM 2022);
- *Tetratheca juncea* Translocation Program (Firebird 2019);
- Traffic Management Plan (Streetwise 2015); and
- Water Management Plan (SLR 2019).

Monitoring Reports

- 2021 Annual Monitoring Report - Karuah East Quarry Biodiversity Offset Area and Lot 12 (Kleinfelder 2022);
- Karuah East Quarry Independent Environmental Audit (Hansen Bailey 2020);
- Karuah East Quarry-Quarterly Noise Monitoring Reports (Thearle Acoustics 2021a, 2021b; and EMM 2021a, and 2021b); and
- *Tetratheca Juncea* Monitoring Report for The Karuah East Quarry Site (Firebird ecoSultants 2021).

Statutory Documents

- Section 2.55 (1A) Modification Report – Proposed Modification to Operational Noise Criteria and Implementation of Improved Acoustic Mitigation Measures, PA 09_0175 (ADW Johnson 2019);
- 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 development.

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

Note: Modifications 3 – 7 – withdrawn

Purple text represents Mod 8 (Operational noise criteria) – December 2020

Blue text represents Mod 9 (Extended operating hours) – November 2021

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DEFINITIONS

Aboriginal object / place	Has the same meaning as the definition of the term in section 5 of the NP&W Act.
Annual review	The review required under condition 4 of Schedule 5
Applicant	Karuah East Quarry Pty Limited or any other person or company who rely on this consent to carry out the development that is the subject of this consent
BCA	Building Code of Australia
BCD	Biodiversity and Conservation Division within the Department
Biodiversity offset strategy	The conservation and enhancement strategy described in the EA, and depicted conceptually in the figure in Appendix 4
Calendar year	A period of 12 months from 1 January to 31 December
CCC	Community Consultative Committee
Conditions of this consent	Conditions contained in Schedules 2 to 5 inclusive
Council	MidCoast Council
CPI	Australian Bureau of Statistics Consumer Price Index
Day	The period from 7 am to 6 pm on Monday to Saturday, and 8 am to 6 pm on Sundays and Public Holidays.
Department	Department of Planning, Industry and Environment
DPIE Water	Water Group within the Department
Development	The development as described in the document/s listed in condition 2(d) of Schedule 2, as modified by this consent
Development layout	The layout of the development as shown in the figures in Appendix 1
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>
EPBC Act	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	Environment Protection Licence under the POEO Act
Extraction Area	Extraction Area shown in Figure 1 in Appendix 1
Feasible	Feasible relates to engineering considerations and what is practical to build

Heritage item	An Aboriginal object, an Aboriginal place, or a place, building, work, relic, moveable object, tree, or precinct of heritage significance, that is listed under any of the following: - the State Heritage Register under the <i>Heritage Act 1977</i>; - a state agency heritage and conservation register under section 170 of the <i>Heritage Act 1977</i>; - a Local Environmental Plan under the EP&A Act; - the World Heritage List; - the National Heritage List or Commonwealth Heritage List under the EPBC Act; or - anything identified as a heritage item under the conditions of this consent.
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	Has the same meaning as the definition of the term in in section 1.4 of the EP&A Act, except where the term is used in the noise and air quality conditions in Schedules 3 and 4 of this consent 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 NSW Land Registry Services at the date of this consent
Material harm	Is harm to the environment that: - 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).
MEG	Regional NSW – Mining, Exploration & Geoscience
Minister	The Minister for Planning and Public Spaces, or delegate
Minor	Not very large, important or serious.
Mitigation	Activities associated with reducing the impacts of the development
Modification 1	Modification 1 to the development, as described in EA (MOD 1)
Modification 2	Modification 2 to the development, as described in EA (MOD 2)
Modification 8	Modification 8 to the development, as described in SEE (MOD 8)
Modification 9	Modification 9 to the development, as described in MR (MOD 9)
MR (MOD 9)	The Modification Report titled <i>S4.55(1A) Modification Report Proposed Modification to Extend Hours of Operation Project Approval 09_0175, dated April 2021 prepared by ADW Johnson</i> and the letter titled <i>Karuah East Quarry Project Mod 9 (MP09_0175 – Mod 9) Proposed Extended Hours of Operation Response to NSW EPA Request for Additional Information Dated 7 September 2021, dated 30 September 2021 prepared by ADW Johnson</i>
NP&W Act	<i>National Parks and Wildlife Act 1974</i>
NPfI	<i>NSW Noise Policy for Industry 2017</i>
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, Karuah East Quarry Pty Limited (or its subsidiary) or another quarry operator (or its subsidiary).
Product loading and dispatch	Empty haulage trucks entering the site and being loaded with stockpiled material before exiting the site via the weighbridge
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 movement of quarry products on the site
Quarry products	Extractive material which is 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
Registered Aboriginal Parties	As described in the <i>National Parks and Wildlife Regulation 2009</i>
Rehabilitation	The restoration of land disturbed by the development to a good condition, to ensure it is safe, stable and non-polluting
Residence	Existing or approved dwelling at the date of approval of Modification 1
RFS	NSW Rural Fire Service
SEE (MOD 8)	The Statement of Environmental Effects titled <i>Karuah East Quarry S4.55 (1A) Modification Report Proposed Modification to Operational Noise Criteria and Implementation of Improved Acoustic Measures</i> prepared by ADW Johnson Pty Limited and dated 20 June 2019.
Site	The development land shown in Figure 1 of Appendix 1, with land Lot and DP numbers identified in Schedule 1.
Statement of commitments	The Applicant's commitments in Appendix 6
TfNSW	Transport for NSW
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 measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development, and any rehabilitation required under this consent.

TERMS OF APPROVAL

2. The Applicant must carry out the development:
 - (a) in compliance with the conditions of this consent;
 - (b) in accordance with the statement of commitments in Appendix 6;
 - (c) in accordance with all written directions of the Planning Secretary; and
 - (d) generally in accordance with the EA, EA (MOD1), EA (MOD 2), SEE (MOD 8) and MR (MOD 9).
3. Consistent with the requirements in this consent, the Planning Secretary may make written directions to the Applicant 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 consent, 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 condition 3(a).
4. The conditions of this consent and directions of the Planning Secretary prevail to the extent of any inconsistency, ambiguity or conflict between them and a document/s listed in condition 2(d). In the event of an inconsistency, ambiguity or conflict between any of the document/s listed in condition 2(d), the most recent document prevails to the extent of the inconsistency, ambiguity or conflict.

LIMITS ON APPROVAL

Quarrying Operations

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

Note: Under this consent, the Applicant is required to rehabilitate the site and carry out additional undertakings to the satisfaction of the Planning Secretary. Consequently, this consent 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 Applicant 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 Applicant must comply with the operating hours in Table 1.

Table 1: Operating hours

Activity	Operating Hours
Quarrying Operations	7:00 am to 9:00 pm, Monday to Friday 7:00 am to 10:00 pm Monday to Friday on 50 calendar days per year; and 7:00 am to 6:00 pm, Saturday. No drilling 6:00 pm to 10:00 pm Monday to Friday or 1:00 pm to 6:00 pm Saturday

Activity	Operating Hours
	No quarrying operations on Sundays or Public Holidays.
Product loading and dispatch	5:00 am to 9:00 pm Monday to Friday 5:00 am to 10:00 pm Monday to Friday on 50 calendar days per year 6:00 am to 6:00 pm Saturday No product loading and dispatch 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 40 dB(A) $L_{Aeq(15\ min)}$ 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 Applicant 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 Applicant is required to obtain construction and occupation certificates for any proposed building works.
- Part 8 of the EP&A Regulation sets out the requirements for the certification of the development.

DEMOLITION

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

DEVELOPER CONTRIBUTIONS

11. The Applicant 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 development; 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: (i) 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 development 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. All plant and equipment used on site, or to monitor the performance of the development, must be:
- (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 Applicant may submit any strategy, plan or program required by this consent on a progressive basis.

Notes:

- While any strategy, plan or program may be submitted on a progressive basis, the Applicant 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 Applicant must:
- (a) provide annual quarry production data to MEG 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 Applicant must ensure that all employees, contractors and sub-contractors are made aware of, and instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development.

APPLICABILITY OF GUIDELINES

16. References in the conditions of this consent 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 consent.

However, consistent with the conditions of this consent and without altering any limits or criteria in this consent, the Planning Secretary may, when issuing directions under this consent 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 consent require consultation with an identified party, the Applicant must:
- (a) consult with the relevant party prior to submitting the subject document;
 - (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 Applicant and how the Applicant has addressed the matters not resolved.

SCHEDULE 3 ENVIRONMENTAL PERFORMANCE CONDITIONS

IDENTIFICATION OF APPROVED LIMITS OF EXTRACTION

1. The Applicant 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 Applicant 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. Except for the carrying out of construction works, the Applicant must ensure that the operational noise generated by the development does not exceed the criteria in Table 2 at any residence^a on privately-owned land.

Table 2: Operational noise criteria dB

Noise Assessment Location ^a	Morning Shoulder <i>L_{Aeq} (15 min)</i>	Morning Shoulder <i>L_{Amax}</i>	Day <i>L_{Aeq} (15 min)</i>	Evening <i>L_{Aeq} (15 min)</i>
A	35	52	42	40
B	35	52	40	40
G	35	52	43	39
H	35	52	44	46
I	35	52	40	37
All other residences	35	52	40	35

^a Noise Assessment Locations referred to in Table 2 are shown in Appendix 2.

Noise generated by the development must be monitored and measured in accordance with the relevant procedures and modifications (including certain meteorological conditions) of the NPfI.

- 3A. The noise criteria in Table 2 do not apply if the Applicant has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and the Applicant has advised the Department in writing of the terms of this agreement.

Road Traffic Noise Criteria

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

Table 3: Road traffic noise criteria

Road	Criteria (Day ^a)
Pacific Highway	60 dB(A) L _{Aeq} (15 hour)
Local roads	55 dB(A) L _{Aeq} (1 hour)

^a Day is the period from 7 am to 10 pm every day in accordance with the EPA's NSW Road Noise Policy (2011).

5. Deleted

Noise Operating Conditions

6. The Applicant must:
 - (a) take all reasonable steps to minimise noise from construction and operational activities, including low frequency noise and other audible characteristics, associated with the development;
 - (b) implement reasonable and feasible noise attenuation measures on all plant and equipment that will operate in noise sensitive areas;
 - (c) operate a comprehensive noise management system commensurate with the risk of impact;
 - (d) take all reasonable steps to minimise the noise impacts of the development during noise-enhancing meteorological conditions when the noise criteria in this consent do not apply (see NPfl);
 - (e) carry out quarterly attended noise monitoring (unless otherwise agreed by the Planning Secretary) to determine whether the development is complying with the relevant conditions of this consent; and
 - (f) regularly assess the noise monitoring data and modify or stop operations on the site to ensure compliance with the relevant conditions of this consent.

Noise Management Plan

7. The Applicant must prepare a Noise Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:
 - (a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;
 - (b) be prepared in consultation with the EPA;
 - (c) describe the measures to be implemented to ensure:
 - (i) compliance with the noise criteria and operating conditions in this consent;
 - (ii) best practice management is being employed;
 - (iii) noise impacts of the development are minimised during noise-enhancing meteorological conditions when the noise criteria in this consent do not apply (see NPfl);
 - (d) describe the noise management system in detail; and
 - (e) include a monitoring program that:
 - (i) is capable of evaluating the performance of the development;
 - (ii) monitors noise at the nearest and/or most affected residences;
 - (iii) adequately supports the noise management system;
 - (iv) includes a protocol for distinguishing noise emissions of the development from any neighbouring developments; and
 - (v) includes a protocol for identifying any noise-related exceedance, incident or non-compliance and for notifying the Department and relevant stakeholders of any such event.

- 7A. The Applicant must implement the plan as approved by the Planning Secretary.

BLASTING

Blasting Criteria

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

Table 4: Blasting criteria

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

However, the blasting criteria in Table 5 do not apply if the **Applicant** has a written agreement with the relevant landowner or infrastructure provider/owner, and the **Applicant** has advised the Department in writing of the terms of this agreement.

Blasting Hours

9. The **Applicant 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 **Applicant 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 **Applicant 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 **Applicant**, unless:
 - the **Applicant** has a written agreement with the relevant landowner to allow blasting to be carried out closer to the land, and the **Applicant** has advised the Department in writing of the terms of this agreement, or
 - the **Applicant** 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 **Applicant must** prepare a Blast Management Plan for the **development** 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 **consent**;
 - 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 **development** including:
 - compliance with the applicable criteria; and
 - minimising fume emissions from the site.

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

AIR QUALITY

Air Quality Criteria

13. The **Applicant must** ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the **development** 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 **development** plus background concentrations due to all other sources);
- ^b Incremental impact (ie incremental increase in concentrations due to the **development** 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 **Applicant must** implement all reasonable and feasible measures to minimise the release of greenhouse gas emissions from the site.

Operating Conditions

15. The **Applicant must**:
- (a) implement best management practice to minimise dust emissions by the **development**;
 - (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 **consent**;
 - (c) minimise the air quality impacts of the **development** 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 **consent**.

Air Quality Management Plan

16. The **Applicant must** prepare an Air Quality Management Plan for the **development** 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 **consent**;
 - best management practice is employed; and
 - the air quality impacts of the **development** 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 **development**;
 - includes a protocol for determining any exceedances of the relevant conditions of **consent**;
 - effectively supports the air quality management system; and
 - evaluates and reports on the adequacy of the air quality management system.

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

METEOROLOGICAL MONITORING

17. For the life of the **development**, the **Applicant 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

Water Supply

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

Surface Water Discharges

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

Effluent Management

20. The **Applicant 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 Applicant must prepare a Water Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:
- (a) be prepared in consultation with the EPA and DPIE Water 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 development;
 - 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 development 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 Applicant must implement the plan as approved by the Planning Secretary.

TRANSPORT

Roadworks

22. The Applicant 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 TfNSW;

- (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 Applicant must keep accurate records of all laden truck movements to and from the site (including time of arrival and dispatch) and publish a summary of records on its website every 6 months and in the Annual Review.

Parking

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

Operating Conditions

25. The Applicant must ensure that all development-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 Applicant must prepare a Transport Management Plan for the development 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 TfNSW 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 consent;
 - that drivers of development-related heavy vehicles are aware of potential safety issues along the haulage routes; and
 - that drivers of development-related heavy vehicles comply with the Driver Code of Conduct; and
 - (e) include a program to monitor the effectiveness of these measures.

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

LANDSCAPE

Tetratheca juncea Translocation

27. The Applicant must develop a translocation program for *Tetratheca juncea* to the satisfaction of the Planning Secretary. This program must:
- (a) be prepared in consultation with BCD, 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 BCD and the Department.

Biodiversity Offset Strategy

28. The Applicant 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 BCD 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 Applicant must implement the strategy as approved by the Planning Secretary.

Long Term Security of Offsets

29. The Applicant 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 BCD 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 Applicant must rehabilitate the site to the satisfaction of the Planning Secretary. This rehabilitation must:
- be consistent with the rehabilitation strategy as described in the EA and shown conceptually in Figure 1 in Appendix 5; and
 - 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 development	Restore ecosystem function, including maintaining or establishing self-sustaining eco-systems comprised of: - 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 Applicant 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 Applicant must prepare a Landscape and Rehabilitation Management Plan for the development 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 BCD 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 consent.
 - 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 consent;
 - 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 Applicant must implement the plan as approved by the Planning Secretary.

Biodiversity Offset Area Management Plan

33. The Applicant must prepare a Biodiversity Offset Area Management Plan for the development 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 BCD and Council;
 - (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.

Conservation & Rehabilitation Bond

34. The Applicant **must** lodge a Conservation and Rehabilitation Bond with the Department 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 Applicant and BCD 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 Applicant **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).

HERITAGE

Heritage Management Plan

36. The Applicant must prepare a Heritage Management Plan for the development 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 BCD, 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 Applicant must implement the plan as approved by the Planning Secretary.

VISUAL

37. The Applicant 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 development 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 Applicant 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 Applicant 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 Applicant must secure the site to ensure public safety at all times, to the satisfaction of the Planning Secretary.

Bushfire Management

41. The Applicant must:
- (a) ensure that the development 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 Applicant must:
- (a) minimise the waste generated by the development; and

- (b) ensure that the waste generated by the development 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 and no longer than 7 days after obtaining monitoring results showing an:
 - (a) exceedance of any noise, blasting and air quality criteria in Schedule 3, the Applicant must provide the details of the exceedance to any affected landowners and/or tenants; and
 - (b) an exceedance of the relevant air quality criteria in Schedule 3, the Applicant 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 a landowner considers the development to be exceeding any noise, blasting or air quality criterion in Schedule 3 of this consent, they may ask the Planning Secretary in writing for an independent review of the impacts of the development on their land.
3. If the Planning Secretary is not satisfied that an independent review is warranted, the Planning Secretary will notify the landowner in writing of that decision, and the reasons for that decision, within 21 days of the request for a review.
4. If the Planning Secretary is satisfied that an independent review is warranted, within 3 months, or as otherwise agreed by the Planning Secretary and the landowner, of the Planning Secretary's decision, the Applicant must:
 - (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Planning Secretary, to:
 - (i) consult with the landowner to determine their concerns;
 - (ii) conduct monitoring to determine whether the development is complying with the relevant criteria in Schedule 3 of this consent; and
 - (iii) if the development is not complying with that criteria, identify measures that could be implemented to ensure compliance with the relevant criteria;
 - (b) give the Planning Secretary and landowner a copy of the independent review; and
 - (c) comply with any written requests made by the Planning Secretary to implement any findings of the review.

MITIGATION UPON REQUEST

5. Upon receiving a written request for mitigation from the owner of any residence on privately-owned land listed in Table 12, the Applicant must implement additional mitigation measures at or in the vicinity of the residence in consultation with the landowner. These measures must be consistent with the measures outlined in the *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Development* (NSW Government, 2014). They must also be reasonable and feasible, proportionate to the level of predicted impact and directed towards reducing the noise impacts of the development. The Applicant must also be responsible for the reasonable costs of ongoing maintenance of these additional mitigation measures until the cessation of quarrying operations.

Table 12: Land subject to additional mitigation upon request

Mitigation Basis	Land ^a
Noise	H

^a The location of the land referred to in Table 12 is shown in Appendix 2

SCHEDULE 5 ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING

ENVIRONMENTAL MANAGEMENT

Environmental Management Strategy

1. The **Applicant must** prepare an Environmental Management Strategy for the **development** 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 **development**;
 - (c) identify the statutory approvals that apply to the development;
 - (d) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the development;
 - (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 **development**;
 - receive, handle, respond to, and record complaints;
 - resolve any disputes that may arise during the course of the **development**;
 - 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 **consent**; and
 - a clear plan depicting all the monitoring required to be carried out under the conditions of this **consent**.

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

Adaptive Management

2. The **Applicant must** assess and manage **development**-related risks to ensure that there are no exceedances of the criteria and/or performance measures in this **consent**. 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 **Applicant 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.

Management Plan Requirements

3. The **Applicant must** ensure that the Management Plans required under this **consent** 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 commitments or recommendations identified in the documents listed in condition 2(d) of Schedule 2**;
 - 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 **development** 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 **development**; 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 development 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 **Applicant** must review the environmental performance of the **development** 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;
 - (b) include a comprehensive review of the monitoring results and complaints records of the **development** 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 **documents referred to in condition 2(d) of Schedule 2 of this consent**;
 - (c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
 - (d) identify any trends in the monitoring data over the life of the **development**;
 - (e) identify any discrepancies between the predicted and actual impacts of the **development**, and analyse the potential cause of any significant discrepancies; and
 - (f) describe the measures that would be implemented over the current calendar year to improve the environmental performance of the **development**.

;

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 **consent**, (unless the conditions require otherwise),
 the **Applicant must** review the strategies, plans, and programs required under this **consent**, 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 **development**.*

Community Consultative Committee

6. The **Applicant must** establish and operate a Community Consultative Committee (CCC) for the **development**. 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 **Applicant** complies with this **consent**.
- In accordance with the guideline, the Committee should comprise an independent chair and appropriate representation from the **Applicant**, Council, recognised environmental groups and the local community.

REPORTING

Incident Notification

7. The **Applicant** must immediately notify the Department and any other relevant agencies immediately after it becomes aware of an incident. The notification must be in writing via the **Major Projects Website** and identify the **development** (including the **development** 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 **Applicant** must notify the Department of the non-compliance. The notification must be in writing via the **Major Projects Website** and identify the **development** (including the **development** application number and name), set out the condition of this **consent** that the **development** 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 **Applicant** must regularly report on the environmental performance of the **development** on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this **consent**.

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 **Applicant** must commission and pay the full cost of an Independent Environmental Audit of the **development**. This audit must:
- be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the **Planning** Secretary;
 - include consultation with the relevant agencies;
 - assess the environmental performance of the **development** and whether it is complying with the relevant requirements in this **consent** and any relevant EPL and/or Water Licence (including any assessment, plan or program required under these approvals);
 - review the adequacy of any approved strategy, plan or program required under these approvals; and
 - recommend measures or actions to improve the environmental performance of the **development**, 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 **Applicant** 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.

ACCESS TO INFORMATION

11. The Applicant must:
- (a) make the following information publicly available on its website:
 - the documents referred to in condition 2(d) of Schedule 2 of this consent;
 - any statutory approvals for the development;
 - approved strategies, plans and/ programs;
 - a summary of the monitoring results of the development, which have been reported in accordance with the various plans and programs approved under the conditions of this consent;
 - a complaints register, updated quarterly;
 - minutes of CCC meetings;
 - annual reviews;
 - any independent environmental audit, and the Applicant'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 DEVELOPMENT LAYOUT

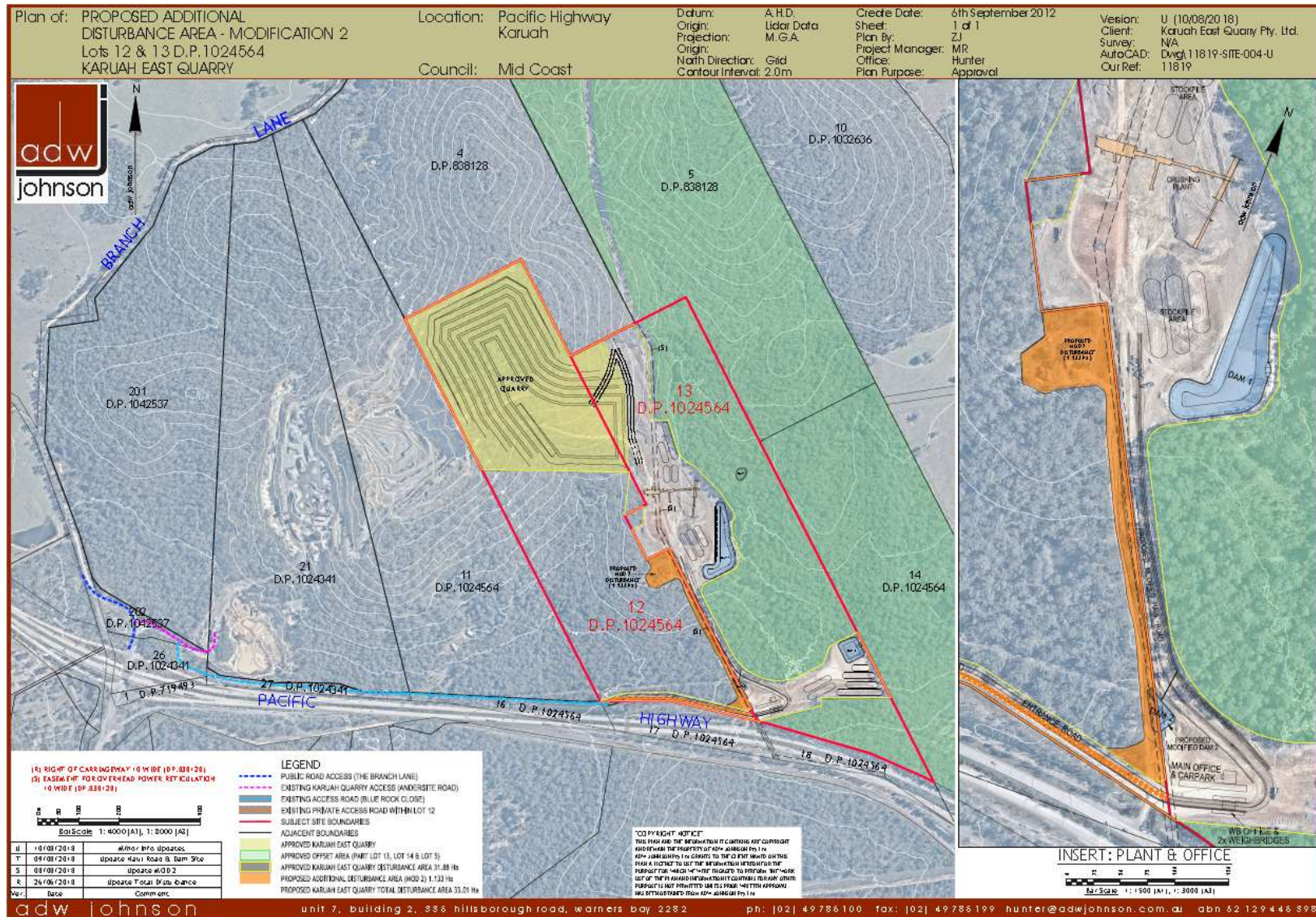


Figure 1: Development Layout

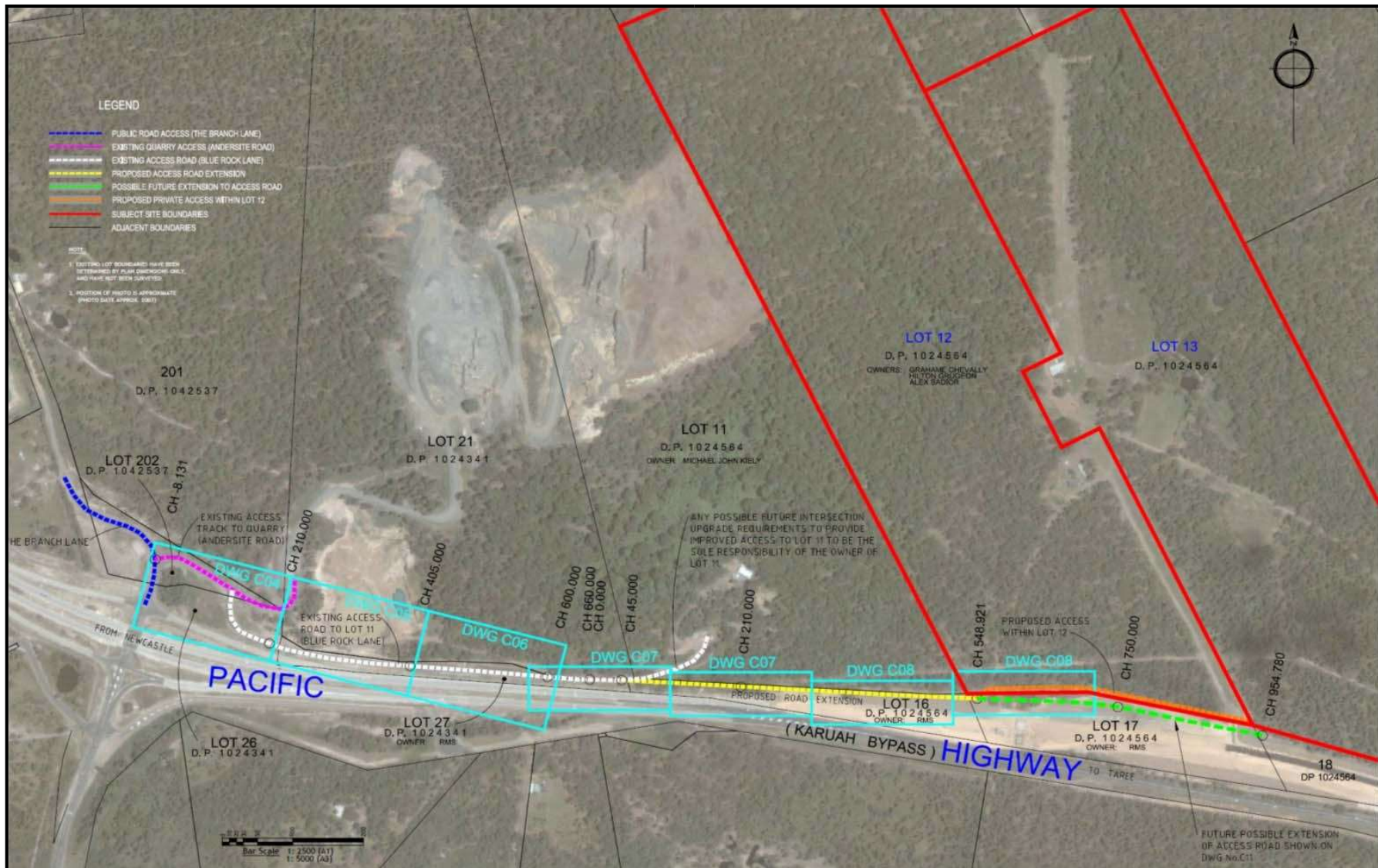


Figure 2: Proposed roadworks

APPENDIX 2
RESIDENCES (NOISE ASSESSMENT LOCATIONS)



Figure 1: Noise Assessment Locations

APPENDIX 3

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APPENDIX 4 CONCEPTUAL BIODIVERSITY OFFSET AREA



Figure 1: Conceptual Biodiversity Offset Area

APPENDIX 5 REHABILITATION STRATEGY

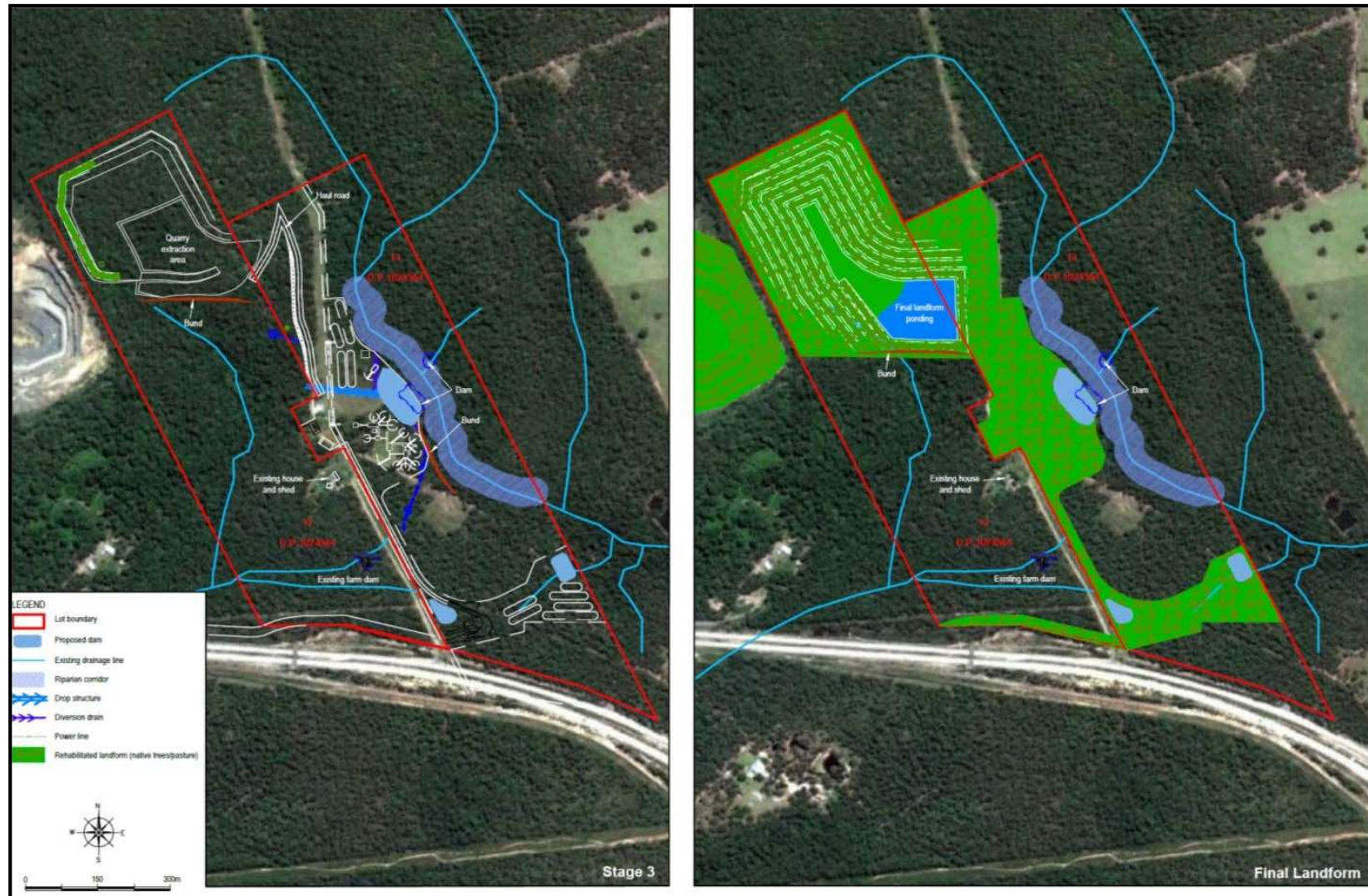


Figure 1: Conceptual Rehabilitated Landform

APPENDIX 6 STATEMENT OF COMMITMENTS

STATEMENT OF COMMITMENTS

The following section outlines the **Applicant'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;
- 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.

Table 1 - Recommended Stripping Depths

Table 1: Recommended Stripping Depth					
Soil Type	Development 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

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 development 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 development 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 bonded 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 development 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:

- 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 storage (ML)	water capacity	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 BCD 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 DPIE Water;
- 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 development consent 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:
 - Containment of dirty water runoff from the active quarry area by directing this water into in-pit sumps;
 - Directing sediment-laden runoff from disturbance areas and rehabilitated areas into designated sediment control dams;
 - Installing temporary erosion and sediment control devices as required (i.e. sediment fences sandbag 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);

- topsoil/subsoil handling and stockpiling procedures; and
- 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 **Development**; and
 - 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 **BCD** 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.
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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.

4.0 BIODIVERSITY & CONSERVATION OFFSET

4.1 Flora and Fauna

The following will be implemented by the **Applicant**:

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 BCD 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 [development consent](#).

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 comprise 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 [BCD](#) for the salvage program will be made and will be subject to a detailed Salvage Plan to be prepared by the [Applicant](#) (and endorsed by [BCD](#) 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 [Applicant](#)). In the event that Lot 5 DP 838128 is unable to be secured by the [Applicant](#), the [Applicant](#) 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 [BCD](#) and be to the satisfaction of the [Planning Secretary](#).

The following will be undertaken by the [Applicant](#) 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 [BCD](#) guidelines. In particular, seasonal survey for *tetratheca juncea* and *grevillea parviflora* ssp *parviflora* will be undertaken and reported to the [BCD](#);
- Prior to establishment of the proposed quarry, the [Applicant](#) 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 [Applicant](#), as noted above, the [Applicant](#) will purchase an alternate offset site (to be agreed to by [BCD](#) and be to the satisfaction of the [Planning Secretary](#)).
- Upon approval of the [development](#), in consultation with the [BCD](#), the [Applicant](#) 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 [Applicant](#)). 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:

- Enclosure of the Jaw Crusher with 100 mm thick concrete panels on the North, East and South sides. Roofing materials to have an acoustic rating of STC28;
- Enclosure of the Cone Crushers on the Northern and eastern elevations with materials having an acoustic rating of STC28. Southern and western elevations and roof to be enclosed with Colorbond;
- Purchase and use of generator sets which are acoustically treated including complete enclosure of the engine and generator, acoustically treated exhaust systems and cooling systems;
- Noise compliance monitoring will be undertaken in accordance with conditions of consent and Noise Management Plan by a suitably qualified acoustic expert. The monitoring will consider the performance of the quarry in relation to the development specific noise (as established in the [EMM Revised Noise Impact Assessment August 2021](#)) and vibration and blast criteria established in the SLR Noise and Blasting Impact Assessment (dated 2 November 2012);
- The Applicant will not fire blasts at the existing quarry and the proposed Karuah East quarry at the same time;
- The Applicant 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 Applicant 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.
- Splitting or hammering of Class 1 (700 mm – 1200 mm) and Class 2 (400 mm – 700 mm) rock will not be undertaken after 6:00 pm;
- The Applicant will implement training to ensure staff are aware of the sensitivity of noise emissions;
- Product will be loaded into trucks from as low a height as possible.
- Loading of Class 1 (700 mm – 1200 mm) and Class 2 (400 mm – 700 mm) rock for dispatch during the following hours will be undertaken via excavator 'grabs' using the hydraulic excavator rock grab attachment rather than a bucket attachment:
 - 5:00 am to 7:00 am, Monday to Friday;
 - 6:00 pm to 9:00 pm, Monday to Friday;
 - 9:00 pm to 10:00 pm, Monday to Friday on up to 50 calendar days per year; and
 - 6:00 am to 7:00 am, Saturdays.

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 [TfNSW](#) 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 **development** 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 **development** site will be considered to reduce transport distances for vehicles entering / exiting the **development** 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 **Applicant**.

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 **Applicant** 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 **BCD** Enviroline 131 555 and relevant Aboriginal stakeholders in order to determine an action plan for the management of the skeletal remains prior to works recommencing 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 **BCD** 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 **Applicant** 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	☐ 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	- 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. ☐ Record details of ground cover (litter, logs, rocks etc).	

20m x 10m plots	- 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	- 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 general in	- 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	☐ 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	• 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	• 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	• 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		
	• 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		

	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.	Quarterly or following rainfall events. Monitoring of receiving waters during a rainfall event which results in runoff.
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11.2 Final Void Managements

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.

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
Extractive activities	> 500000-2000000 T annually extracted or processed

Contact Us
NSW EPA
4 Parramatta Square
12 Darcy Street
PARRAMATTA NSW 2150
Phone: 131 555
Email: info@epa.nsw.gov.au
Locked Bag 5022
PARRAMATTA NSW 2124



Environment Protection Licence

Licence - 20611

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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).



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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	Extractive activities	> 500000 - 2000000 T annually extracted or processed

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



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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.

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.

Any other document and/or management plan is not to be taken as part of the documentation in condition A3.1, other than those documents and/or management plans specifically referenced in 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 identi- fication 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.

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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
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

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.



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Noise/Weather

EPA identi- fication 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

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 &/or none visible
pH	pH				6.5 - 8.5
Total suspended solids	milligrams per litre				40

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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.

L4 Noise limits

- 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 2: Operational Noise Criteria, and Figure 1 of the document titled Project Approval 09_0175 Modification 9 (MOD 9) Department of Planning, Industry & Environment - which has been filed on EPA file Doc22/715570-1.

Noise Assessment Location	Morning Shoulder LAeq(15 min)	Morning shoulder LAmax	Day LAeq (15 min)	Evening LAeq (15 min)
A (74 Mill Hill Close, Karuah, Lot 100 DP 1028885)	35	52	42	40
B (64 Mill Hill Close, Karuah, Lot 3 DP785172)	35	52	40	40
G (2 Halloran Road, North Arm Cove Lot 1 DP1032636)	35	52	43	39
H (21 Halloran Road, North Arm Cove Lot 10 DP1032636)	35	52	44	46
I (83 Halloran Road, North Arm Cove Lot 12 DP1032636)	35	52	40	37
All other residences	35	52	40	35

- L4.2 Noise limit definitions - For the purpose of the table at L4.1, the following definitions apply:
 Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and Public Holidays;
 Morning Shoulder is defined as the period from 5:00am to 7:00am Monday to Saturday;
 Evening is defined as the period from 6:00pm to 10:00pm Monday to Saturday.

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

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- c) Stability category G temperature inversion conditions.

L4.4 Determining Compliance

To determine compliance with the noise limits set out in the table above, the licensee must locate monitoring equipment:

- a) within 30 metres of a dwelling façade (but not closer than 3 metres) where any dwelling on the property is situated more than 30 metres from the property boundary that is closest to the premises;
- b) approximately on the boundary where any dwelling is situated 30 metres or less from the property boundary that is closest to the premises;
- c) at the most affected point at a location where there is no dwelling at the location; and
- d) within approximately 50 metres of the boundary of a national park or nature reserve.

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:

- 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.

- L4.5 For the purposes of determining the noise generated at the premises the modification factors in Fact Sheet C of the EPA's "Noise Policy for Industry" must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

L5 Blasting

- L5.1 Blasting in or on the premises must only be carried out between the hours of 9:00 am and 4:00 pm Monday to Friday. No blasting is permitted on 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:
- a) 115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period; and
 - b) 120 dB (Lin Peak) at any time,
- at monitoring point 11 detailed in Condition P1.4.
- L5.4 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:
- a) 5 mm/second for more than 5% of the total number of blasts during each reporting period; and
 - b) 10 mm/second at any time,
- at monitoring point 11 detailed in Condition P1.4.
- L5.5 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.
- L5.6 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.



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L5.7 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 Hours of operation for each activity type permitted by this Licence are shown in the table below:.

Activity	Operating hours
Quarrying Operations	7:00 am to 9:00 pm, Monday to Friday. No quarrying operations on Sundays or Public Holidays. 7:00 am to 10:00 pm Monday to Friday on 50 calendar days per year; and 7:00am to 6:00 pm, Saturday. No drilling 6:00 pm to 10:00 pm Monday to Friday or 1:00 pm to 6:00 pm Saturday.
Product loading and dispatch	5:00 am to 9:00 pm Monday to Friday 5:00 am to 10:00 pm Monday to Friday on 50 calendar days per year 6:00 am to 6:00 pm Saturday No product loading and dispatch 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 40 dB(A) LAeq(15 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

L7 Potentially offensive odour

L7.1 No condition of this licence identifies a potentially offensive odour for the purposes of Section 129 of the

Environment Protection Licence

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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.

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.

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O4 Emergency response

Note: 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 PIRMP 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;
 - 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.

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

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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 The licensee must implement all necessary procedural controls to all mobile plant to limit engine RPM (revolutions per minute) so as to reduce noise in order to achieve compliance with the noise limits specified in this licence.

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:
- 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

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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

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.

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Note: The *Protection of the Environment Operations (Clean Air) Regulation 2021* 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
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:



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- a) the date and time of the complaint;
- b) the method by which the complaint was made;
- c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
- d) the nature of the complaint;
- e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
- f) 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.

M7 Blasting

- M7.1 To determine compliance with Blast Limit conditions of this licence:
 - a) 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
 - b) 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:
 - a) during a period of normal quarry operations;
 - b) at each one of the locations listed in the noise limits table of this licence;

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- c) occur quarterly in the reporting period;
- d) occur during each day period as defined in the NSW Noise Policy for Industry.

Note: Quarterly attended noise monitoring must be completed (unless otherwise agreed by the Planning Secretary) to determine whether the development is complying with the relevant conditions of this consent. The frequency of noise monitoring will be reviewed, upon request.

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:

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

At the end of each reporting period, the EPA will provide to the licensee notification that the Annual Return is due.

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.

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



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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

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.

- 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 they became aware of the incident.

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 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.

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- 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 quarterly noise monitoring report must be submitted to the EPA within 30 days of completion of each round of quarterly noise monitoring. The assessment must be prepared by a suitably qualified and experienced acoustical consultant and include:
- a) a description of the plant in operation and activities being undertaken on the premises during each noise monitoring assessment;
 - b) an assessment of compliance with noise limits presented in this licence; and
 - c) an outline of any management actions taken within the monitoring period to address any exceedances 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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G2 Other general conditions

G2.1 Completed Programs

Program	Description	Completed Date
Pollution Reduction Study 1 - Design the Necessary Noise Mitigation Measures	Engage an acoustic engineer to investigate the site-specific noise mitigation measure/s that are necessary to meet the noise limits of this licence at all times.	01-March-2019



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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> .



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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
Wellhead	Has the same meaning as in Schedule 1 to the Protection of the Environment Operations (General) Regulation 2021.

Mr Peter Jamieson

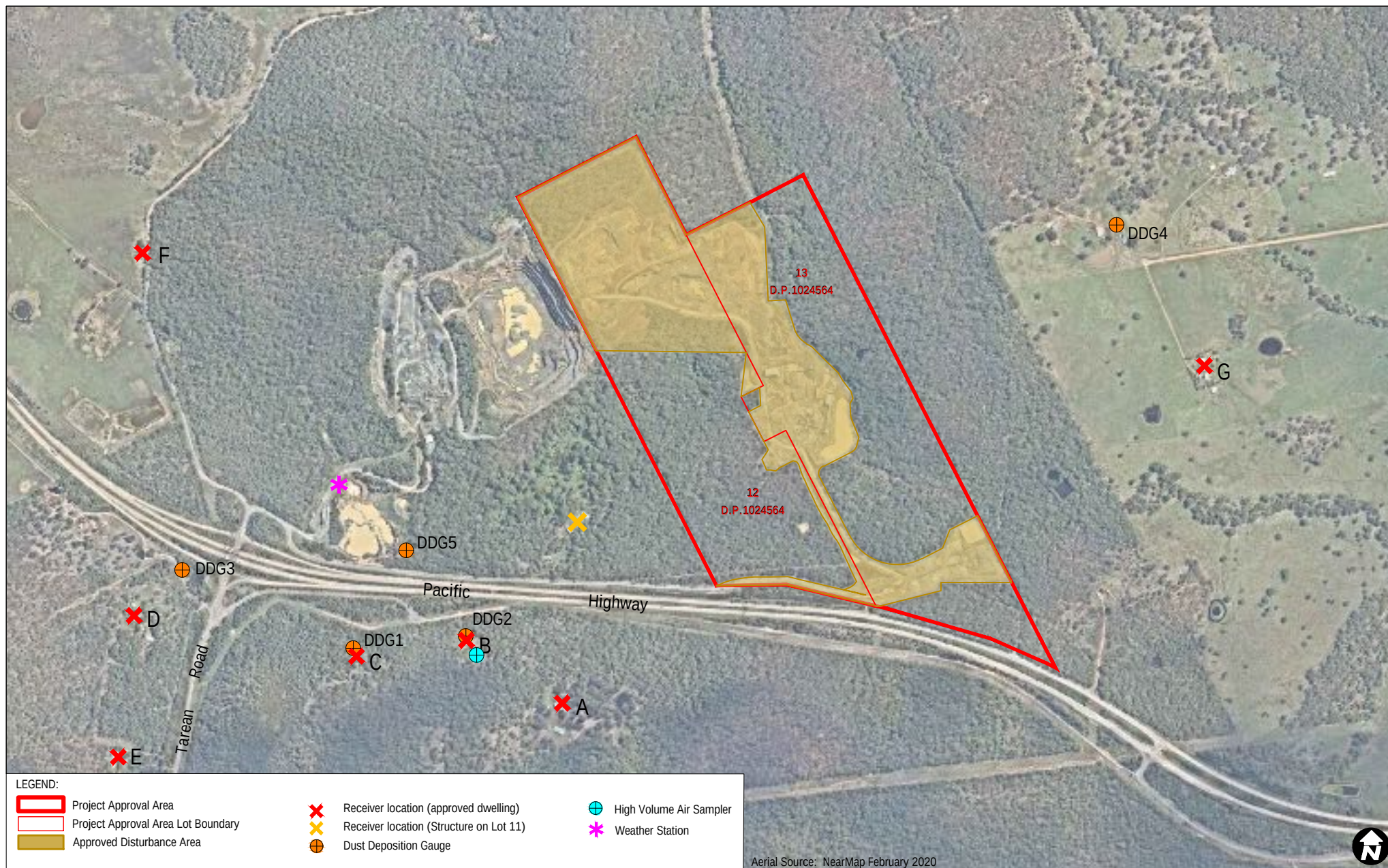
Environment Protection Authority

(By Delegation)

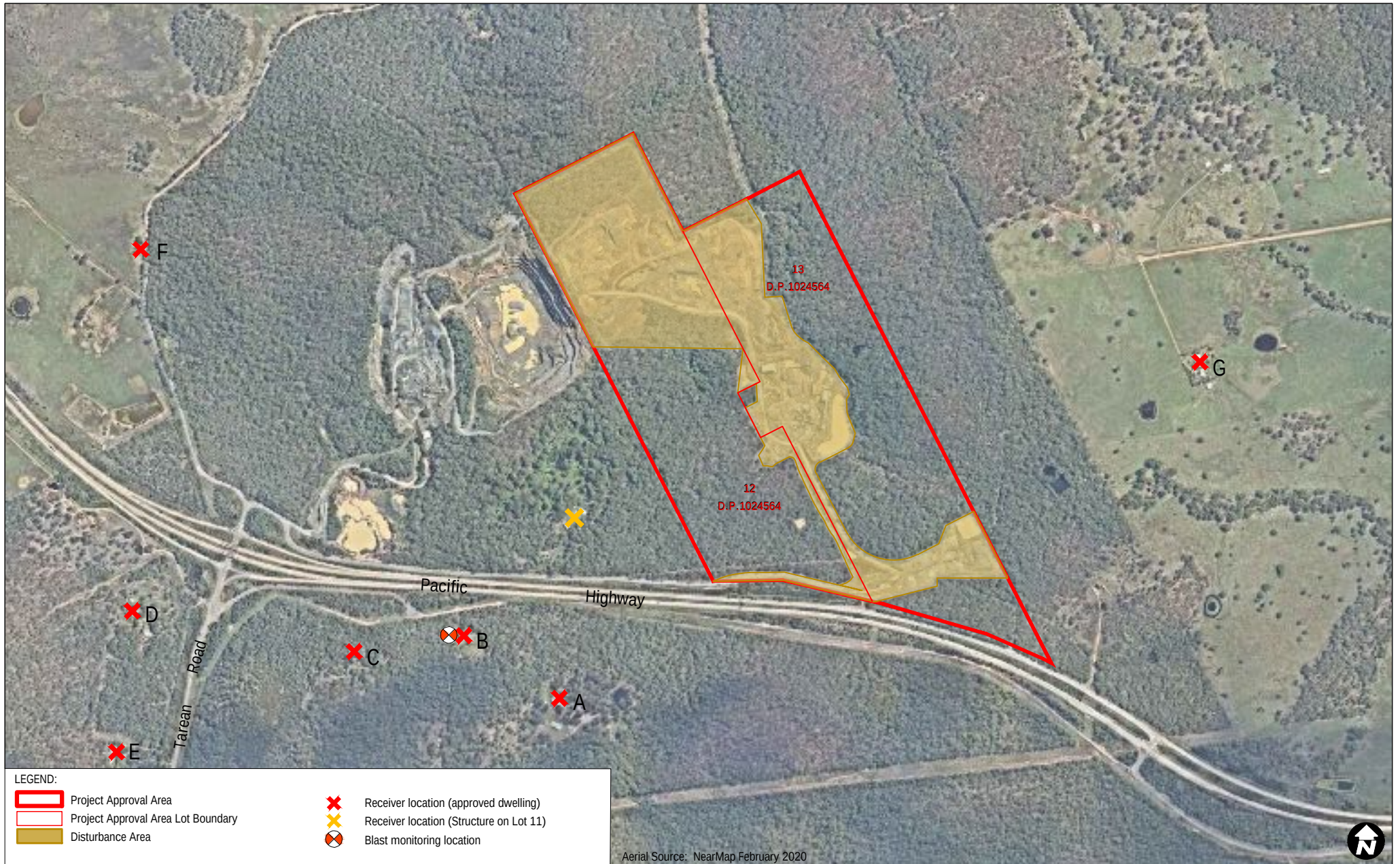
Date of this edition: 26-August-2015

End Notes		
2	Licence varied by notice	1533596 issued on 21-Sep-2015
3	Licence varied by notice	1547416 issued on 06-Dec-2016
4	Licence varied by notice	1571215 issued on 16-Jan-2019
5	Licence varied by notice	1578081 issued on 25-Jun-2019
6	Licence format updated on	18-Jul-2019
7	Licence varied by notice	1621603 issued on 02-Sep-2022

APPENDIX 3 – Key Figures/Plans



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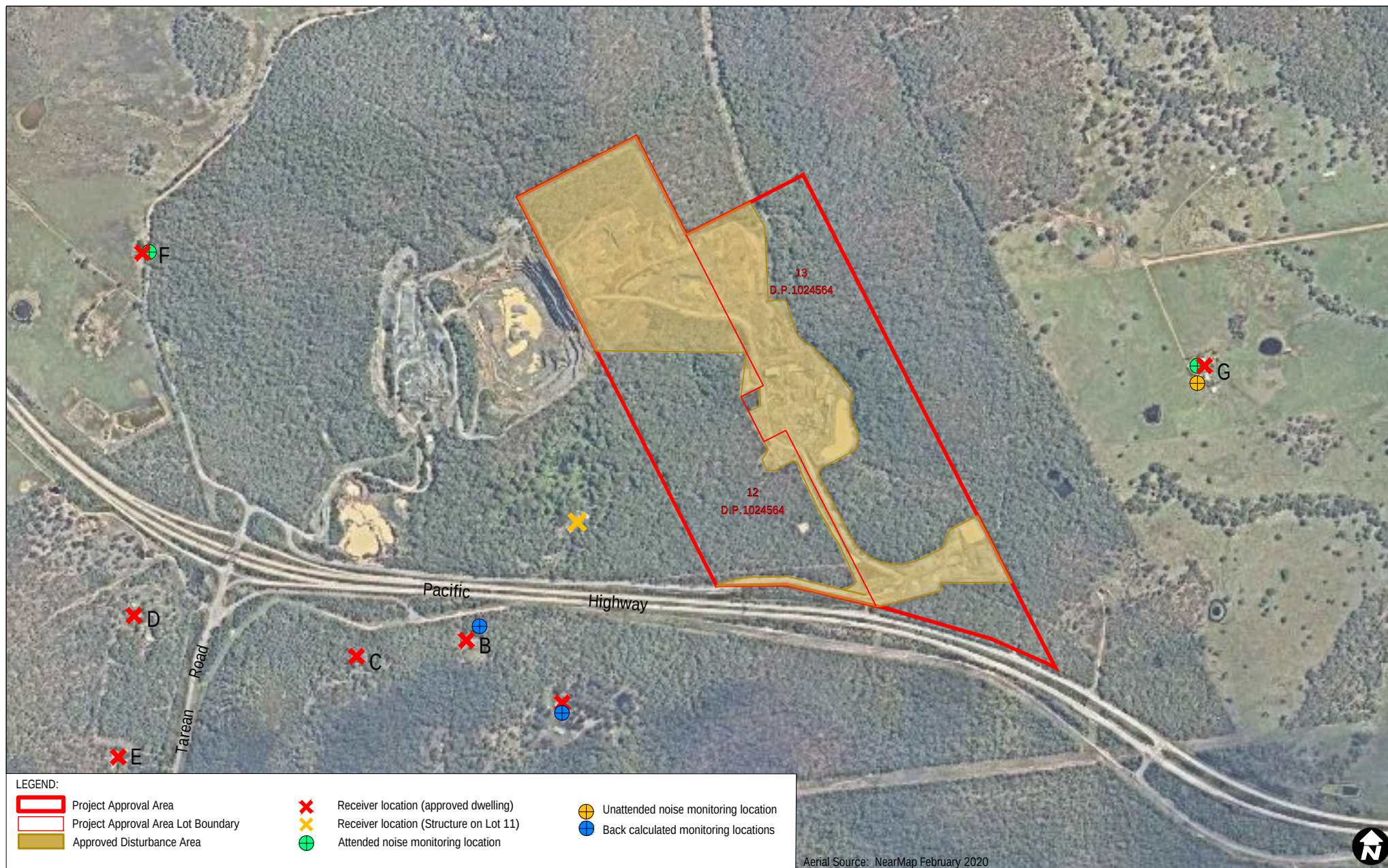


- LEGEND:
- Project Approval Area
 - Project Approval Area Lot Boundary
 - Disturbance Area
 - Receiver location (approved dwelling)
 - Receiver location (Structure on Lot 11)
 - Blast monitoring location

Aerial Source: NearMap February 2020

Scale: 1:12500
(GDA94) MGA Zone 56

17.03.2020
630.11235



LEGEND:

Project Approval Area

Project Approval Area Lot Boundary

Approved Disturbance Area

✕ Receiver location (approved dwelling)

✕ Receiver location (Structure on Lot 11)

⊕ Attended noise monitoring location

⊕ Unattended noise monitoring location

⊕ Back calculated monitoring locations

Aerial Source: NearMap February 2020

Scale: 1:12500
(GDA94) MGA Zone 56

17.03.2020
630.11235

APPENDIX 4 – Noise Monitoring Reports



KARUAH EAST QUARRY

Quarterly Noise Monitoring

February 2021

1. INTRODUCTION

This report summarises the quarterly noise monitoring at Karuah East Quarry completed to meet the requirements of Section 66(6) of the Protection of the Environment Operations Act 1997 and the NSW Environmental Protection Authority's Requirements for Publishing Pollution Monitoring Data (October 2013). Included is the required monitoring data under Environmental Protection License (EPL) 20611, Project Approval 09_0175 and the approved Statement of Commitments for the Karuah East Quarry.

Table 1 – Licence Information

Environmental Protection License Number	20611
Licensee's Name	Karuah East Quarry Pty Ltd
Licensee's Address	Postal Address: PO Box 3284 Thornton NSW 2322 Quarry Location: Lot 12 DPI024564 Pacific Highway Karuah NSW 2324

The monitoring was conducted as per Schedule 3 Condition 3 of the Project Approval and Condition L4.1 of the EPL to ensure the noise generated by the quarry operations does not exceed the criteria outlined in Table 2.

The report has been prepared in accordance with the requirements of the NSW Noise Policy for Industry (2017).

Table 2 – Operational Noise Criteria (dBA LA_{eq(15min)})

LOCATION	CRITERIA (DAY ¹)
RESIDENCE ON LOT 11 DP 10244564	43
A	40
B	37
G	38
ALL OTHER RESIDENCE	35

Note 1: Day period defined as Monday to Saturday 7am to 6pm, Sunday and Public Holidays 8am to 6pm

The quarry is operational with no construction activities being completed. As such construction noise is not being considered.

The noise monitoring has been completed in accordance with the Noise Management Plan (SLR, 2015) and EPL 20611 Date 25 June 2019. A summary of requirements is presented in Table 3.

Table 3 – Operational Noise Monitoring Program

MONITORING METHOD	LOCATION	FREQUENCY	CRITERIA
Unattended Noise Monitoring	G	Quarterly	As Per Table 10,12,13 of the Noise Management Plan (SLR, 2015)
Attended Noise Monitoring	A		As Per EPL 20611
Attended Noise Monitoring	B		As Per EPL 20611
Attended Noise Monitoring	F		As Per Table 10,12,13 of the Noise Management Plan (SLR, 2015)
Attended Noise Monitoring	G		As Per Table 10,12,13 of the Noise Management Plan (SLR, 2015) and EPL 20611



Figure 1 – Noise Monitoring Locations

2. OPERATOR ATTENDED MONITORING RESULTS

Results are presented in Table 4. Ambient noise levels in the table include all sources such as traffic, insects, birds, Karuah Quarry and Karuah East Quarry.

Quarry contributions listed are noted only when a contribution could be quantified.

Table 4 – Attended Noise Monitoring Results

LOCATION	DATE START TIME WEATHER	L _{AMAX}	L _{A1}	L _{A10}	L _{A90}	L _{AEQ}	DESCRIPTION OF NOISE AND TYPICAL MAXIMUM NOISE LEVELS (DBA)
A	23/02/2021 10:23 am Calm	85	60	57	52	55	Birds 50 - 55 Pacific Highway 55 Karuah East Quarry Inaudible
B	23/02/2021 10:53 am Calm	86	71	67	59	64	Pacific Highway 60 - 65 Karuah East Quarry Inaudible
F	23/02/2021 11:28 am Calm	88	53	57	53	56	Birds and Insects 40 Local Traffic 65 Pacific Highway 55 Karuah East Quarry Inaudible
G	23/02/2021 12:07 pm Calm	75	57	56	50	54	Birds and Insects 40 - 55 Pacific Highway 50 Karuah East Quarry Inaudible

3. OPERATING EQUIPMENT

The nominal equipment operating on the day of attended monitoring was noted as:

- Volvo Loader L180 #2
- Volvo Loader L220
- Komatsu Loader WA470 (hired)
- Volvo Excavator EC750
- Komatsu HM400 (I) – Dump truck (hired)
- Cat 740 B – Dump truck
- HD465 – Komatsu dump truck
- Volvo A40F – Dump truck
- Volvo A40F – Dump truck (hired)
- Isuzu watercart
- Gen set 1 (control room)
- Gen set 2 (secondary plant)
- Gen set 3 (secondary plant)
- Primary crushing plant
- Secondary crushing plant

4. UNATTENDED NOISE MONITORING

Table 5 – Unattended Noise Monitoring Results

INP PERIOD	L _{A1}	L _{A10}	L _{A90}	L _{AEQ}
DAY	59	54	48	53
EVENING	62	59	52	57
NIGHT	58	56	50	54

5. EQUIPMENT DETAILS

	Serial Number	Microphone and Preamp Serial Number	Calibration Date	Calibration Expiry
NTI XL2-TA	A2A-14797-E0	A15893 / 7656	20/11/2019	19/11/2021
Precision Calibrator CAL200	15642		20/11/2019	19/11/2021

6. SUMMARY

The attended noise monitoring conducted during February 2021 identified that Karuah East Quarry was not audible at location A, B, F and G. Karuah East Quarry is determined to be compliant for the monitoring completed in February 2021.



KARUAH EAST QUARRY

Quarterly Noise Monitoring

April 2021

1. INTRODUCTION

This report summarises the quarterly noise monitoring at Karuah East Quarry completed to meet the requirements of Section 66(6) of the Protection of the Environment Operations Act 1997 and the NSW Environmental Protection Authority's Requirements for Publishing Pollution Monitoring Data (October 2013). Included is the required monitoring data under Environmental Protection License (EPL) 20611, Project Approval 09_0175 and the approved Statement of Commitments for the Karuah East Quarry.

Table 1 – Licence Information

Environmental Protection License Number	20611
Licensee's Name	Karuah East Quarry Pty Ltd
Licensee's Address	Postal Address: PO Box 3284 Thornton NSW 2322 Quarry Location: Lot 12 DPI024564 Pacific Highway Karuah NSW 2324

The monitoring was conducted as per Schedule 3 Condition 3 of the Project Approval and Condition L4.1 of the EPL to ensure the noise generated by the quarry operations does not exceed the criteria outlined in Table 2.

The report has been prepared in accordance with the requirements of the NSW Noise Policy for Industry (2017).

Table 2 – Operational Noise Criteria (dBA LA_{eq(15min)})

LOCATION	CRITERIA (DAY ¹)
RESIDENCE ON LOT 11 DP 10244564	43
A	40
B	37
G	38
ALL OTHER RESIDENCE	35

Note 1: Day period defined as Monday to Saturday 7am to 6pm, Sunday and Public Holidays 8am to 6pm

The quarry is operational with no construction activities being completed. As such construction noise is not being considered.

The noise monitoring has been completed in accordance with the Noise Management Plan (SLR, 2015) and EPL 20611 Date 25 June 2019. A summary of requirements is presented in Table 3.

Table 3 – Operational Noise Monitoring Program

MONITORING METHOD	LOCATION	FREQUENCY	CRITERIA
Unattended Noise Monitoring	G	Quarterly	As Per Table 10,12,13 of the Noise Management Plan (SLR, 2015)
Attended Noise Monitoring	A		As Per EPL 20611
Attended Noise Monitoring	B		As Per EPL 20611
Attended Noise Monitoring	F		As Per Table 10,12,13 of the Noise Management Plan (SLR, 2015)
Attended Noise Monitoring	G		As Per Table 10,12,13 of the Noise Management Plan (SLR, 2015) and EPL 20611



Figure 1 – Noise Monitoring Locations

2. OPERATOR ATTENDED MONITORING RESULTS

Results are presented in Table 4. Ambient noise levels in the table include all sources such as traffic, insects, birds, Karuah Quarry and Karuah East Quarry.

Quarry contributions listed are noted only when a contribution could be quantified.

Table 4 – Attended Noise Monitoring Results

LOCATION	DATE START TIME WEATHER	L _{AMAX}	L _{A1}	L _{A10}	L _{A90}	L _{AEQ}	DESCRIPTION OF NOISE AND TYPICAL MAXIMUM NOISE LEVELS (DBA)
A	06/05/2021 14:00 pm Wind 20 kph	85	60	59	56	58	Wind Noise 50 – 60 Motorbike 50 – 55 Pacific Highway 45 - 55 Karuah East Quarry Inaudible
B	06/05/2021 15:05 pm Wind 20 kph	87	71	67	60	64	Pacific Highway 55 - 65 Birds 40 – 45 Karuah East Quarry Inaudible
F	06/05/2021 13:20 pm Wind 20 kph	85	59	57	54	56	Wind Noise 50 – 55 Insects 40 - 45 Karuah East Quarry Inaudible
G	06/05/2021 09:50 am Wind 20 kph	68	49	47	46	47	Wind Noise 40 – 45 Insects 40 - 45 Birds 35 - 40 Karuah East Quarry Inaudible

3. OPERATING EQUIPMENT

Equipment operating on the day of attended monitoring was noted as:

- Volvo Loader L180 #2
- Volvo Loader L220
- Komatsu Loader WA470 (hired)
- Volvo Excavator EC750
- Komatsu HM400 (I) – Dump truck (hired)
- Cat 740 B – Dump truck
- HD465 – Komatsu dump truck
- Volvo A40F – Dump truck
- Volvo A40F – Dump truck (hired)
- Isuzu watercart
- Gen set 1 (control room)
- Gen set 2 (secondary plant)
- Gen set 3 (secondary plant)
- Primary crushing plant
- Secondary crushing plant

4. UNATTENDED NOISE MONITORING

Table 5 – Unattended Noise Monitoring Results

INP PERIOD	L _{A1}	L _{A10}	L _{A90}	L _{AEQ}
DAY	63	57	52	58
EVENING	65	63	55	57
NIGHT	57	55	51	50

5. EQUIPMENT DETAILS

	Serial Number	Microphone and Preamp Serial Number	Calibration Date	Calibration Expiry
NTI XL2-TA	A2A-14797-E0	A15893 / 7656	20/11/2019	19/11/2021
Precision Calibrator CAL200	15642		20/11/2019	19/11/2021

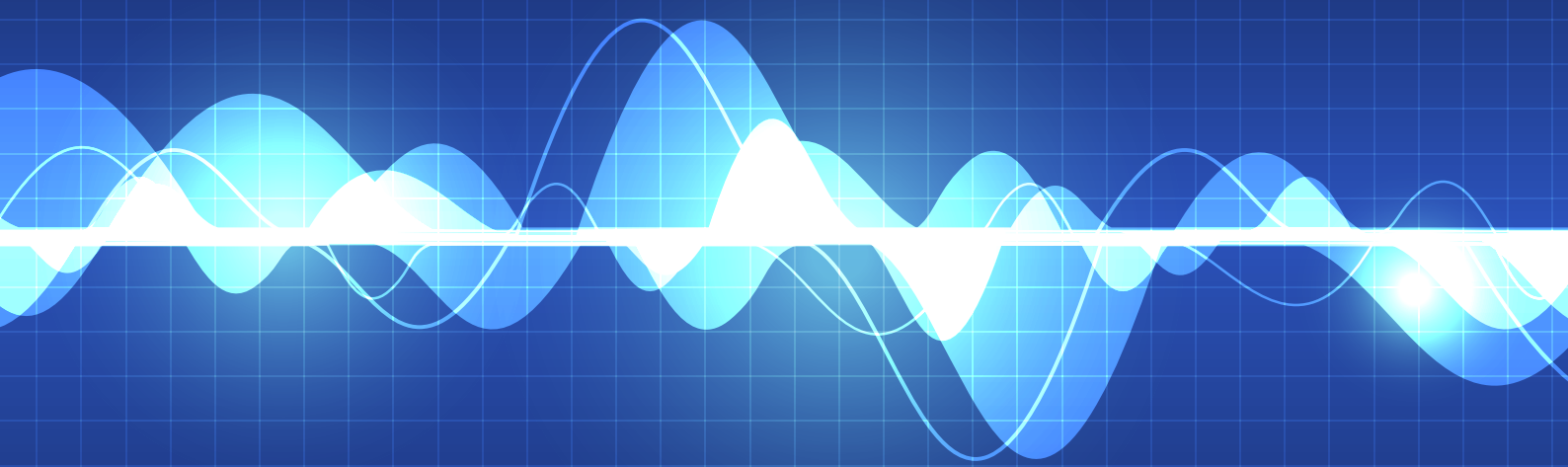
6. SUMMARY

The attended noise monitoring conducted during April 2021 identified that Karuah East Quarry was not audible at location A, B, F and G. Karuah East Quarry is determined to be compliant for the monitoring completed in April 2021.

Karuah East Quarry

EPL quarterly attended noise monitoring
Quarter 3 - 2021

Prepared for Hunter Quarries Pty Limited
September 2021





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Karuah East Quarry

Quarterly attended noise monitoring - Q3 2021

Report Number

E210782 RP#1

Client

Hunter Quarries Pty Limited

Date

30 September 2021

Version

v1-0 Final

Prepared by



Lucas Adamson

Senior Acoustic Consultant

30 September 2021

Approved by



Katie Teyhan

Associate

30 September 2021

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

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1 Introduction

EMM Consulting Pty Limited (EMM) was engaged to undertake noise compliance monitoring on behalf of Hunter Quarries Pty Limited (Hunter Quarries).

Noise compliance monitoring is required to be undertaken in accordance with the *Karuah East Quarry Project Noise Management Plan* (NMP) which has been prepared to meet the relevant requirements of Department of Planning and Environment (DPE), Project Approval PA 09_0175, as modified in December 2020 (current as of 31 August 2021) and Environment Protection Authority (EPA) Environment Protection Licence (EPL) 20611 as varied on 18 July 2019 (current as of 31 August 2021).

The Noise Policy for Industry (NPfI) (EPA 2017) has also been referenced as part of this assessment.

This report presents the results and findings of attended noise monitoring conducted on 31 August 2021.

Several technical terms are discussed in this report. These are explained in the Glossary.

2 Noise limits and monitoring requirements

2.1 Noise limits

Karuah East Quarry noise limits are provided in Table 2, Condition 3 of PA 09_0175 and Condition L4.1 of EPL 20611. Extracts of the relevant sections of PA 09_0175 and EPL 20611 pertaining to noise are provided in Appendix A and B, respectively. The approved NMP adopts four attended noise monitoring locations that are representative of residences outlined in the PA 09_0175 and EPL 20611. The noise monitoring locations and relevant criteria from the PA 09_0175, EPL 20611 and NMP are summarised in Table 2.1.

Table 2.1 Noise limits

Monitoring location	Location description	EPL	PA
		Day $L_{Aeq,15\text{ minute}}$, dB	Day $L_{Aeq,15\text{ minute}}$, dB
A	Residence A on Lot 100 DP 785172	40	42
B	Residence B on Lot 3 DP 785172	37	40
G	Residence G on Lot 1 DP 1032636	38	43
H	Residence H on Lot 10 DP 1032636	Not specified	45
Any approved residence on Lot 11 DP 1024564		43	Not Specified
Any other residence or sensitive receiver not subject to a private negotiated agreement		35	40

Condition L4.4 of EPL 20611 states that the noise measurement equipment must be located:

- within 30 metres of a dwelling façade, but not closer than 3 metres, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises;
- approximately on the property, where any dwelling is situated 30 metres or less from the property boundary closest to the premises;
- at the most affected point at a location where there is no dwelling at the location; and
- within approximately 50 metres of the boundary of a National Park or Nature Reserve.

2.2 Meteorological conditions

PA 09_0175 specifies that noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Noise Policy for Industry. This is consistent with the requirements of Condition L4.3 of EPL 20611 which states that noise limits do not apply under the following meteorological conditions:

- wind speeds greater than 3 m/s at 10 m above ground level;

- stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 m above ground level; or
- stability category G temperature inversion conditions.

2.3 Modifying factors

2.3.1 Low frequency noise criteria

Condition L4.5 of EPL 20611 requires that the modifying factor adjustments outlined in Fact Sheet C of the NPfI (EPA 2017) are to be used when assessing the characteristics of a noise source (eg low frequency noise).

Fact sheet C of the NPfI provides guidelines for applying modifying factor corrections to account for low frequency noise (LFN) emissions. The NPfI specifies that a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels identifies the potential for an unbalanced spectrum and potential increased annoyance.

Where a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels is identified, the one-third octave noise levels recorded should be compared to the values (ie threshold levels) in Table C2 of the NPfI, which has been reproduced in Table 2.2.

Table 2.2 One-third octave LFN threshold levels

One-third octave $L_{Zeq,15\text{ minute}}$ threshold levels													
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB (Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The following modifying factor correction is to be applied where the site 'C-weighted' and site 'A-weighted' noise emission level is 15 dB or more, and:

- where any of the one-third octave noise levels in Table 3.2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period; or
- where any of the one-third octave noise levels in Table 3.2 are exceeded by more than 5 dB and cannot be mitigated, a 2 dB positive adjustment to measured/predicted A-weighted levels applies for the daytime period and a 5 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period.

Hence, where possible throughout each survey the operator has estimated the difference between site 'C-weighted' and site 'A-weighted' noise emission levels by matching audible sounds with the response of the sound analyser ($L_{Ceq}-L_{Aeq}$). Where this was deemed to be 15 dB or greater, the measured one-third octave centre frequency levels have been compared to the values in Table 2.2 to identify the relevant modifying factor correction (if applicable). This method has been applied to this assessment as presented in Section 5.

It is of note that the NPfI states that LFN corrections only apply under the standard or noise-enhancing meteorological conditions. In this case, the standard or noise-enhancing meteorological conditions are the same as those under which the noise limits are applicable.

2.3.2 Tonal noise

Tonal noise is defined in the NPfl as noise containing a prominent frequency and characterised by a definite pitch. Examples of tonal noise sources include ventilation fans, reversing beepers or alarms. It is of note that Karuah East Quarry uses broadband reversing alarms instead of beeping alarms. Fact sheet C of the NPfl provides guidelines for applying modifying factor corrections to account for tonal noise emissions.

The NPfl specifies that a 5 dB positive adjustment to measured/predicted A-weighted levels applies if the level of one-third octave band centre frequency (measured using unweighted or Z-weighted weighting) exceeds the level of the adjacent band on both sides by:

- 5 dB or more if the centre frequency of the band containing the tone is in the range 500-10,000 Hz; or
- 8 dB or more if the centre frequency of the band containing the tone is in the range 160-400 Hz; or
- 15 dB or more if the centre frequency of the band containing the tone is in the range 25-125 Hz.

Quarry noise experienced at the nearest residences is relatively continuous (e.g. quarry hum). Field observations during the noise compliance monitoring, and the measured one-third octave noise levels from 25 Hz to 12 kHz, confirm that site noise is not tonal in nature at any of the monitoring locations. Hence, adjustments to measured levels are not required for tonality.

2.4 Noise monitoring methodology requirements

Condition M8.1 of the EPL states that noise generated by Karuah East Quarry is to be measured in accordance with a number of requirements. An extract of the requirements outlined in Condition M8.1 is provided here.

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:

- a) during a period of normal quarry operations;
- b) at each one of the locations listed in the noise limits table of this licence;
- c) occur quarterly in the reporting period;
- d) occur during each day period as defined in the NSW Noise Policy for Industry.

2.5 Unattended noise monitoring

Section 8.4 of the NMP states that unattended noise monitoring will be undertaken each quarter to quantify overall ambient noise levels in the vicinity of location G (see Figure 4.1). An extract of the requirements outlined in Section 8.4 of the NMP is provided here.

In order to supplement the operator-attended measurements, unattended continuous noise monitoring shall be conducted at Locations G, for a minimum period of seven (7) days per quarter during operations, to quantify overall ambient noise amenity levels resulting from quarrying, road traffic and other environmental noise sources.

...

Unattended noise monitoring will be conducted initially on a quarterly basis. The frequency of monitoring will be reviewed after the first 12 months of operations in order to determine future requirements.

EMM has undertaken an analysis of the quarterly unattended noise monitoring data to identify any trends captured during the noise monitoring events and to review the suitability of the unattended noise monitoring program. This is further explained in Section 4.2 of this report.

3 Assessment methodology

3.1 Attended noise monitoring

To quantify noise emissions from Karuah East Quarry, 15-minute attended noise monitoring surveys were completed at representative monitoring locations with reference to the sites approved NMP.

The attended noise monitoring locations, as per the sites approved NMP, and their coordinates are listed in Table 3.1 and are shown in Figure 3.1.

Table 3.1 **Attended noise monitoring locations**

Monitoring location	Location description	Coordinates (MGA56)	
		Easting	Northing
A	74 Mill Hill Close, Karuah	406623	6388704
B	64 Mill Hill Close, Karuah	406405	6388859
G	2 Halloran Road, North Arm Cove	405629	6389766
F	1714 The Branch Lane, Karuah	408154	6385923

3.2 Instrumentation

A Brüel & Kjær (B&K) 2250 Type 1 sound analyser (s/n 2759405) was used to conduct 15-minute attended measurements and record 1/3 octave centre frequency and statistical noise indices. The sound analyser was calibrated before and on completion of the survey using a Svantek SV36 calibrator (s/n 79952). The instruments were within their NATA laboratory calibration period during the time of these readings and certificates are provided in Appendix C.

Where possible throughout each survey, the operator quantified the contribution of each significant noise source. This was done by matching audible sounds with the response of the sound analyser (where applicable) and/or via post-analysis of recorded noise data.

3.3 Weather and operating conditions

The meteorological data was obtained from the Karuah East Quarry on-site weather station. Communications with the site operator and observations made during the attended measurements confirmed that the site was operating as normal during the noise surveys.



- KEY**
- Site boundary
 - A Attended noise monitoring location
 - Approved disturbance area
 - Major road
 - Minor road
 - Vehicular track
 - Watercourse/drainage line
 - Cadastral boundary
 - Waterbody
 - NPWS reserve
 - State forest

Attended noise monitoring locations

Karuah East Quarry
Quarterly attended noise monitoring
Figure 4.1

4 Review of data and discussion

4.1 Summary

The results of EMM's attended noise measurements are summarised in Table 4.1. Karuah East Quarry's noise contribution was determined using in-field observations and post-analysis of recorded data as required. Attended noise monitoring was completed on 31 August 2021.

The meteorological data for the monitoring period was sourced from the Karuah East Quarry on-site weather station to determine applicability of criteria in accordance with the EPL and PA. In accordance with the EPL and PA, noise limits were applicable during all four measurements.

Low frequency noise was conservatively assessed by comparison of the site measured one-third octave L_{Aeq} noise levels to the NPfI one-third octave low-frequency noise thresholds. Measured noise levels did not exceed the relevant LFN thresholds during any of the measurements. Therefore, in accordance with the NPfI, LFN modifying factors were not applied to estimated site noise levels at any of the monitoring locations. Graphs of the total linear noise levels measured in one-third octave frequency bands are presented in Appendix D.

Karuah East Quarry noise contributions and cumulative quarry noise contributions were below (i.e. complied with) the relevant noise limits at all monitoring locations.

Table 4.1 Karuah East Quarry attended noise monitoring results – Q3 2021

Location	Date	Start time (Period)	Total noise levels, dB							Site contribution, dB	EPL / PA Limits, dB	Meteorological conditions ² EPL limits apply (Y/N)	Exceedance, dB	Comments	
			L _{Amin}	L _{A90}	L _{Aeq}	L _{A10}	L _{A1}	L _{Amax}	L _{Ceq}	LFN mod. Factor ¹	L _{Aeq}				L _{Aeq}
A	31/8	10:36	39	45	50	53	55	62	65	Nil	IA	40 / 42	1.2 m/s @ 359° A stability class Y	Nil	Karuah East Quarry inaudible. Traffic on the Pacific Highway and bird noise consistently audible.
B	31/8	10:55	42	52	61	66	69	74	70	Nil	IA	37 / 40	1.4 m/s @ 0° A stability class Y	Nil	Karuah East Quarry inaudible. Traffic on the Pacific Highway and bird noise consistently audible. Karuah Quarry occasionally audible (37 dB L _{Aeq,15 minute}).
F	31/8	11:13	36	41	47	49	54	70	59	Nil	IA	35 / 40	1.0 m/s @ 41° A stability class Y	Nil	Karuah East Quarry inaudible. Distant traffic on the Pacific Highway and bird noise consistently audible. Wind in foliage occasionally audible.
G	31/8	11:37	33	35	43	46	54	60	63	Nil	37	38 / 43	1.4 m/s @ 314° A stability class Y	Nil	Karuah East Quarry engine revs and processing plant consistently audible with alarms and bangs on occasion. Distant traffic on the Pacific Highway and bird noise consistently audible. Aircraft noise, dogs barking and wind in foliage occasionally audible.

Notes: 1. Modifying factor correction for LFN in accordance with Fact sheet C of the NPfI.
2. Meteorological data were taken as an average over 15 minutes from the Karuah East Quarry on-site weather station (Refer to Section 5.1).
3. IA = inaudible.
4. N/A = not applicable.

4.2 Unattended noise monitoring data review

A review of the historical unattended noise monitoring data, supplied by Hunter Quarries, has been completed. These quarterly unattended noise monitoring results have been summarised in Table 4.2.

Table 4.2 Unattended noise monitoring data

Quarter	Period	Measured noise levels, dB			
		L _{A90}	L _{Aeq}	L _{A10}	L _{A1}
Q2 2020 June 2020	Day	37	54	51	61
	Evening	37	48	51	55
	Night	34	45	48	52
Q4 2020 November 2020	Day	41	49	49	56
	Evening	41	48	50	57
	Night	37	46	48	52
Q1 2021 February 2021	Day	48	53	54	59
	Evening	52	57	59	62
	Night	50	54	56	58
Q2 2021 April 2021	Day	52	58	57	63
	Evening	55	57	63	65
	Night	51	50	55	57

Observations during the operator attended measurements suggest that the main sources of noise at the unattended noise monitoring location are Karuah East Quarry operations (during the day period only) and road traffic noise from the Pacific Highway (particularly during peak traffic periods), with bird noise and aircraft noise also noted to be audible.

Given that the evening period L_{A90} noise levels (when Karuah East Quarry is not operational) were measured to be at or above the day period L_{A90} noise levels during all of the monitoring events, it is likely that road traffic noise from the Pacific Highway is the main contributor to measured ambient noise levels at the unattended noise monitoring location.

A review of the historical unattended noise monitoring data has found no evident trends associated with Karuah East Quarry operations. Without an operator present to discern the noise sources contributing to the measured noise levels, it is difficult to establish any meaningful conclusions or trends from the historical unattended noise monitoring data.

As a result of this review, the Karuah East Quarry has decided to cease the unattended noise monitoring component of the quarterly compliance noise monitoring program.

5 Conclusion

EMM has completed a review of operational noise from Karuah East Quarry within the surrounding community based on attended measurements conducted on 31 August 2021.

The meteorological data for the monitoring period was sourced from the Karuah East Quarry on-site weather station to determine applicability of criteria in accordance with the EPL. In accordance with the EPL, noise limits were applicable during all four measurements.

The assessment of noise contributions from site included consideration of modifying factors for noise characteristics where relevant and in accordance with the NPfI.

Karuah East Quarry noise contributions were below (satisfied) the noise limits at all monitoring locations for this round of monitoring.

A review of the historical unattended noise monitoring data found no evident trends associated with Karuah East Quarry operations. As a result, Karuah East Quarry has decided to cease the unattended noise monitoring component of the quarterly compliance noise monitoring program.

Glossary

Several technical terms are discussed in this report. These are explained in Table G.1.

Table G.1 **Glossary of acoustic terms**

Term	Description
dB	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
L _{A1}	The 'A-weighted' noise level which is exceeded 1% of the time.
L _{A1,1minute}	The 'A-weighted' noise level exceeded for 1% of the specified time period of 1 minute.
L _{A10}	The 'A-weighted' noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise level.
L _{A90}	Commonly referred to as the background noise level. The 'A-weighted' noise level exceeded 90% of the time.
L _{Aeq}	The energy average noise from a source. This is the equivalent continuous 'A-weighted' sound pressure level over a given period. The L _{Aeq,15 minute} descriptor refers to an L _{Aeq} noise level measured over a 15 minute period.
L _{Amin}	The minimum 'A-weighted' noise level received during a measuring interval.
L _{Amax}	The maximum root mean squared 'A-weighted' sound pressure level (or maximum noise level) received during a measuring interval.
L _{Ceq}	The equivalent continuous 'C-weighted' sound pressure level over a given period. The L _{Ceq,15 minute} descriptor refers to an L _{Ceq} noise level measured over a 15 minute period. C-weighting can be used to measure low frequency noise.
Day period	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
Evening period	Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
Night period	Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 8 am.
Temperature Inversion	A meteorological condition where the atmospheric temperature increases with altitude.

It is useful to have an appreciation of the decibel (dB), the unit of noise measurement. Table G.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure G.1.

Table G.2 Perceived change in noise level

Change in sound pressure level (dB)	Perceived change in noise
up to 2	not perceptible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

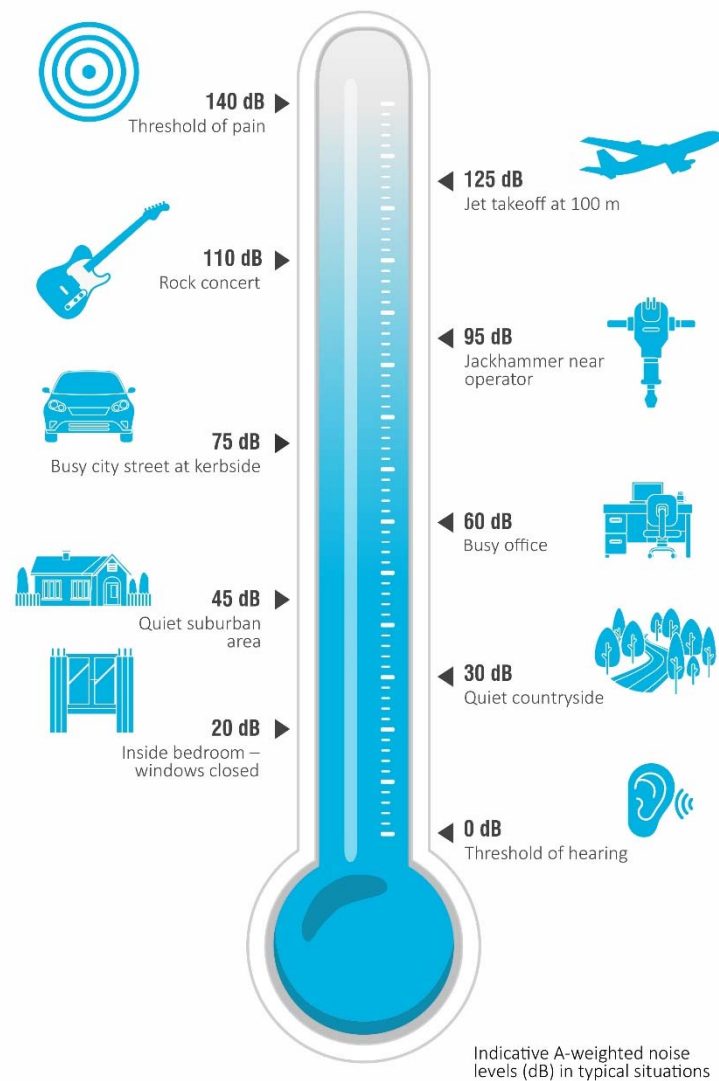


Figure G.1 Common noise levels

References

Department of Planning and Environment (DPE), Project Approval PA 09_0175, 2020.

Environment Protection Authority, Environment Protection Licence 20611, 2019.

Environment Protection Authority, Industrial Noise Policy Application notes, 2013.

Environment Protection Authority, Industrial Noise Policy, 2000.

Environment Protection Authority, Noise Policy for Industry, 2017.

SLR Consulting, Karuah East Quarry Project Noise Management Plan, 2015.

Appendix A

Project approval extract

SCHEDULE 3 ENVIRONMENTAL PERFORMANCE CONDITIONS

IDENTIFICATION OF APPROVED LIMITS OF EXTRACTION

1. The Applicant 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 Applicant 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. Except for the carrying out of construction works, the Applicant must ensure that the operational noise generated by the development does not exceed the criteria in Table 2 at any residence^a on privately-owned land.

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

Residence (Noise Assessment Location) ^a	Criteria (Day)
A	42
G	43
H	45
All other residences	40

^a The Residences (Noise Assessment Locations) referred to in Table 2 are shown in Appendix 2.

Noise generated by the development must be monitored and measured in accordance with the relevant procedures and modifications (including certain meteorological conditions) of the NPfI.

- 3A. The noise criteria in Table 2 do not apply if the Applicant has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and the Applicant has advised the Department in writing of the terms of this agreement.

Road Traffic Noise Criteria

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

Table 3: Road traffic noise criteria

Road	Criteria (Day ^a)
Pacific Highway	60 dB(A) L _{Aeq} (15 hour)
Local roads	55 dB(A) L _{Aeq} (1 hour)

^a Day is the period from 7 am to 10 pm every day in accordance with the EPA's NSW Road Noise Policy (2011).

5. Deleted

Noise Operating Conditions

6. The Applicant must:
 - (a) take all reasonable steps to minimise noise from construction and operational activities, including low frequency noise and other audible characteristics, associated with the development;
 - (b) implement reasonable and feasible noise attenuation measures on all plant and equipment that will operate in noise sensitive areas;
 - (c) operate a comprehensive noise management system commensurate with the risk of impact;
 - (d) take all reasonable steps to minimise the noise impacts of the development during noise-enhancing meteorological conditions when the noise criteria in this consent do not apply (see NPfl);
 - (e) carry out quarterly attended noise monitoring (unless otherwise agreed by the Planning Secretary) to determine whether the development is complying with the relevant conditions of this consent; and
 - (f) regularly assess the noise monitoring data and modify or stop operations on the site to ensure compliance with the relevant conditions of this consent.

Noise Management Plan

7. The Applicant must prepare a Noise Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:
 - (a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;
 - (b) be prepared in consultation with the EPA;
 - (c) describe the measures to be implemented to ensure:
 - (i) compliance with the noise criteria and operating conditions in this consent;
 - (ii) best practice management is being employed;
 - (iii) noise impacts of the development are minimised during noise-enhancing meteorological conditions when the noise criteria in this consent do not apply (see NPfl);
 - (d) describe the noise management system in detail; and
 - (e) include a monitoring program that:
 - (i) is capable of evaluating the performance of the development;
 - (ii) monitors noise at the nearest and/or most affected residences;
 - (iii) adequately supports the noise management system;
 - (iv) includes a protocol for distinguishing noise emissions of the development from any neighbouring developments; and
 - (v) includes a protocol for identifying any noise-related exceedance, incident or non-compliance and for notifying the Department and relevant stakeholders of any such event.

- 7A. The Applicant must implement the plan as approved by the Planning Secretary.

BLASTING

Blasting Criteria

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

Appendix B

EPL extract

Environment Protection Licence

Licence - 20611



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.

L4 Noise limits

- 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 noise limits set out in the table above, the licensee must locate monitoring equipment:

- within 30 metres of a dwelling façade (but not closer than 3 metres) where any dwelling on the property is situated more than 30 metres from the property boundary that is closest to the premises;
- approximately on the boundary where any dwelling is situated 30 metres or less from the property boundary that is closest to the premises;
- at the most affected point at a location where there is no dwelling at the location; and
- within approximately 50 metres of the boundary of a national park or nature reserve.

Environment Protection Licence

Licence - 20611



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:

- 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.

L4.5 For the purposes of determining the noise generated at the premises the modification factors in Fact Sheet C of the EPA's "Noise Policy for Industry" must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

L5 Blasting

L5.1 Blasting in or on the premises must only be carried out between the hours of 9:00 am and 4:00 pm Monday to Friday. No blasting is permitted on 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:
a) 115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period; and
b) 120 dB (Lin Peak) at any time,
at monitoring point 11 detailed in Condition P1.4.

L5.4 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:
a) 5 mm/second for more than 5% of the total number of blasts during each reporting period; and
b) 10 mm/second at any time,
at monitoring point 11 detailed in Condition P1.4.

L5.5 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.

L5.6 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.

L5.7 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.*

Environment Protection Licence

Licence - 20611

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.

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:

- during a period of normal quarry operations;
- at each one of the locations listed in the noise limits table of this licence;
- occur quarterly in the reporting period;
- occur during each day period as defined in the NSW Noise Policy for Industry.

Note: The frequency of noise monitoring will be reviewed, upon request, after two years of quarterly monitoring (approximately June 2021).

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,

Appendix C

Calibration certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE No: **C28053**

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Svantek

Type No: SV-36

Serial No: 79952

Owner: EMM Consulting Pty Ltd
L3, 175 Scott Street
Newcastle, NSW 2300

Tests Performed: Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 µPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	94.13	1000.00	1.26
Level 2:	NA	N	114.04	1000.00	0.50
Uncertainty:			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

CONDITIONS OF TEST:

Ambient Pressure: 995 hPa ±1.5 hPa **Relative Humidity:** 57 % ±5%

Temperature: 24 °C ±2° C

Date of Calibration: 15/10/2020

Issue Date: 16/10/2020

Acu-Vib Test Procedure: AVP02 (Calibrators)

Test Method: AS IEC 60942 - 2017

CHECKED BY: *[Signature]* **AUTHORISED SIGNATURE:**

Hein Soe

Accredited for compliance with ISO/IEC 17025 – Calibration

Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.



Accredited Lab. 9262
Acoustic and Vibration
Measurements

ACU-VIB
ELECTRONICS

HEAD OFFICE

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 26291 & FILT 5615

Equipment Description: Sound Level Meter

Manufacturer: B & K

Model No: 2250 **Serial No:** 2759405

Microphone Type: 4189 **Serial No:** 2888134

Preamplifier Type: ZC0032 **Serial No:** 16037

Filter Type: 1/3 Octave **Serial No:** 2759405

Comments: All tests passed for class 1.
(See over for details)

Owner: EMM Consulting
Level 3, 175 Scott Street
Newcastle, NSW 2300

Ambient Pressure: 1007 hPa ± 1.5 hPa

Temperature: 24 °C $\pm 2^\circ$ C **Relative Humidity:** 53% $\pm 5\%$

Date of Calibration: 05/02/2020 **Issue Date:** 05/02/2020

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: JKB

AUTHORISED SIGNATURE:

Jack Kiehl

Accredited for compliance with ISO/IEC 17025 - Calibration

The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.



ACU-VIB

ELECTRONICS

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Accredited Lab. No. 9262
Acoustic and Vibration
Measurements

Page 1 of 2
AVCERT10 Rev. 1.3 15.05.18

Appendix D

Low Frequency Noise analysis

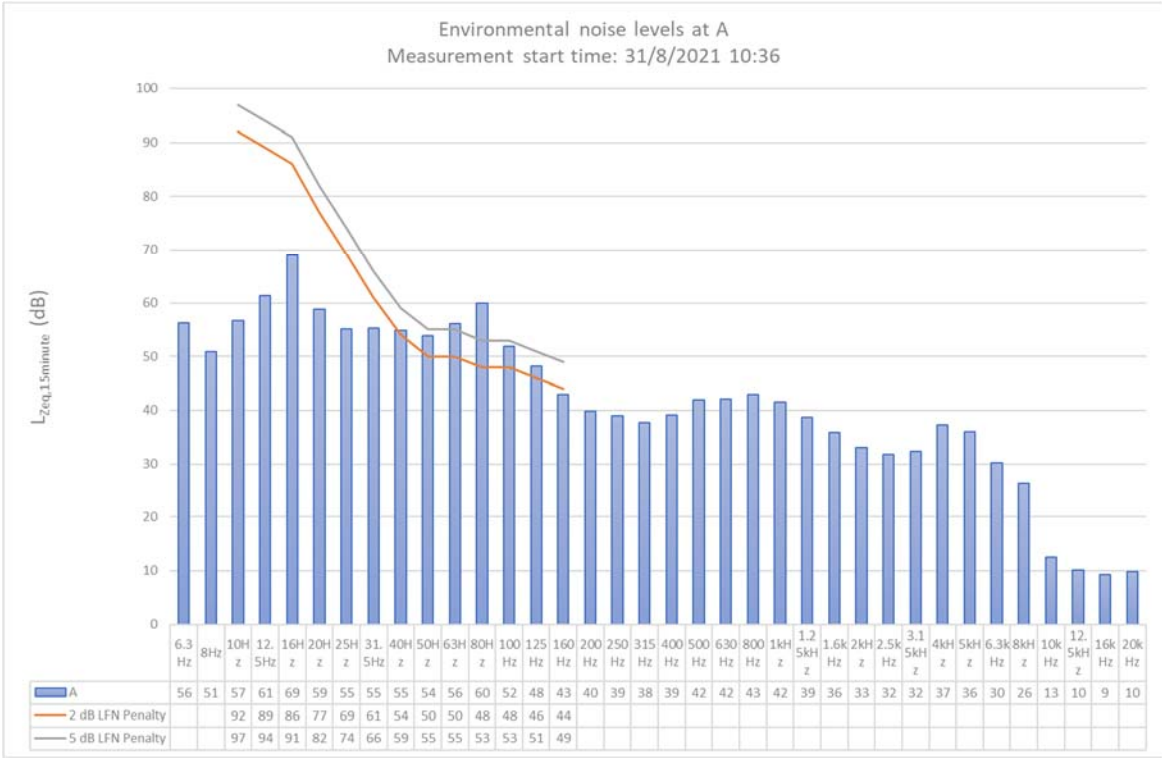


Figure D.1 Location A - Total measured one-third octave band frequencies

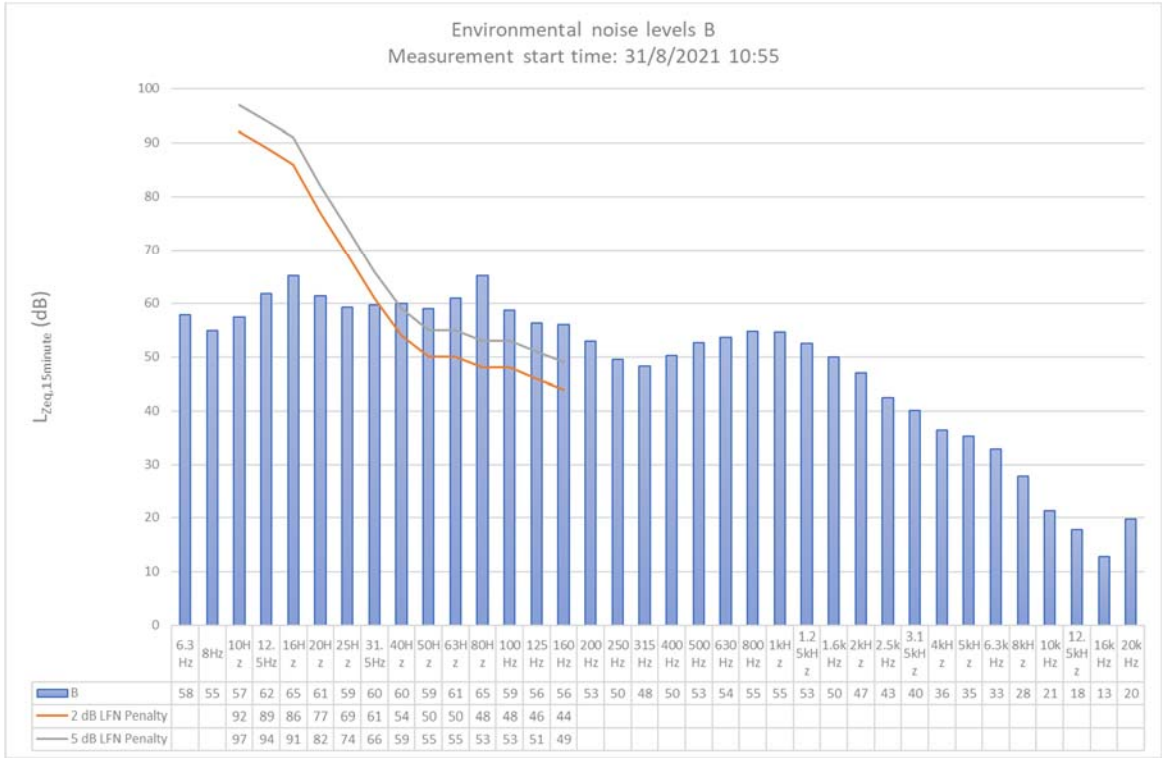


Figure D.2 Location B - Total measured one-third octave band frequencies

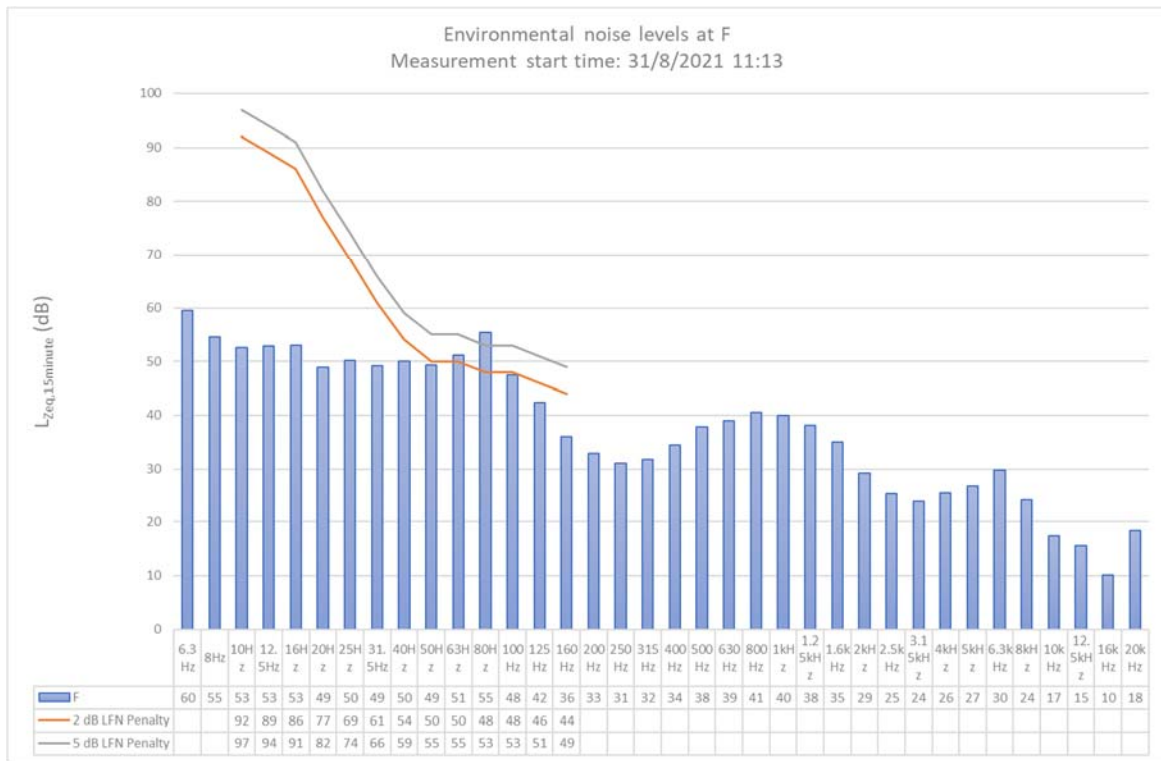


Figure D.3 Location F - Total measured one-third octave band frequencies

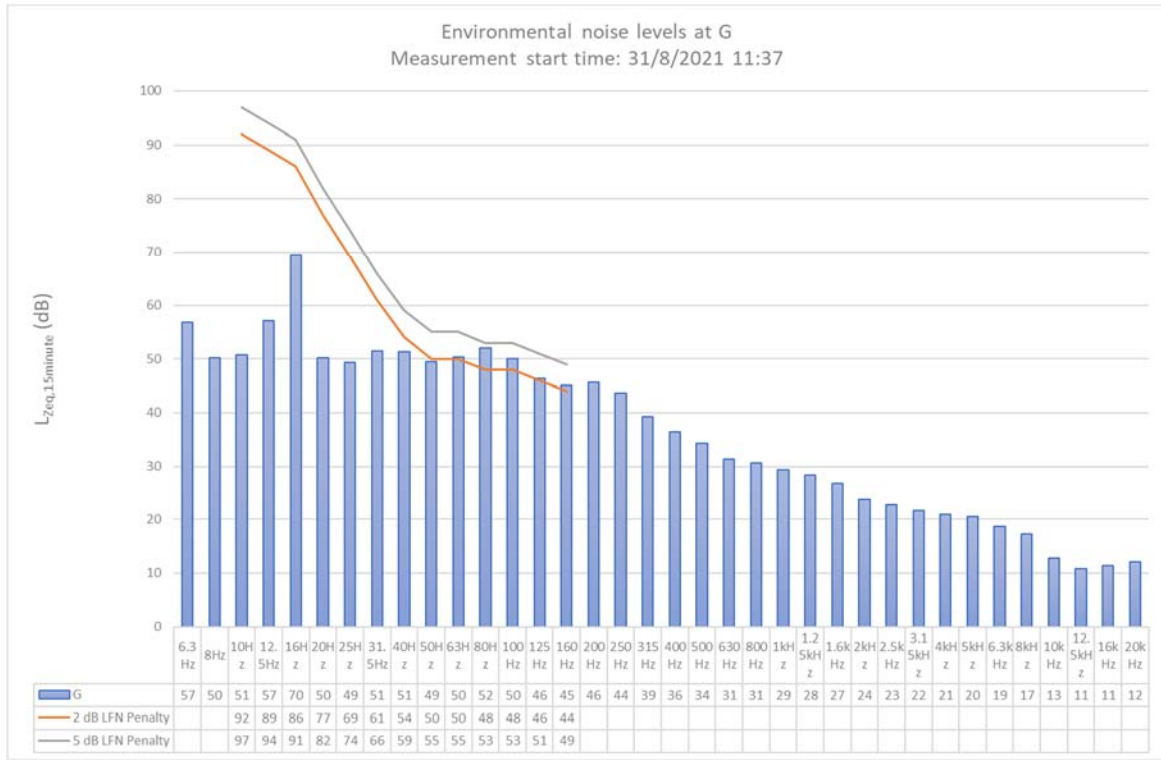
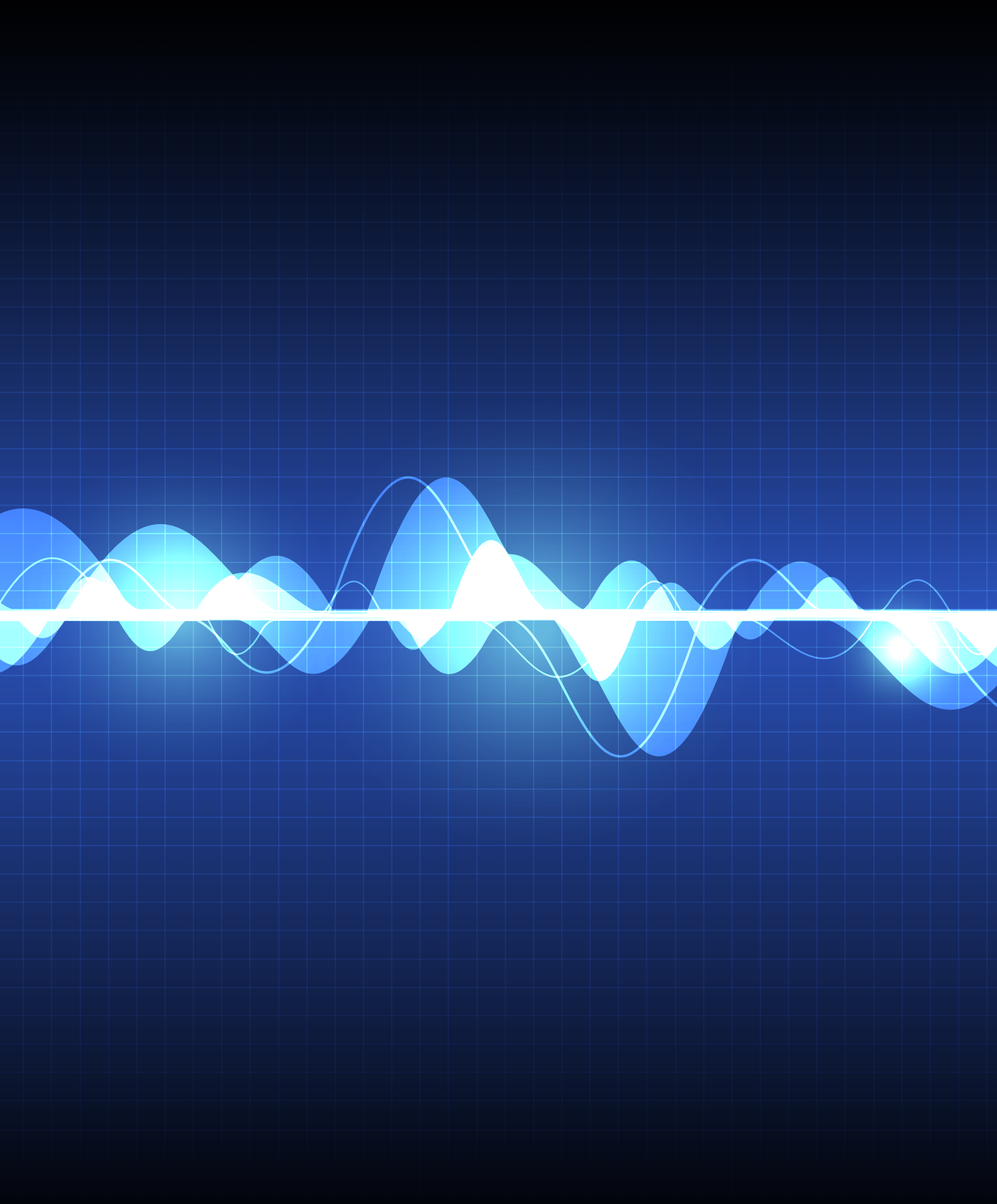


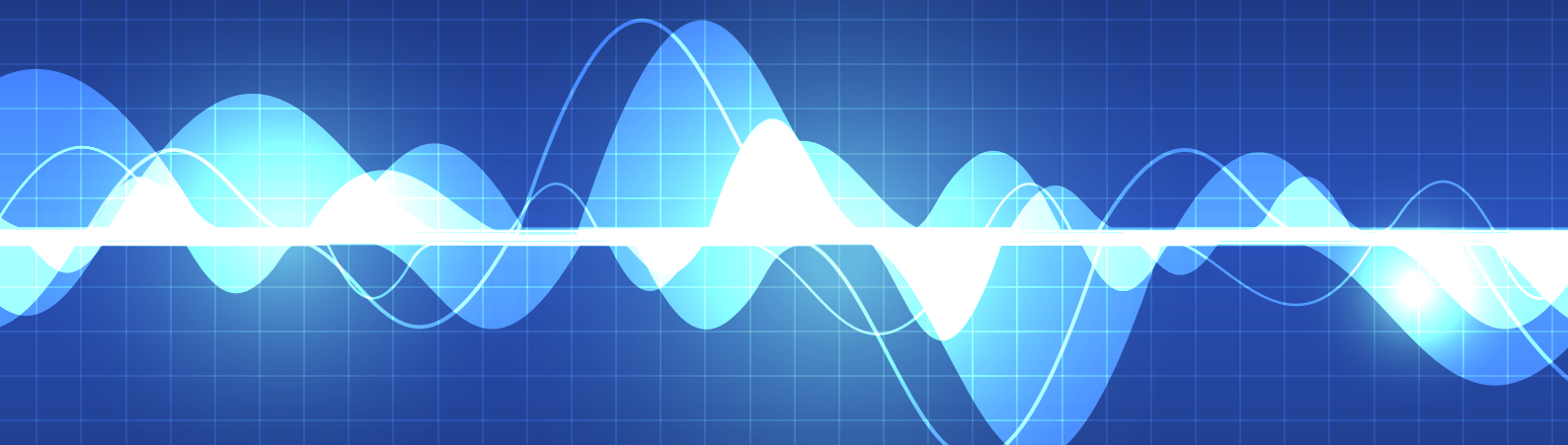
Figure D.4 Location G - Total measured one-third octave band frequencies



Karuah East Quarry

EPL quarterly attended noise monitoring
Quarter 4 - 2021

Prepared for Karuah East Quarry Pty Ltd
December 2021





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Karuah East Quarry

Quarterly attended noise monitoring - Q4 2021

Prepared for Karuah East Quarry Pty Ltd
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Karuah East Quarry

Quarterly attended noise monitoring - Q4 2021

Report Number

E210782 RP#2

Client

Karuah East Quarry Pty Ltd

Date

14 December 2021

Version

v1-0 Final

Prepared by**Approved by**



Lucas Adamson

Senior Acoustic Consultant

14 December 2021



Katie Teyhan

Associate

14 December 2021

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

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1 Introduction

EMM Consulting Pty Limited (EMM) was engaged to undertake noise compliance monitoring on behalf of Karuah East Quarry Pty Ltd.

This report presents the results and findings of attended noise monitoring conducted on 19 November 2021.

Noise compliance monitoring is required to be undertaken in accordance with the *Karuah East Quarry Project Noise Management Plan* (NMP) which has been prepared to meet the relevant requirements of Department of Planning and Environment (DPE), Project Approval PA 09_0175, as modified in December 2020 (current as of 19 November 2021) and Environment Protection Authority (EPA) Environment Protection Licence (EPL) 20611 as varied on 18 July 2019 (current as of 19 November 2021).

The Noise Policy for Industry (NPfI) (EPA 2017) has also been referenced as part of this assessment.

Several technical terms are discussed in this report. These are explained in the Glossary.

2 Noise limits and monitoring requirements

2.1 Noise limits

Karuah East Quarry noise limits are provided in Table 2, Condition 3 of PA 09_0175 and Condition L4.1 of EPL 20611. Extracts of the relevant sections of PA 09_0175 and EPL 20611 pertaining to noise are provided in Appendix A and B, respectively. The approved NMP adopts four attended noise monitoring locations that are representative of residences outlined in the PA 09_0175 and EPL 20611. The noise monitoring locations and relevant criteria from the PA 09_0175, EPL 20611 and NMP are summarised in Table 2.1.

Table 2.1 Noise limits

Monitoring location	Location description	EPL	PA
		Day $L_{Aeq,15\text{ minute}}$, dB	Day $L_{Aeq,15\text{ minute}}$, dB
A	Residence A on Lot 100 DP 785172	40	42
B	Residence B on Lot 3 DP 785172	37	40
G	Residence G on Lot 1 DP 1032636	38	43
H	Residence H on Lot 10 DP 1032636	Not specified	45
Any approved residence on Lot 11 DP 1024564		43	Not Specified
Any other residence or sensitive receiver not subject to a private negotiated agreement		35	40

Condition L4.4 of EPL 20611 states that the noise measurement equipment must be located:

- within 30 metres of a dwelling façade, but not closer than 3 metres, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises;
- approximately on the property, where any dwelling is situated 30 metres or less from the property boundary closest to the premises;
- at the most affected point at a location where there is no dwelling at the location; and
- within approximately 50 metres of the boundary of a National Park or Nature Reserve.

2.2 Meteorological conditions

PA 09_0175 specifies that noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Noise Policy for Industry. This is consistent with the requirements of Condition L4.3 of EPL 20611 which states that noise limits do not apply under the following meteorological conditions:

- wind speeds greater than 3 m/s at 10 m above ground level;

- stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 m above ground level; or
- stability category G temperature inversion conditions.

2.3 Modifying factors

2.3.1 Low frequency noise criteria

Condition L4.5 of EPL 20611 requires that the modifying factor adjustments outlined in Fact Sheet C of the NPfI (EPA 2017) are to be used when assessing the characteristics of a noise source (eg low frequency noise).

Fact sheet C of the NPfI provides guidelines for applying modifying factor corrections to account for low frequency noise (LFN) emissions. The NPfI specifies that a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels identifies the potential for an unbalanced spectrum and potential increased annoyance.

Where a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels is identified, the one-third octave noise levels recorded should be compared to the values (ie threshold levels) in Table C2 of the NPfI, which has been reproduced in Table 2.2.

Table 2.2 One-third octave LFN threshold levels

One-third octave $L_{Zeq,15\text{ minute}}$ threshold levels													
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB (Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The following modifying factor correction is to be applied where the site 'C-weighted' and site 'A-weighted' noise emission level is 15 dB or more, and:

- where any of the one-third octave noise levels in Table 3.2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period; or
- where any of the one-third octave noise levels in Table 3.2 are exceeded by more than 5 dB and cannot be mitigated, a 2 dB positive adjustment to measured/predicted A-weighted levels applies for the daytime period and a 5 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period.

Hence, where possible throughout each survey the operator has estimated the difference between site 'C-weighted' and site 'A-weighted' noise emission levels by matching audible sounds with the response of the sound analyser ($L_{Ceq}-L_{Aeq}$). Where this was deemed to be 15 dB or greater, the measured one-third octave centre frequency levels have been compared to the values in Table 2.2 to identify the relevant modifying factor correction (if applicable). This method has been applied to this assessment as presented in Section 5.

It is of note that the NPfI states that LFN corrections only apply under the standard or noise-enhancing meteorological conditions. In this case, the standard or noise-enhancing meteorological conditions are the same as those under which the noise limits are applicable.

2.3.2 Tonal noise

Tonal noise is defined in the NPfl as noise containing a prominent frequency and characterised by a definite pitch. Examples of tonal noise sources include ventilation fans, reversing beepers or alarms. It is of note that Karuah East Quarry uses broadband reversing alarms instead of beeping alarms. Fact sheet C of the NPfl provides guidelines for applying modifying factor corrections to account for tonal noise emissions.

The NPfl specifies that a 5 dB positive adjustment to measured/predicted A-weighted levels applies if the level of one-third octave band centre frequency (measured using unweighted or Z-weighted weighting) exceeds the level of the adjacent band on both sides by:

- 5 dB or more if the centre frequency of the band containing the tone is in the range 500-10,000 Hz; or
- 8 dB or more if the centre frequency of the band containing the tone is in the range 160-400 Hz; or
- 15 dB or more if the centre frequency of the band containing the tone is in the range 25-125 Hz.

Quarry noise experienced at the nearest residences is relatively continuous (e.g. quarry hum). Field observations during the noise compliance monitoring, and the measured one-third octave noise levels from 25 Hz to 12 kHz, confirm that site noise is not tonal in nature at any of the monitoring locations. Hence, adjustments to measured levels are not required for tonality.

2.4 Noise monitoring methodology requirements

Condition M8.1 of the EPL states that noise generated by Karuah East Quarry is to be measured in accordance with a number of requirements. An extract of the requirements outlined in Condition M8.1 is provided here.

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:

- a) during a period of normal quarry operations;
- b) at each one of the locations listed in the noise limits table of this licence;
- c) occur quarterly in the reporting period;
- d) occur during each day period as defined in the NSW Noise Policy for Industry.

2.5 Unattended noise monitoring

Section 8.4 of the NMP states that unattended noise monitoring will be undertaken each quarter to quantify overall ambient noise levels in the vicinity of location G (see Figure 4.1). An extract of the requirements outlined in Section 8.4 of the NMP is provided here.

In order to supplement the operator-attended measurements, unattended continuous noise monitoring shall be conducted at Locations G, for a minimum period of seven (7) days per quarter during operations, to quantify overall ambient noise amenity levels resulting from quarrying, road traffic and other environmental noise sources.

...

Unattended noise monitoring will be conducted initially on a quarterly basis. The frequency of monitoring will be reviewed after the first 12 months of operations in order to determine future requirements.

A review of the historical unattended noise monitoring data (undertaken in Quarter 3 2021) found no evident trends associated with Karuah East Quarry operations. Without an operator present to discern the noise sources contributing to the measured noise levels, it is difficult to establish any meaningful conclusions or trends from the historical unattended noise monitoring data.

As a result, the Karuah East Quarry has ceased the unattended noise monitoring component of the quarterly compliance noise monitoring program.

3 Assessment methodology

3.1 Attended noise monitoring

To quantify noise emissions from Karuah East Quarry, 15-minute attended noise monitoring surveys were completed at representative monitoring locations with reference to the sites approved NMP.

The attended noise monitoring locations, as per the sites approved NMP, and their coordinates are listed in Table 3.1 and are shown in Figure 3.1.

Table 3.1 Attended noise monitoring locations

Monitoring location	Location description	Coordinates (MGA56)	
		Easting	Northing
A	74 Mill Hill Close, Karuah	406623	6388704
B	64 Mill Hill Close, Karuah	406405	6388859
G	2 Halloran Road, North Arm Cove	405629	6389766
F	1714 The Branch Lane, Karuah	408154	6385923

3.2 Instrumentation

A Brüel & Kjær (B&K) 2250 Type 1 sound analyser (s/n 3029363) was used to conduct 15-minute attended measurements and record 1/3 octave centre frequency and statistical noise indices. The sound analyser was calibrated before and on completion of the survey using a Svantek SV36 calibrator (s/n 79952). The instruments were within their NATA laboratory calibration period during the time of these readings and certificates are provided in Appendix C.

Where possible throughout each survey, the operator quantified the contribution of each significant noise source. This was done by matching audible sounds with the response of the sound analyser (where applicable) and/or via post-analysis of recorded noise data.

3.3 Weather and operating conditions

The meteorological data was obtained from the Karuah East Quarry on-site weather station. Communications with the site operator and observations made during the attended measurements confirmed that the site was operating as normal during the noise surveys.



- KEY**
- Site boundary
 - A Attended noise monitoring location
 - Approved disturbance area
 - Major road
 - Minor road
 - Vehicular track
 - Watercourse/drainage line
 - Cadastral boundary
 - Waterbody
 - NPWS reserve
 - State forest

Attended noise monitoring locations

Karuah East Quarry
Quarterly attended noise monitoring
Figure 4.1

4 Review of data and discussion

4.1 Summary

The results of EMM's attended noise measurements are summarised in Table 4.1. Karuah East Quarry's noise contribution was determined using in-field observations and post-analysis of recorded data as required. Attended noise monitoring was completed on 19 November 2021.

The meteorological data for the monitoring period was sourced from the Karuah East Quarry on-site weather station to determine applicability of criteria in accordance with the EPL and PA. In accordance with the EPL and PA, noise limits were applicable during all four measurements.

Low frequency noise was conservatively assessed by comparison of the site measured one-third octave L_{Aeq} noise levels to the NPfI one-third octave low-frequency noise thresholds. Site measured noise levels did not exceed the relevant LFN thresholds during any of the measurements. Therefore, in accordance with the NPfI, LFN modifying factors were not applied to estimated site noise levels at any of the monitoring locations. Graphs of the total linear noise levels measured in one-third octave frequency bands are presented in Appendix D.

Karuah East Quarry noise contributions and cumulative quarry noise contributions were below (i.e. complied with) the relevant noise limits at all monitoring locations.

Table 4.1 Karuah East Quarry attended noise monitoring results – Q4 2021

Location	Date	Start time (Period)	Total noise levels, dB							Site contribution, dB	EPL / PA Limits, dB	Meteorological conditions ² EPL limits apply (Y/N)	Exceedance, dB	Comments	
			L _{Amin}	L _{A90}	L _{Aeq}	L _{A10}	L _{A1}	L _{Amax}	L _{Ceq}	LFN mod. Factor ¹	L _{Aeq}				L _{Aeq}
A	19/11	10:44	45	48	66	53	81	96	70	Nil	IA	40 / 42	0.5 m/s @ 213° A stability class Y	Nil	Karuah East Quarry inaudible. Traffic on the Pacific Highway, insects, frogs and bird noise consistently audible. Resident noise and a dog barking frequently audible.
B	19/11	11:19	56	59	63	65	68	69	70	Nil	IA	37 / 40	0.8 m/s @ 219° A stability class Y	Nil	Karuah East Quarry inaudible. Traffic on the Pacific Highway and bird noise consistently audible.
F	19/11	10:10	42	44	59	49	68	89	64	Nil	IA	35 / 40	0.5 m/s @ 213° A stability class Y	Nil	Karuah East Quarry inaudible. Distant traffic on the Pacific Highway, insects and bird noise consistently audible. Car passbys occasionally audible.
G	19/11	11:48	36	39	43	45	53	60	63	Nil	37	38 / 43	0.8 m/s @ 219° A stability class Y	Nil	Karuah East Quarry engine revs and processing plant consistently audible with bangs on occasion. Distant traffic on the Pacific Highway, insects, frogs and bird noise consistently audible. Aircraft noise, resident noise and livestock occasionally audible.

Notes: 1. Modifying factor correction for LFN in accordance with Fact sheet C of the NPfI.
2. Meteorological data were taken as an average over 15 minutes from the Karuah East Quarry on-site weather station (Refer to Section 5.1).
3. IA = inaudible.
4. N/A = not applicable.

5 Conclusion

EMM has completed a review of operational noise from Karuah East Quarry within the surrounding community based on attended measurements conducted on 19 November 2021.

The meteorological data for the monitoring period was sourced from the Karuah East Quarry on-site weather station to determine applicability of criteria in accordance with the EPL. In accordance with the EPL, noise limits were applicable during all four measurements.

The assessment of noise contributions from site included consideration of modifying factors for noise characteristics where relevant and in accordance with the NPfI.

Karuah East Quarry noise contributions were below (satisfied) the noise limits at all monitoring locations for this round of monitoring.

Glossary

Several technical terms are discussed in this report. These are explained in Table G.1.

Table G.1 **Glossary of acoustic terms**

Term	Description
dB	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
L _{A1}	The 'A-weighted' noise level which is exceeded 1% of the time.
L _{A1,1minute}	The 'A-weighted' noise level exceeded for 1% of the specified time period of 1 minute.
L _{A10}	The 'A-weighted' noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise level.
L _{A90}	Commonly referred to as the background noise level. The 'A-weighted' noise level exceeded 90% of the time.
L _{Aeq}	The energy average noise from a source. This is the equivalent continuous 'A-weighted' sound pressure level over a given period. The L _{Aeq,15 minute} descriptor refers to an L _{Aeq} noise level measured over a 15 minute period.
L _{Amin}	The minimum 'A-weighted' noise level received during a measuring interval.
L _{Amax}	The maximum root mean squared 'A-weighted' sound pressure level (or maximum noise level) received during a measuring interval.
L _{Ceq}	The equivalent continuous 'C-weighted' sound pressure level over a given period. The L _{Ceq,15 minute} descriptor refers to an L _{Ceq} noise level measured over a 15 minute period. C-weighting can be used to measure low frequency noise.
Day period	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
Evening period	Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
Night period	Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 8 am.
Temperature Inversion	A meteorological condition where the atmospheric temperature increases with altitude.

It is useful to have an appreciation of the decibel (dB), the unit of noise measurement. Table G.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure G.1.

Table G.2 **Perceived change in noise level**

Change in sound pressure level (dB)	Perceived change in noise
up to 2	not perceptible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

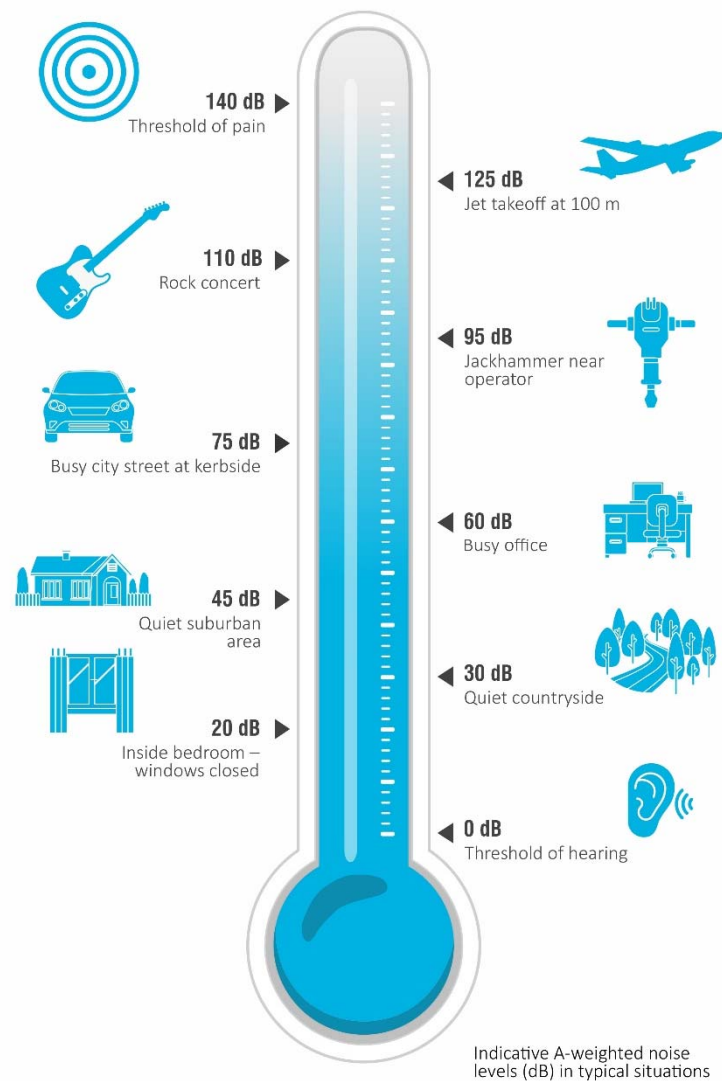


Figure G.1 **Common noise levels**

References

Department of Planning and Environment (DPE), Project Approval PA 09_0175, 2020.

Environment Protection Authority, Environment Protection Licence 20611, 2019.

Environment Protection Authority, Industrial Noise Policy Application notes, 2013.

Environment Protection Authority, Industrial Noise Policy, 2000.

Environment Protection Authority, Noise Policy for Industry, 2017.

SLR Consulting, Karuah East Quarry Project Noise Management Plan, 2015.

Appendix A

Project approval extract

SCHEDULE 3 ENVIRONMENTAL PERFORMANCE CONDITIONS

IDENTIFICATION OF APPROVED LIMITS OF EXTRACTION

1. The Applicant 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 Applicant 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. Except for the carrying out of construction works, the Applicant must ensure that the operational noise generated by the development does not exceed the criteria in Table 2 at any residence^a on privately-owned land.

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

Residence (Noise Assessment Location) ^a	Criteria (Day)
A	42
G	43
H	45
All other residences	40

^a The Residences (Noise Assessment Locations) referred to in Table 2 are shown in Appendix 2.

Noise generated by the development must be monitored and measured in accordance with the relevant procedures and modifications (including certain meteorological conditions) of the NPfI.

- 3A. The noise criteria in Table 2 do not apply if the Applicant has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and the Applicant has advised the Department in writing of the terms of this agreement.

Road Traffic Noise Criteria

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

Table 3: Road traffic noise criteria

Road	Criteria (Day ^a)
Pacific Highway	60 dB(A) L _{Aeq} (15 hour)
Local roads	55 dB(A) L _{Aeq} (1 hour)

^a Day is the period from 7 am to 10 pm every day in accordance with the EPA's NSW Road Noise Policy (2011).

5. Deleted

Noise Operating Conditions

6. The Applicant must:
 - (a) take all reasonable steps to minimise noise from construction and operational activities, including low frequency noise and other audible characteristics, associated with the development;
 - (b) implement reasonable and feasible noise attenuation measures on all plant and equipment that will operate in noise sensitive areas;
 - (c) operate a comprehensive noise management system commensurate with the risk of impact;
 - (d) take all reasonable steps to minimise the noise impacts of the development during noise-enhancing meteorological conditions when the noise criteria in this consent do not apply (see NPfl);
 - (e) carry out quarterly attended noise monitoring (unless otherwise agreed by the Planning Secretary) to determine whether the development is complying with the relevant conditions of this consent; and
 - (f) regularly assess the noise monitoring data and modify or stop operations on the site to ensure compliance with the relevant conditions of this consent.

Noise Management Plan

7. The Applicant must prepare a Noise Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:
 - (a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;
 - (b) be prepared in consultation with the EPA;
 - (c) describe the measures to be implemented to ensure:
 - (i) compliance with the noise criteria and operating conditions in this consent;
 - (ii) best practice management is being employed;
 - (iii) noise impacts of the development are minimised during noise-enhancing meteorological conditions when the noise criteria in this consent do not apply (see NPfl);
 - (d) describe the noise management system in detail; and
 - (e) include a monitoring program that:
 - (i) is capable of evaluating the performance of the development;
 - (ii) monitors noise at the nearest and/or most affected residences;
 - (iii) adequately supports the noise management system;
 - (iv) includes a protocol for distinguishing noise emissions of the development from any neighbouring developments; and
 - (v) includes a protocol for identifying any noise-related exceedance, incident or non-compliance and for notifying the Department and relevant stakeholders of any such event.

- 7A. The Applicant must implement the plan as approved by the Planning Secretary.

BLASTING

Blasting Criteria

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

Appendix B

EPL extract

Environment Protection Licence

Licence - 20611



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.

L4 Noise limits

- 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 noise limits set out in the table above, the licensee must locate monitoring equipment:

- within 30 metres of a dwelling façade (but not closer than 3 metres) where any dwelling on the property is situated more than 30 metres from the property boundary that is closest to the premises;
- approximately on the boundary where any dwelling is situated 30 metres or less from the property boundary that is closest to the premises;
- at the most affected point at a location where there is no dwelling at the location; and
- within approximately 50 metres of the boundary of a national park or nature reserve.

Environment Protection Licence

Licence - 20611



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:

- 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.

L4.5 For the purposes of determining the noise generated at the premises the modification factors in Fact Sheet C of the EPA's "Noise Policy for Industry" must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.

L5 Blasting

L5.1 Blasting in or on the premises must only be carried out between the hours of 9:00 am and 4:00 pm Monday to Friday. No blasting is permitted on 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:
a) 115 dB (Lin Peak) for more than 5% of the total number of blasts during each reporting period; and
b) 120 dB (Lin Peak) at any time,
at monitoring point 11 detailed in Condition P1.4.

L5.4 The ground vibration peak particle velocity from blasting operations carried out in or on the premises must not exceed:
a) 5 mm/second for more than 5% of the total number of blasts during each reporting period; and
b) 10 mm/second at any time,
at monitoring point 11 detailed in Condition P1.4.

L5.5 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.

L5.6 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.

L5.7 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.*

Environment Protection Licence

Licence - 20611

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.

M7 Blasting

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

- a) 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
- b) 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:

- a) during a period of normal quarry operations;
- b) at each one of the locations listed in the noise limits table of this licence;
- c) occur quarterly in the reporting period;
- d) occur during each day period as defined in the NSW Noise Policy for Industry.

Note: The frequency of noise monitoring will be reviewed, upon request, after two years of quarterly monitoring (approximately June 2021).

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:

1. a Statement of Compliance,
2. a Monitoring and Complaints Summary,

Appendix C

Calibration certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: C30591

EQUIPMENT TESTED : Sound Level Calibrator

Manufacturer: Svantek

Type No: SV-36

Serial No: 79952

Owner: EMM Consulting Pty Ltd
L3, 175 Scott Street
Newcastle, NSW 2300

Tests Performed: Measured Output Pressure level, Frequency & Distortion

Comments: See Details overleaf. All Test Passed.

Parameter	Pre-Adj	Adj Y/N	Output: (dB re 20 µPa)	Frequency (Hz)	THD&N (%)
Level1:	NA	N	94.12 dB	999.99 Hz	1.58 %
Level2:	NA	N	114.05 dB	999.99 Hz	1.12 %
Uncertainty			±0.11 dB	±0.05%	±0.20 %

Uncertainty (at 95% c.i.) k=2

CONDITION OF TEST:

Ambient Pressure 1007 hPa ±1 hPa

Temperature 21 °C ±1° C

Relative Humidity 43 % ±5%

Date of Receipt : 16/09/2021

Date of Calibration : 16/09/2021

Date of Issue : 16/09/2021

Acu-Vib Test AVP02 (Calibrators)

Procedure: Test Method: AS IEC 60942 - 2017

CHECKED BY:

AUTHORISED
SIGNATURE:

Wein Sae

Accredited for compliance with ISO/IEC 17025 - Calibration

Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.



WORLD RECOGNISED
ACCREDITATION

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Measurements

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Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
(02) 9680 8133
www.acu-vib.com.au

CERTIFICATE OF CALIBRATION

No: CDK2007931

Page 1 of 12

CALIBRATION OF

Sound Level Meter:	Brüel & Kjær Type 2250	No: 3029363	Id: -
Microphone:	Brüel & Kjær Type 4189	No: 3260501	
PreAmplifier:	Brüel & Kjær Type ZC-0032	No: 30109	
Supplied Calibrator:	None		
Software version:	BZ7222 Version 4.7.6	Pattern Approval:	-
Instruction manual:	BE1712-22		

CUSTOMER

EMM Consulting
Ground Floor, Suite 1
20 Chandos Street
2065 St Leonards
New South Wales, Australia

CALIBRATION CONDITIONS

Preconditioning: 4 hours at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$
Environment conditions: *See actual values in sections.*

SPECIFICATIONS

The Sound Level Meter Brüel & Kjær Type 2250 has been calibrated in accordance with the requirements as specified in IEC 61672-1:2013 class 1. Procedures from IEC 61672-3:2013 were used to perform the periodic tests. The accreditation assures the traceability to the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System 3630 with application software type 7763 (version 8.2 - DB: 8.20) by using procedure B&K proc 2250, 4189 (IEC 61672:2013).

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

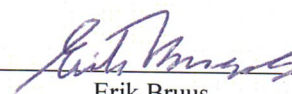
Date of calibration: 2020-11-26

Date of issue: 2020-11-26



Lene Petersen

Calibration Technician



Erik Bruus

Approved Signatory

Appendix D

Low Frequency Noise analysis

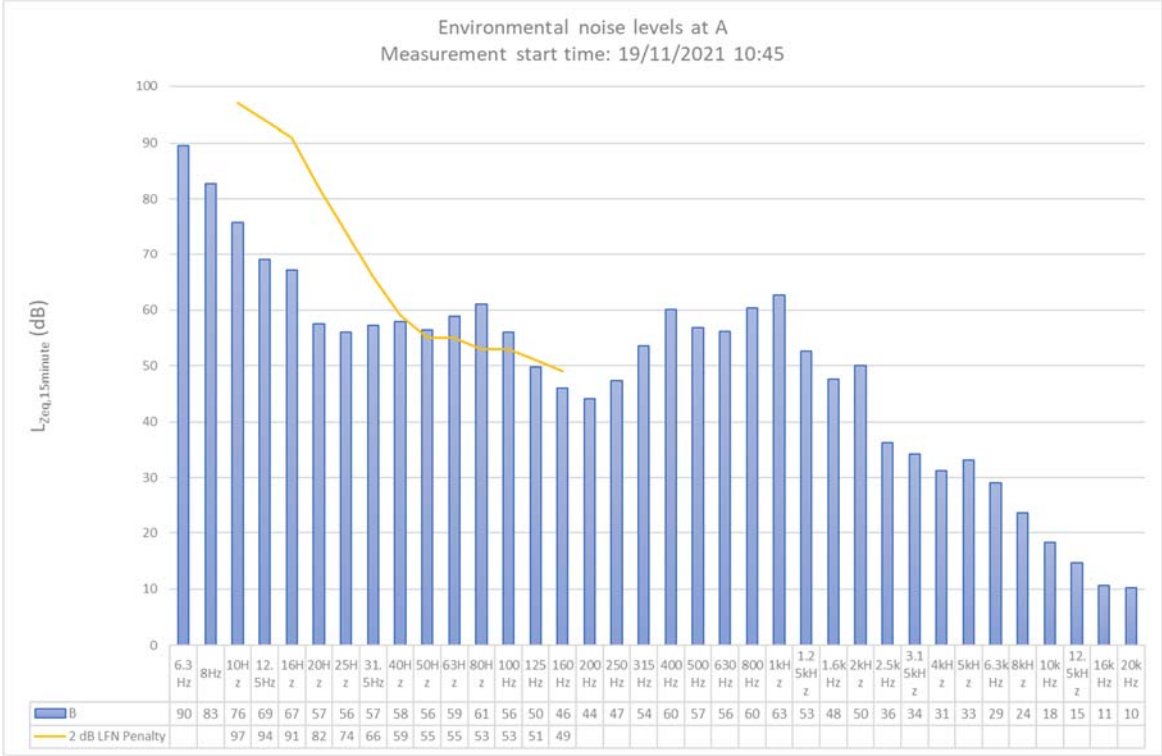


Figure D.1 Location A - Total measured one-third octave band frequencies

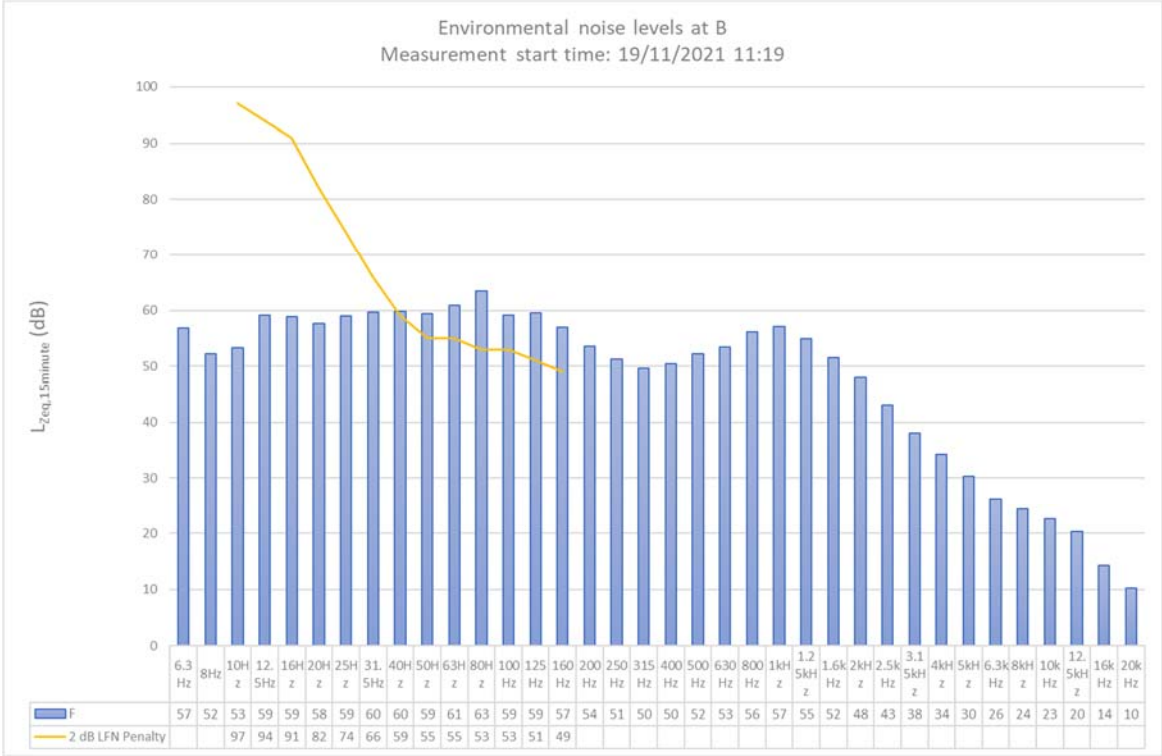


Figure D.2 Location B - Total measured one-third octave band frequencies

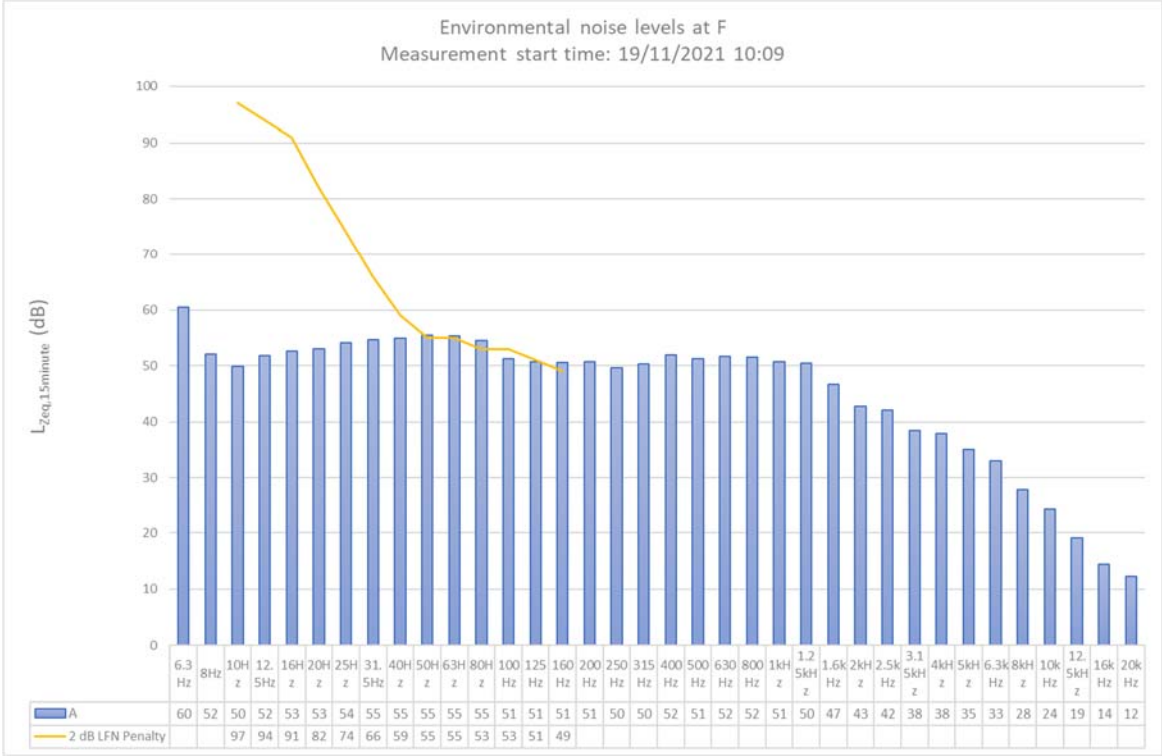


Figure D.3 Location F - Total measured one-third octave band frequencies

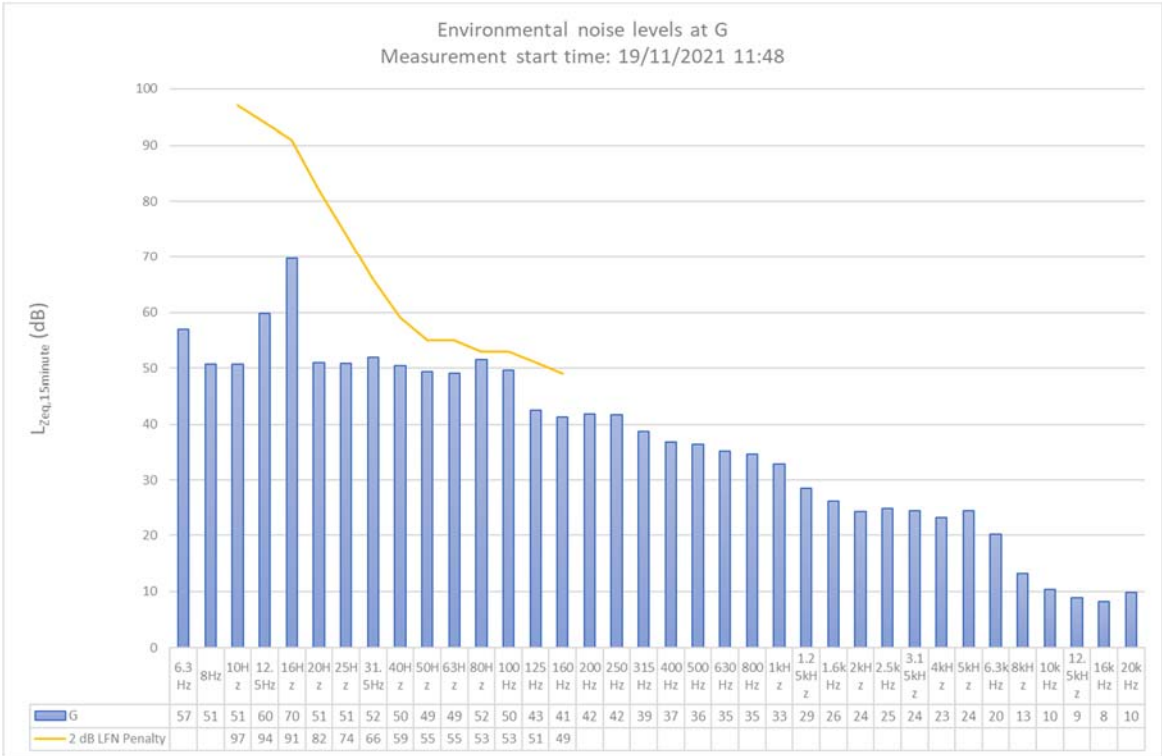
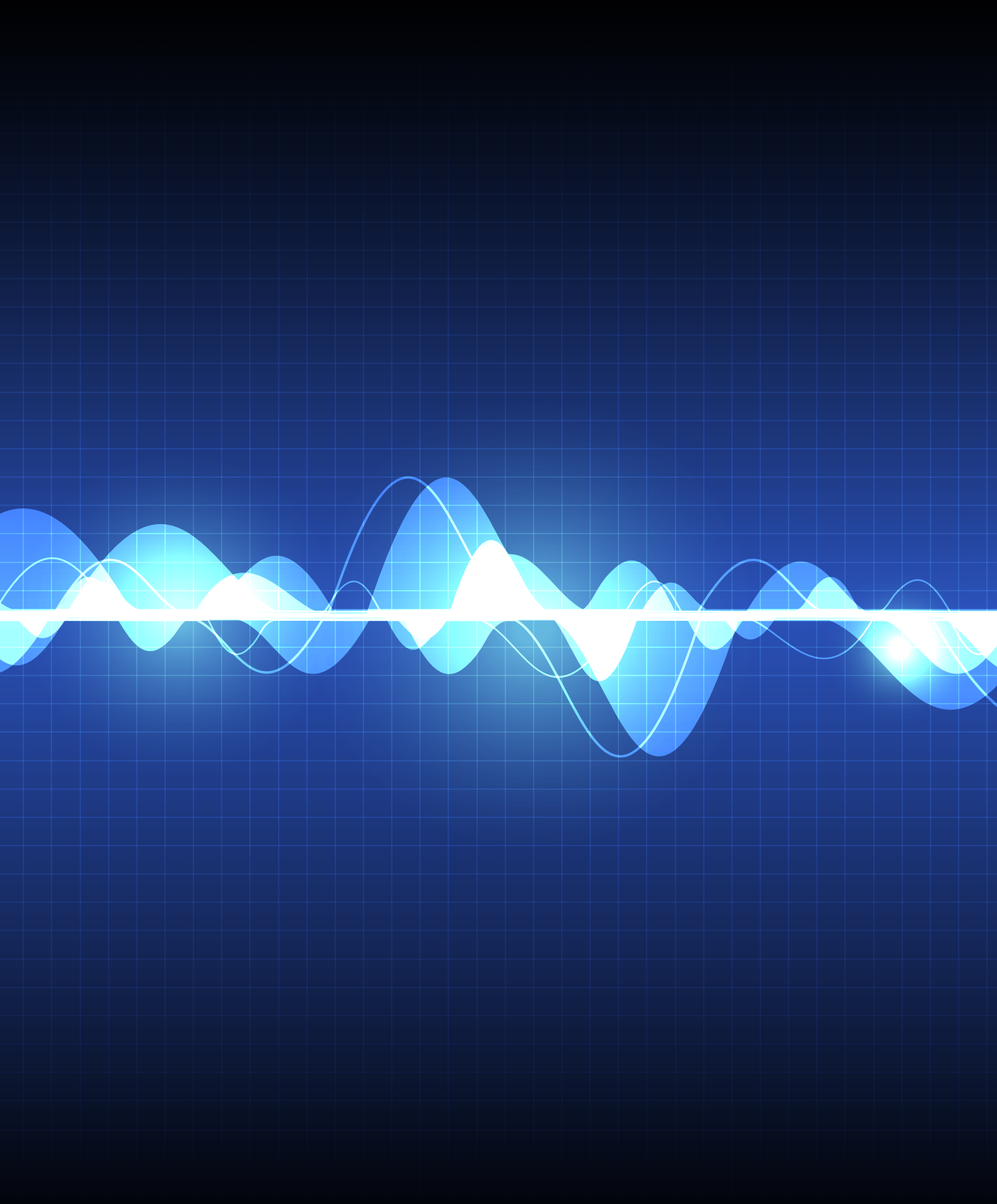


Figure D.4 Location G - Total measured one-third octave band frequencies



APPENDIX 5 – Ecological Monitoring Report

Karuah East Quarry Biodiversity Offset Area 2021 Annual Monitoring Report

Karuah East Quarry Biodiversity Offset Area and Lot 12

NCA21R134713

15 March 2022



Suite 3, 240-244 Pacific Highway,
Charlestown, NSW 2290
Phone: +61 2 4949 5200



Karuah East Quarry Biodiversity Offset Area 2021 Annual Monitoring Report

Karuah East Quarry Biodiversity Offset Area and Lot 12

Kleinfelder Document: NCA21R134713

Kleinfelder Project: 20222184

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Prepared for:

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Document Control:

Version	Description	Date
1.0	Draft	15 March 2022
Prepared	Reviewed	Endorsed
		
James Baldry	David Martin	Daniel O'Brien

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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). Subsequent modification was approved on 27 April 2018 (Modification 1) and 19 December 2018 (Modification 2) 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) (now known as Department of Agriculture, Water and the Environment - DAWE) 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 (part Lot 13 DP1024564, Lot 14 DP1024564, Lot 5 DP838128) 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 DoE on 16 March 2016. The BOAMP has since been updated in consideration of Modification 1 (February 2019) and Modification 2 (June 2021). Establishment of a Conservation Agreement or Stewardship Site Agreement for the BOA is currently in progress (with the Biodiversity Conservation Trust) as required under the project approval - Condition 29.

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/>).

The first year of annual monitoring of the BOA and Lot 12 was undertaken in October 2016. This report provides the results of the sixth annual monitoring event undertaken in November/December 2021. 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 7 of the BOAMP implementation to ensure compliance with relevant performance criteria.

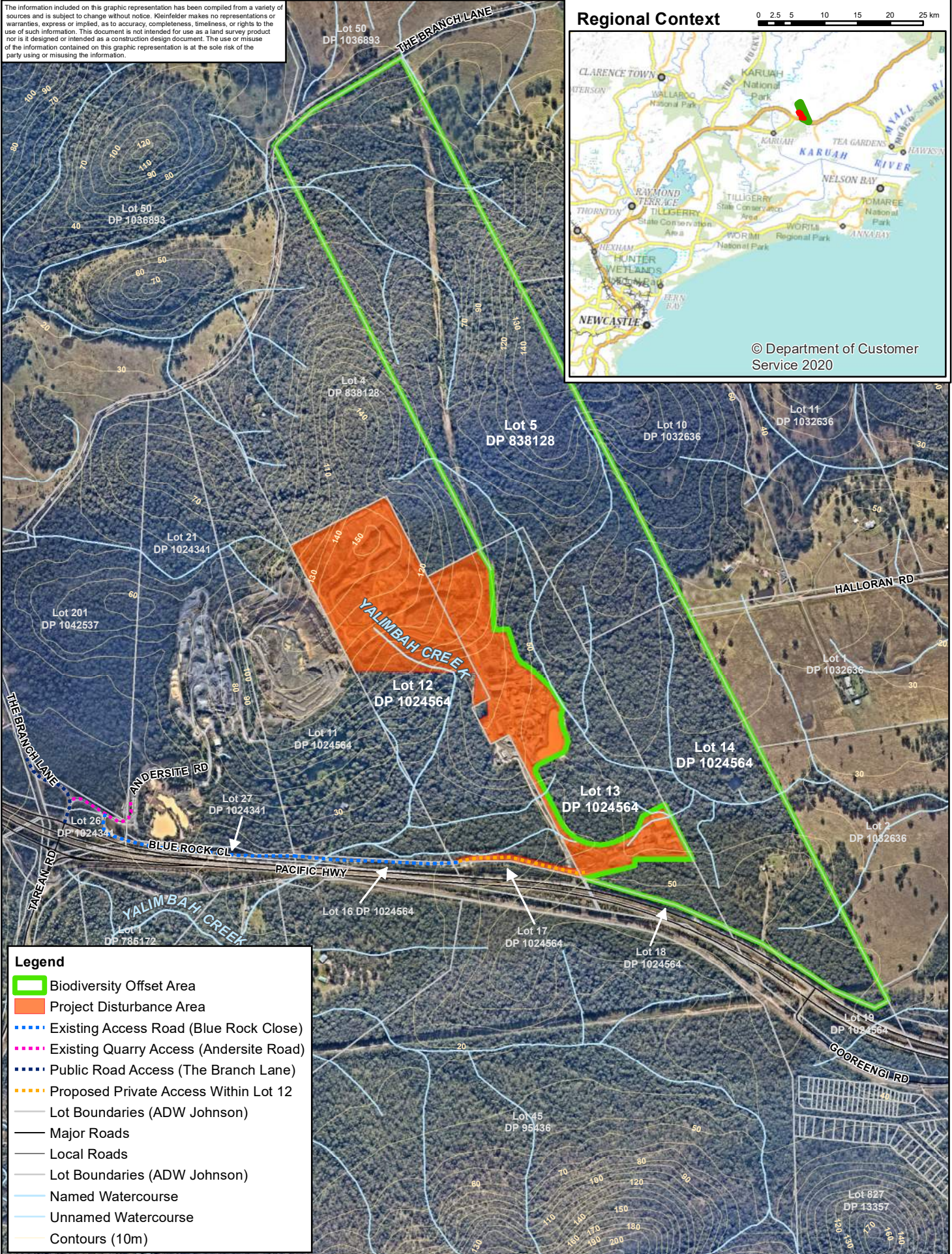
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Regional Context

0 2.5 5 10 15 20 25 km



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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



PROJECT REFERENCE: 20222184

DATE DRAWN: 2022/01/18 09:15 Version 1

DRAWN BY: G.Joyce

DATA SOURCE:

NSW DFSI - 2017
ADW Johnson - 2015
Nearmap - 2021

Karuah East Quarry and Biodiversity Offset Area

Karuah East Quarry Pty Ltd
2021 Annual Monitoring Report
Karuah East Quarry Project

FIGURE:

1





1.2 SCOPE

Section 3 of the BOAMP details the annual monitoring requirements for the Karuah East Quarry 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 Quarry 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 2021 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 2021
Vegetation and Threatened Flora Monitoring 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 the life of quarry (LOQ)	Completed
Fencing 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	Completed
Tracks 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 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 2021
Existing Dwellings 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 Nest boxes will be inspected and maintained (or replaced) every two years following installation: Nest boxes 1 – 30 installed in April 2016 Nest boxes 31 – 125 installed in February 2018 Nest boxes 126 – 318 installed in July-August 2020	Section 3.8 of BOAMP	Boxes 1-30 and 31 – 125 monitoring required in 2020.	No further nest box monitoring was required in 2021 Monitoring completed for nest boxes 1 – 30 in 2018. Monitoring completed for nest boxes 1 – 125 in 2020.
Weeds 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) Weed mapping for BOA updated in this report (2021).
Vertebrate Pest Assessment 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)	Completed
Aerial Fauna Crossings 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	Aerial fauna crossings installed. Monitoring program proposed. Remote cameras to be installed on either side of each crossing.
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 2021)



1.3 KARUAH EAST QUARRY PROGRESS

The Karuah East Quarry (KEQ) Project commenced operations in May 2019 after the plant's construction in 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 additional clearing also occurring in November 2016, May 2018, July 2018, October 2019, November 2019, September 2020, March 2021, June 2021 and October 2021. The majority of the disturbance area has been cleared to date. Major earthworks have also been completed, including the 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
- Lot Boundaries (ADW Johnson)
- Named Watercourse
- Unnamed Watercourse

Lot 4
DP 838128

Lot 5
DP 838128

Lot 10
DP 1032636

Lot 11
DP 1024564

Lot 12
DP 1024564

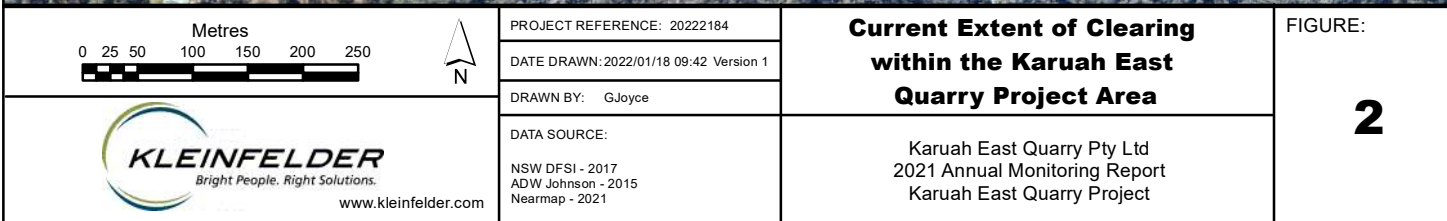
Lot 13
DP 1024564

Lot 14
DP 1024564

YALIMBAH CREEK

PACIFIC HWY

PACIFIC HWY





1.4 BIODIVERSITY VALUES

Section 2.3 of the BOAMP provides a detailed description of the biodiversity values identified in the Karuah East Quarry 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 is provided in **Table 2**. The locations of threatened flora species and the distribution of vegetation communities across the BOA are shown in **Figure 3**.

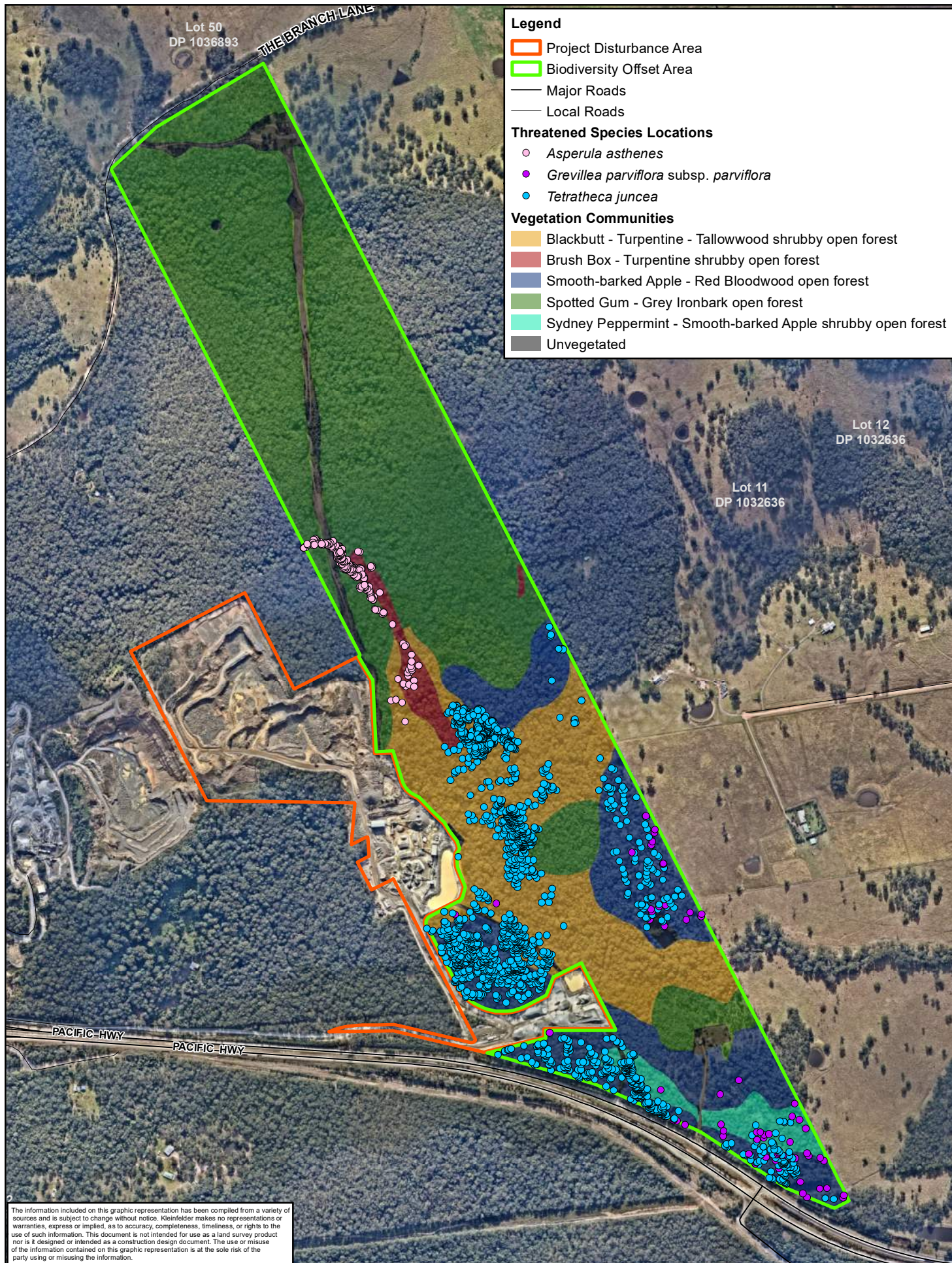
Table 2 Key biodiversity values recorded within the Karuah East BOA

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 subsp. parviflora</i> (Small-flower Grevillea)	100+
	*^ <i>Asperula asthenes</i> (Trailing Woodruff)	399
Threatened and Migratory Fauna Species	* <i>Falsistrellus tasmaniensis</i> (Eastern Falsistrelle)	-
	* <i>Miniopterus australis</i> (Little Bent-winged Bat)	-
	* <i>Miniopterus orianae oceanensis</i> (Eastern Bent-winged Bat)	-
	* <i>Micronomus norfolkensis</i> (Eastern Coastal Free-tailed Bat)	-
	* <i>Myotis macropus</i> (Southern Myotis)	-
	* <i>Vespadelus troughtoni</i> (Eastern Cave Bat)	-
	* <i>Calyptrorhynchus lathamii</i> (Glossy Black-Cockatoo)	-
	* <i>Daphoenositta chrysoptera</i> (Varied Sittella)	-
	* <i>Ninox strenua</i> (Powerful Owl)	-
	+ <i>Rhipidura rufifrons</i> (Rufous Fantail)	-

* = listed as Vulnerable under the BC Act 2016

^ = listed as Vulnerable under the EPBC Act 1999

+ = listed as Migratory under the EPBC Act 1999



Metres 0 50 100 200 300 400 500 KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT REFERENCE: 20222184 DATE DRAWN: 2022/01/18 09:53 Version 1 DRAWN BY: G.Joyce DATA SOURCE: NSW DFSI - 2018 ADW Johnson - 2015 Nearmap - 2021	Vegetation Types and Threatened Flora Locations Karuah East Quarry Pty Ltd 2021 Annual Monitoring Report Karuah East Quarry Project	FIGURE: 3



2 METHODS

2.1 VEGETATION AND THREATENED FLORA MONITORING

A total of 18 monitoring sites were established in October 2015, including 13 sites within the Biodiversity Offset Area (BOA), and five sites on Lot 12 DP 1024564 within 50 m of the project disturbance area and along Yalimbah Creek. The location of each monitoring site was recorded with a handheld GPS (Trimble™ Juno 5S unit) and permanently marked with a capped star picket (see **Figure 4**).

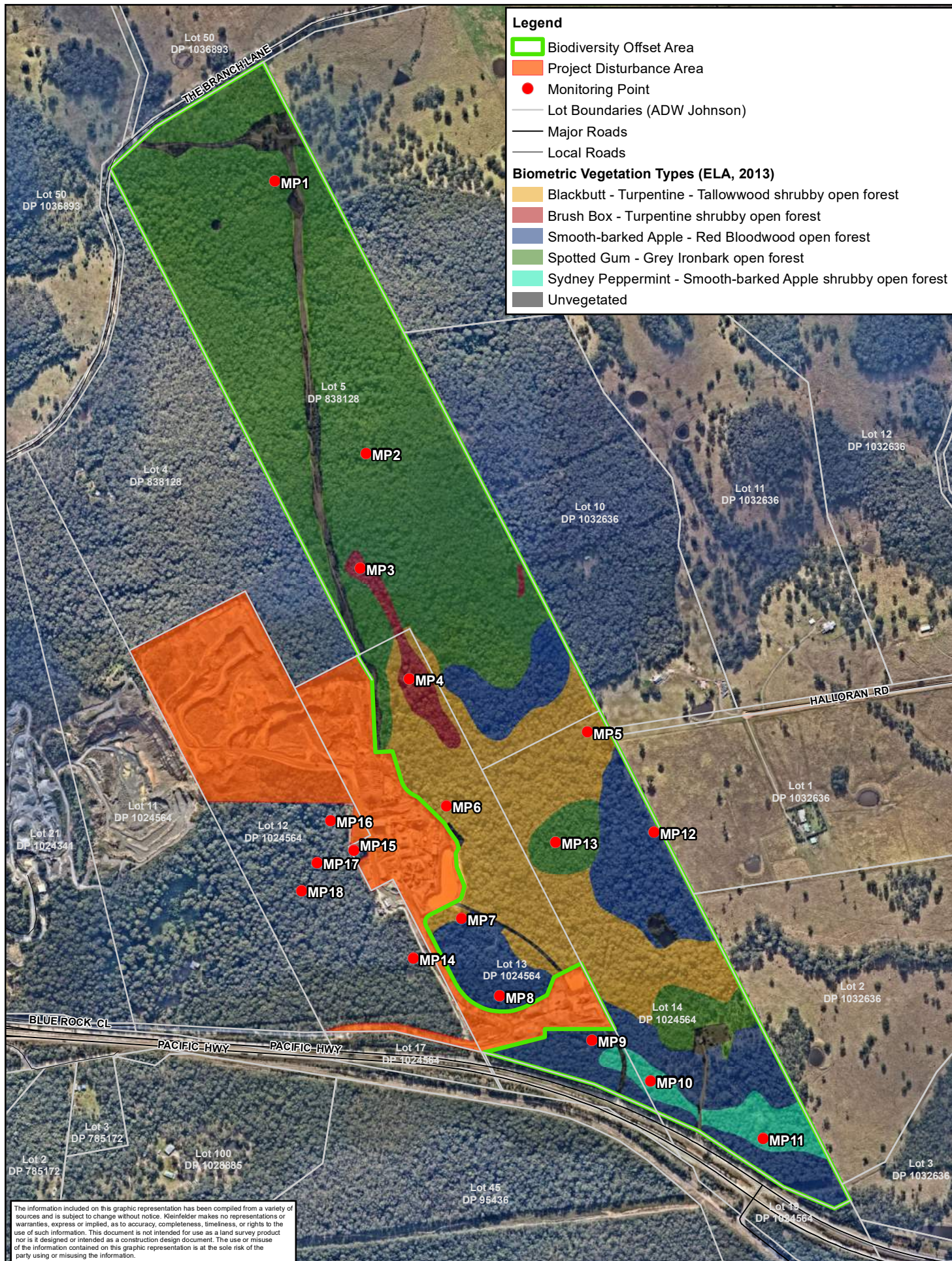
Baseline surveys were completed across the 18 monitoring sites in October 2015 and subsequently surveyed in October 2016, 2017, 2018, 2019, 2020 and 2021 (1st, 5th and 9th December 2021). Vegetation condition monitoring (**Section 2.1.1**) was conducted across all 18 monitoring sites. Threatened flora monitoring (**Section 2.1.2**) was previously carried out at nine of the monitoring sites, however, *Asperula asthenes* was identified in MP16 during the 2021 monitoring period. As such, threatened species monitoring was completed at ten of the monitoring sites in 2021 (see **Table 3**).

Table 3 Summary of vegetation and threatened flora monitoring sites

Monitoring Site	Location	Vegetation Community	Threatened Flora Species Monitored
MP 1	BOA – Lot 5	Spotted Gum - Grey Ironbark open forest	-
MP 2	BOA – Lot 5	Spotted Gum - Grey Ironbark open forest	-
MP 3	BOA – Lot 5	Brush Box - Turpentine shrubby open forest	<i>Asperula asthenes</i>
MP 4	BOA – Lot 13	Brush Box - Turpentine shrubby open forest	<i>Asperula asthenes</i>
MP 5	BOA – Lot 14	Blackbutt - Turpentine - Tallowwood shrubby open forest	-
MP 6	BOA – Lot 13	Blackbutt - Turpentine - Tallowwood shrubby open forest	-
MP 7	BOA – Lot 13	Smooth-barked Apple - Red Bloodwood open forest	<i>Tetratheca juncea</i>
MP 8	BOA – Lot 13	Smooth-barked Apple - Red Bloodwood open forest	<i>Tetratheca juncea</i> and <i>Grevillea parviflora</i> subsp. <i>parviflora</i>
MP 9	BOA – Lot 13	Smooth-barked Apple - Red Bloodwood open forest	-
MP 10	BOA – Lot 14	Sydney Peppermint - Smooth-barked Apple shrubby open forest	-
MP 11	BOA – Lot 14	Sydney Peppermint - Smooth-barked Apple shrubby open forest	<i>Grevillea parviflora</i> subsp. <i>parviflora</i> and <i>Tetratheca juncea</i>
MP 12	BOA – Lot 14	Smooth-barked Apple – Red Bloodwood open forest	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>
MP 13	BOA – Lot 14	Spotted Gum – Grey Ironbark open forest	-
MP 14	Lot 12	Smooth-barked Apple - Red Bloodwood open forest	-
MP 15	Lot 12	Blackbutt - Turpentine - Tallowwood shrubby open forest	<i>Tetratheca juncea</i>
MP 16	Lot 12	Spotted Gum – Grey Ironbark open forest	<i>Asperula asthenes</i>



Monitoring Site	Location	Vegetation Community	Threatened Flora Species Monitored
MP 17	Lot 12	Brush Box - Turpentine shrubby open forest	<i>Asperula asthenes</i>
MP 18	Lot 12	Brush Box - Turpentine shrubby open forest	<i>Asperula asthenes</i>





2.1.1 Vegetation Condition Assessment

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.
- Four photographs (north, south, east and west) were taken at each of the monitoring points.

2.1.2 Threatened Flora Monitoring

Monitoring of threatened flora species was undertaken at the previously observed nine monitoring sites as per the BOAMP and L&RMP as well as MP16, where *Asperula asthenes* was identified in 2021. 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. Note separate individual plants were delineated based on criteria described in **Table 4**.

Table 4 Criteria for delineation of “individual” plants

Species	Definition of “individual”
<i>Asperula asthenes</i>	Individual plants 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 <i>Asperula asthenes</i> occurring 40 cm or more apart are considered separate individuals.
<i>Tetratheca juncea</i>	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.
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Stems occurring 30 cm or more apart were considered separate individuals.

For each individual identified in the survey area, the following information was recorded:

- Clump/individual ID 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.



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 December 2021 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.

2.2.1 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 MidCoast 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).



3 RESULTS AND DISCUSSION

3.1 ENVIRONMENTAL CONDITIONS

Monitoring point field surveys were conducted on the 1st, 5th and 9th December 2021. Rainfall in the preceding months was variable, with higher-than-average rainfall occurring in August, September and October. November experienced well above average rainfall, followed by slightly below average rainfall in December (**Table 5, Plate 1**). Rainfall was generally higher in 2021 when compared to the dry conditions recorded throughout 2019, which recorded an annual rainfall total (597.8 mm) half of the annual long-term average (1067.9 mm) and was the driest year since baseline monitoring was completed in 2015.

Table 5 Local Rainfall Data in mm (Clarence Town (Prince Street) Station – BOM Station 61010) (BOM 2021)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	134.2	32.0	128.2	451.8	130.6	54.0	25.2	35.6	85.6	48.6	162.8	147.4	1436.0
2016	472.2	38.6	36.4	43.0	14.8	113.0	54.6	68.2	55.0	50.0	64.6	83.6	1094.0
2017	62.4	88.8	218.0	91.2	14.8	121.6	8.6	17.4	8.0	91.0	41.2	53.2	816.2
2018	16.2	79.2	149.2	83.4	15.4	153.6	1.0	28.4	49.8	143.2	90.2	87.0	896.6
2019	23.4	73.6	152.0	53.8	36.0	77.6	16.8	36.0	85.0	19.6	21.0	3.0	597.8
2020	78.0	274.0	110.0	26.8	82.4	56.6	141.8	44.0	34.6	169.2	48.2	163.2	1228.8
2021	200.4	141.4	363.8	31.0	61.2	72.2	35.0	60.6	62.0	72.0	236.4	92.6	1428.6
Mean	105.0	111.7	124.8	99.9	86.4	101.3	68.0	60.3	61.9	68.9	79.2	99.7	1067.9

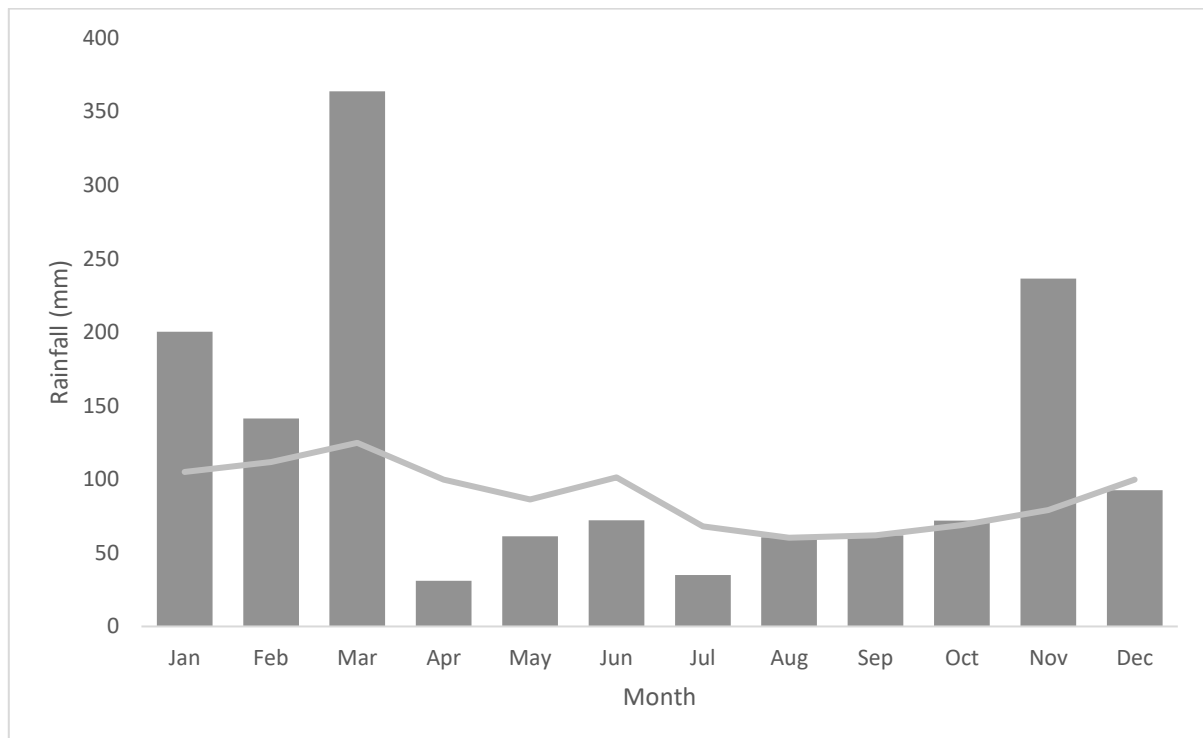


Plate 1 Local Rainfall Data (BOM Station 61010) (BOM 2021) – Columns (2021 rainfall data), Line (Long-term mean rainfall)



3.2 VEGETATION AND THREATENED SPECIES MONITORING

3.2.1 Vegetation Condition

The 2021 KEQ vegetation condition assessment was completed over three days (1st, 5th and 9th December 2021) across all 18 monitoring sites and represents the sixth annual inspection of vegetation condition within the KEQ BOA and Lot 12, with baseline data collected in 2015.

Vegetation condition, exotic species cover and records of disturbance are summarised in the results below. Site-specific results and photo monitoring results are detailed further in **Appendix A** and **Appendix B**.

General health of vegetation

Vegetation condition across KEQ BOA and Lot 12 monitoring sites remain relatively stable since the previous monitoring event in 2020, with almost all monitoring sites recording signs of regeneration.

Canopy condition, measured as Projected Foliage Cover (PFC%), shows little change since 2020, or since baseline results collected in 2015 (see **Plate 2**), beyond natural variation likely in response to prevailing weather conditions (**Plate 1**). The only exception was a reduction in Canopy PFC within *Spotted Gum – Grey Ironbark open forest* sites which declined in mean PFC from 48% to 39% in 2019/2020, much of this influenced by variation at MP 13. The results from the current monitoring event indicate that canopy cover has largely stabilized within this community, further monitoring events will identify any longer term trends in canopy condition. Whilst signs of minor dieback were observed at several monitoring sites, trees also show signs of recovering, with new growth recorded in 2021. Several of the monitoring points experienced an increase in overall PFC during this year, likely in response to improved conditions such as high rainfall.

There have been discernable changes in PFC across mid-storey or shrub strata since baseline records in 2015, including between 2020 and 2021 (current survey) (see **Plate 3** and **Plate 4**). These changes are largely within the natural variation of each of the vegetation communities within the Subject Site, and likely the result of variable conditions within the site since 2015 (i.e. rainfall and dry conditions). The largest change in shrub PFC was recorded within *Brush Box – Turpentine shrubby open forest* (decrease from 23% to 17%), and *Blackbutt – Turpentine – Tallowood shrubby open forest* (increase from 8% to 17%) sites (**Plate 4**). As with canopy PFC, the continuation of this monitoring programme will allow for the identification of any long-term trends in shrub/mid-storey cover within the Subject Site.

Grass groundcover PFC has declined across all vegetation communities, since the completion of baseline surveys in 2015 (**Plate 5**). This is unlikely to be the result of any direct or indirect impacts of quarry operations, instead is more likely a combination of natural variability and increasing competition from shrub/mid-storey species as well as a small level of variability expected between surveyors. Additionally, non-grass groundcover, appears to be recovering despite a substantial decrease last year (**Plate 6**).

Exotics

Exotic species cover has remained relatively stable since baseline surveys in 2015, with a minor increase since the last survey period (**Plate 7**). This may also be attributed to the high rainfall throughout 2021, creating more favourable conditions for pre-established communities of exotic plants. The highest level of exotic species cover continues to occur within *Brush Box – Turpentine shrubby open forest* sites and includes large thickets of *Lantana camara* var. *camara*. Weed coverage is further discussed and mapped in **Section 3.3**.

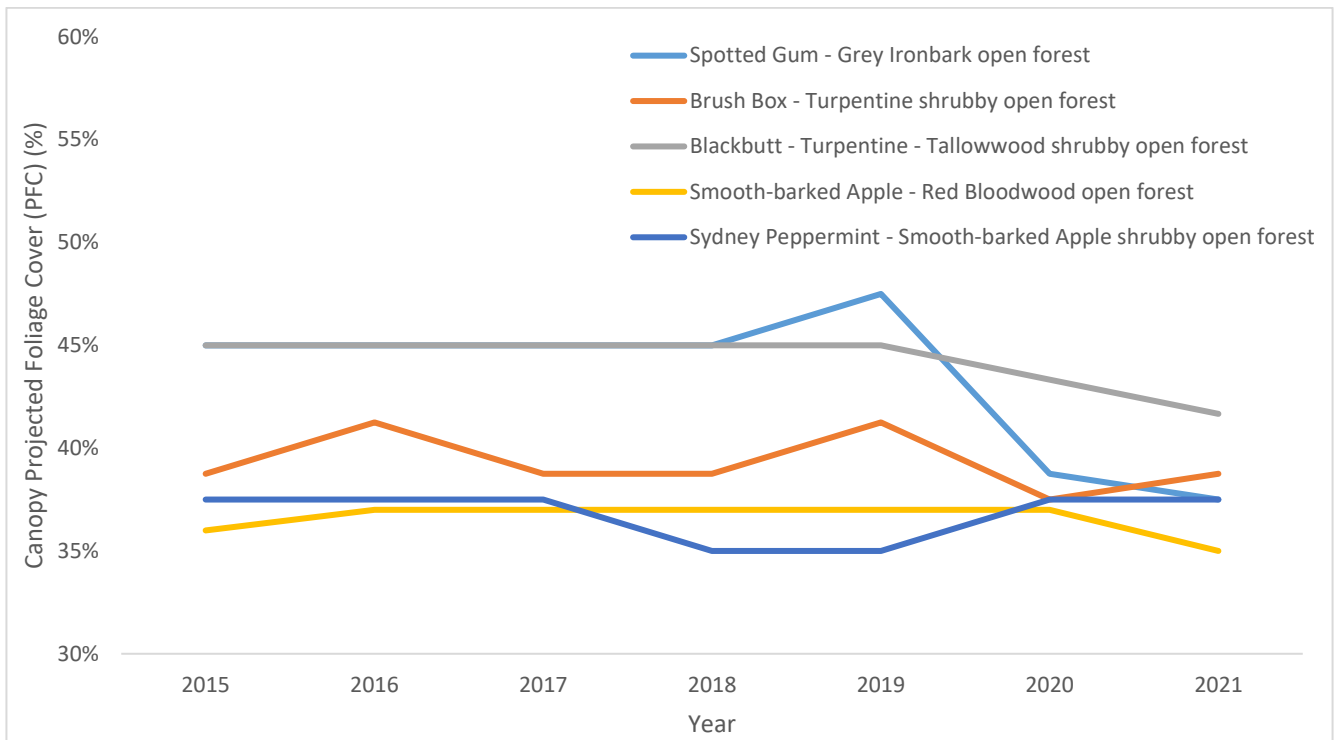


Plate 2 Mean Canopy Projected Foliage Cover (%) by vegetation community (2015-2021)

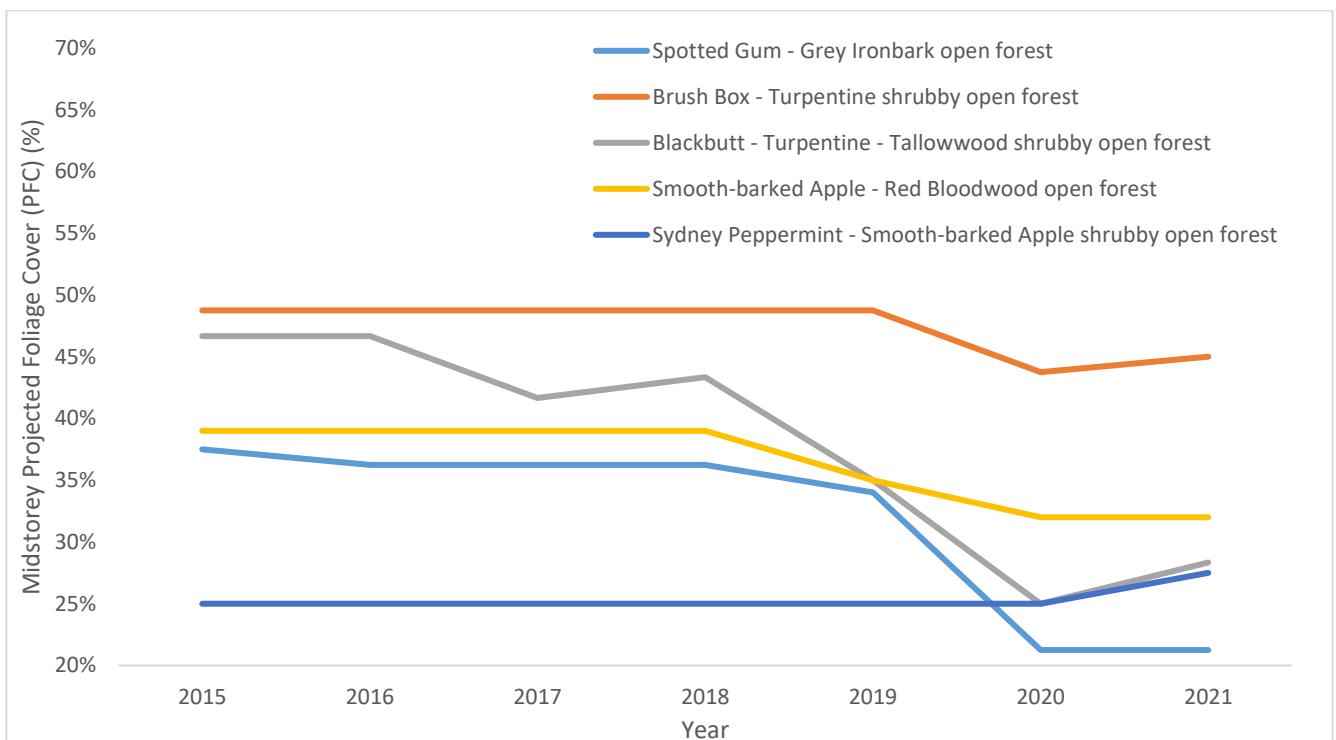


Plate 3 Mean Mid-storey Projected Foliage Cover (%) by vegetation community (2015-2021)

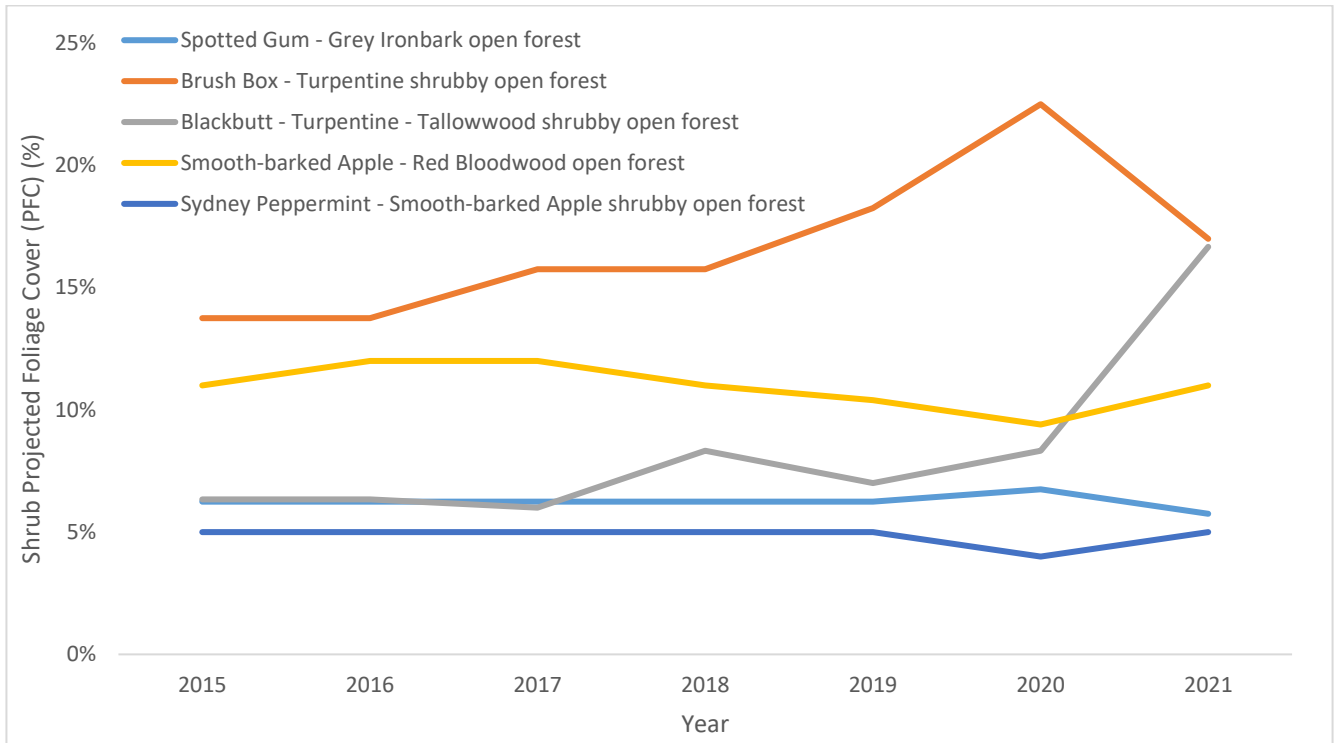


Plate 4 Mean Shrub Projected Foliage Cover (%) by vegetation community (2015-2021)

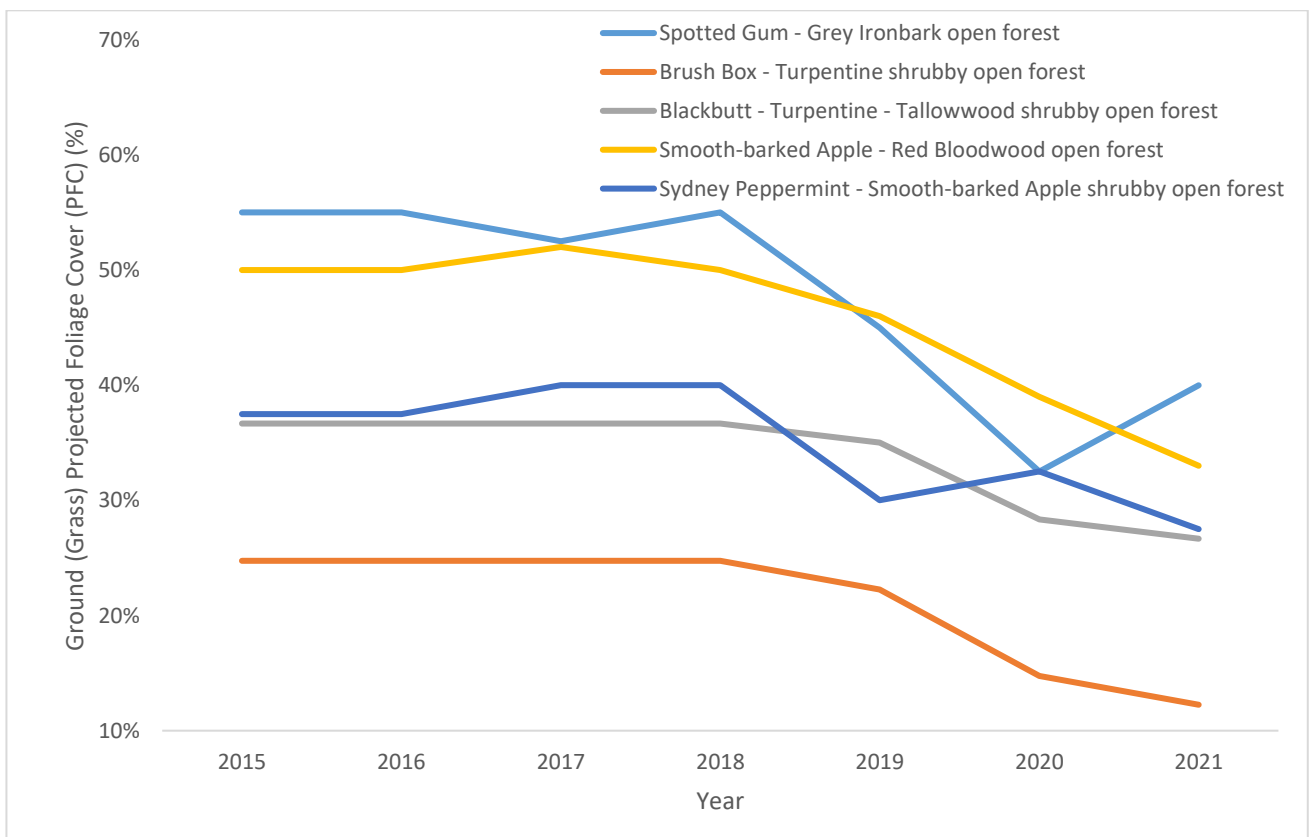


Plate 5 Mean Ground (Grass) Projected Foliage Cover (%) by vegetation community (2015-2021)

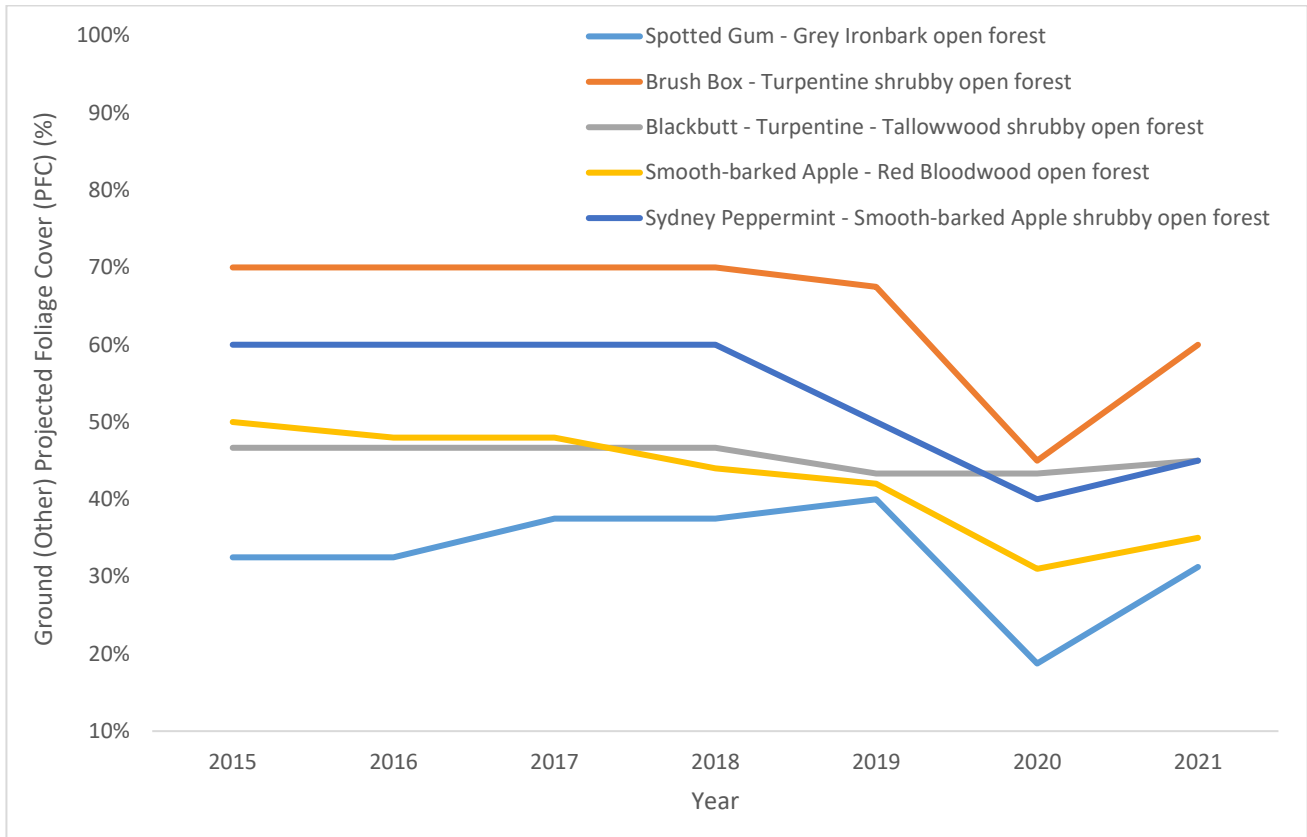


Plate 6 Mean Ground (Other) Projected Foliage Cover (%) by vegetation community (2015-2021)

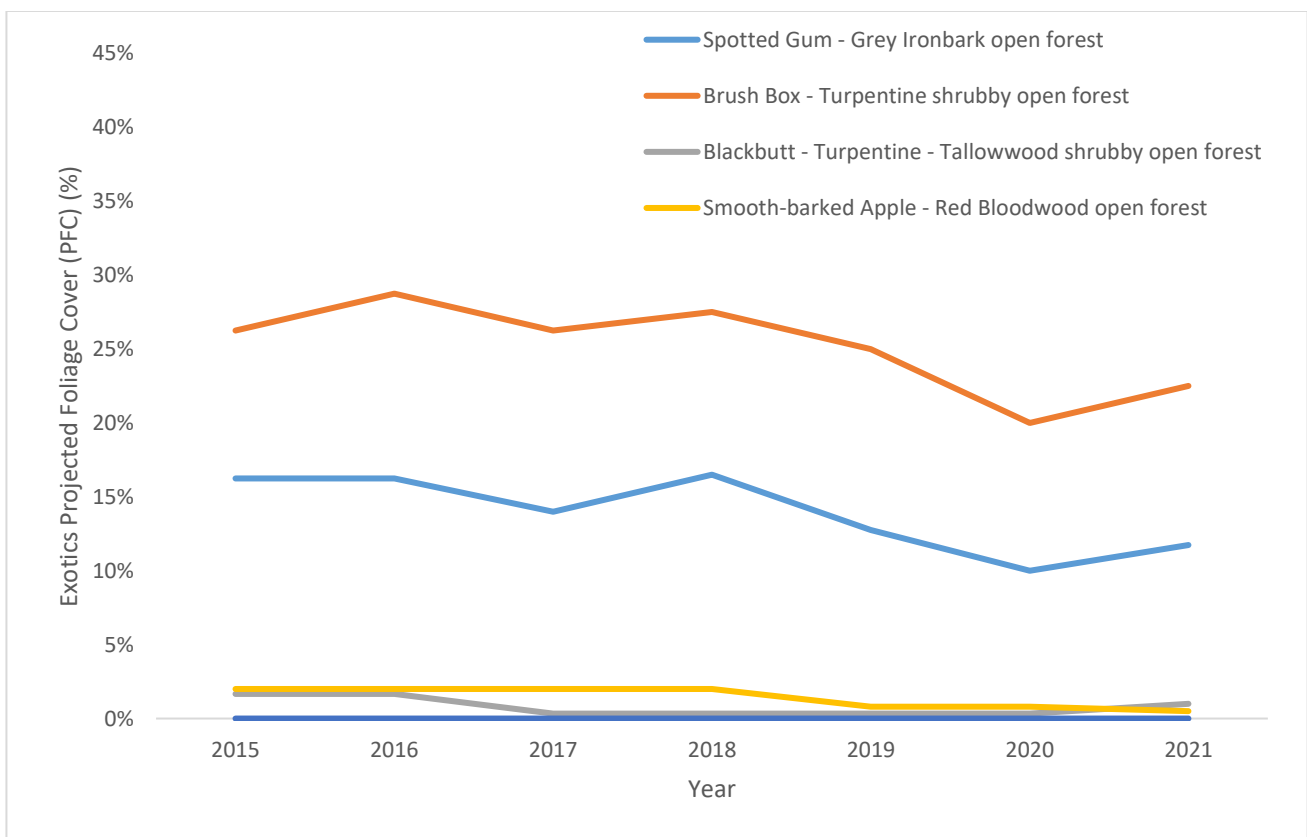


Plate 7 Mean Exotics Projected Foliage Cover (%) by vegetation community (2015-2021)



Disturbance

Minor disturbance was recorded at a number of monitoring sites. These are detailed in **Appendix A**, however, the following key observations are noted below:

- Similar to the 2020 monitoring, minor scouring of creek bank was recorded at MP 18, MP 17 within a gully to the west of the quarry. This is likely the result of high rainfall events during the preceding months and may have removed several of *Asperula asthenes* individuals growing on the creek banks.
- Wild pigs were observed within the vicinity of monitoring site MP 4. Recent erosion and disturbance to the groundcover within this area is likely the result of the pest species - Impacts of vertebrate pests are further discussed in **Section 3.3.4**.
- Past clearing at MP 12 is beginning to show signs of regeneration, despite continued maintenance of the accessway. The stockpiled timber of removed trees may have impacted several *Grevillea parviflora* individuals that were not observed in 2021.
- Moderate levels of dust were observed on foliage (see **Plate 8**) and on the ground at several monitoring sites along the boundaries of quarry operations. Dust levels remain relatively similar to the previous survey period, as such monitoring of this disturbance should be continued in future years to assess any potential influence on remnant vegetation.



Plate 8: Dust cover on foliage recorded at MP 4 in 2020.



3.2.2 Threatened Flora

The 2021 threatened species monitoring identified a total of 75 individual *Asperula asthenes* plants, 41 clumps of *Tetratheca juncea*, and 17 *Grevillea parviflora* subsp. *parviflora* shrubs representing a small decrease in threatened flora abundance for most species and at the majority of the monitoring locations.

Species specific results are discussed below, for more detailed threatened flora results including site specific observations on abundance and condition see **Appendix C**.

Asperula asthenes

Monitoring for *A. asthenes* was completed at the four original monitoring sites; MP 3, MP 4, MP 17, and MP 18, as well as MP16, where the species was identified during the 2021 surveys. MP3 experienced an increase in *A. asthenes* abundance since 2020 with 15 individuals in 2020 to 18 in 2021. The remaining monitoring points experienced a small decrease in the overall abundance of this species (**Plate 9**). The most significant decrease was at MP 4 where 40 individuals were recorded in 2020 (highest number recorded since 2015) and 32 individuals in 2021. This was followed by MP 17 where 17 individuals were recorded in 2020 and 10 were recorded in 2021. MP 18 experienced a marginal decrease from 10 individuals in 2020 to 9 in 2021. It is likely that many new individuals that germinated in 2020 in response to favourable conditions and have subsequently been outcompeted following the return of other groundcover species. Additionally, several of the individuals residing on the banks of a creek may have been removed by heavy rainfall events.

The decrease in abundance for the species across the majority of the monitoring sites continues a pattern of fluctuating abundance results for the species since 2015. There is no discernible pattern to suggest impacts from quarry operations in relation to *A. asthenes* abundance.

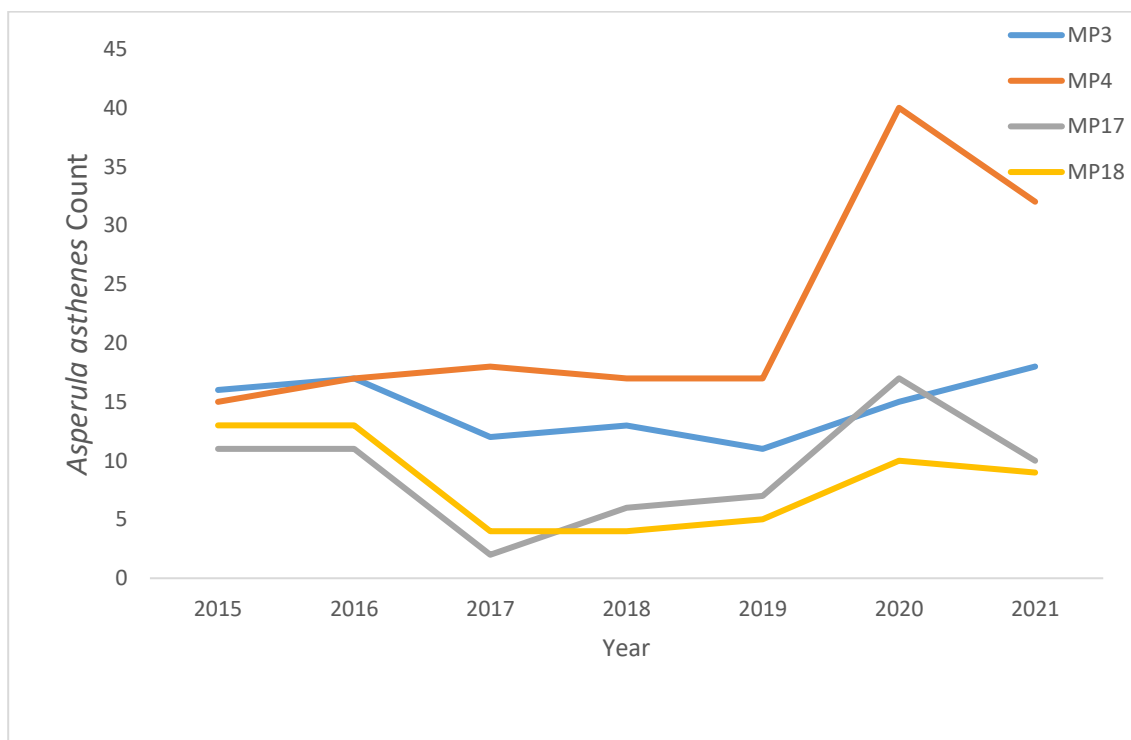


Plate 9 *Asperula asthenes* abundance at monitoring sites, excluding the newly added MP16 (2015-2021)



Tetratheca juncea

Monitoring for *T. juncea* was completed at four monitoring sites; MP 7, MP 8, MP 11 and MP 15. The population remains stable with only a small decline in abundance was recorded between 2020 and 2021 at MP 7 (16 to 15 plants), whilst an increase was recorded at MP 15 (9 to 12 plants) (see **Plate 10**). Both MP 8 and MP 11 remain equally as abundant as in 2020 (13 and 1 individuals, respectively). *T. juncea* abundance has generally remained stable across the original monitoring sites (MP 7, MP 8, and MP 15) since the 2015 baseline monitoring event (**Plate 10**). A reduction in numbers has occurred within MP 15, which similar to MP 7 and MP 8, is in close proximity to quarry operations (see **Figure 4**). No major disturbances were recorded within MP 15 during the 2021 monitoring event, however, some dust on foliage was noted. Overall, the abundance of *T. juncea* individuals within the monitoring plots was stable within the 2021 monitoring period.

Flowering was recorded for the species across all four monitoring plots (MP 7, MP 8, MP 11 and MP 15) during the 2021 monitoring event. Of the 15 plants recorded at MP 7, eight were in flower (53%) with a mean of 4.75 flowers per flowering plant, compared to 60% flowering and 5.8 flowers in 2020. MP 8 saw a decrease from 92% flowering and 2.3 flowers on average in 2020 to 38.5% flowering and a mean of 5.6 flowers per flowering plant. The single plant identified within MP 11 continued to be viable and was in flower during this monitoring period (17 flowers, 5 fruit in total). MP 15 decreased from 100% flowering and 2.3 flowers per flowering plant in 2020 to 50% and 2 flowers per flowering plant in 2021. Overall, despite a reduction in the overall flower abundance, the results indicate *Tetratheca juncea* is in good reproductive condition.

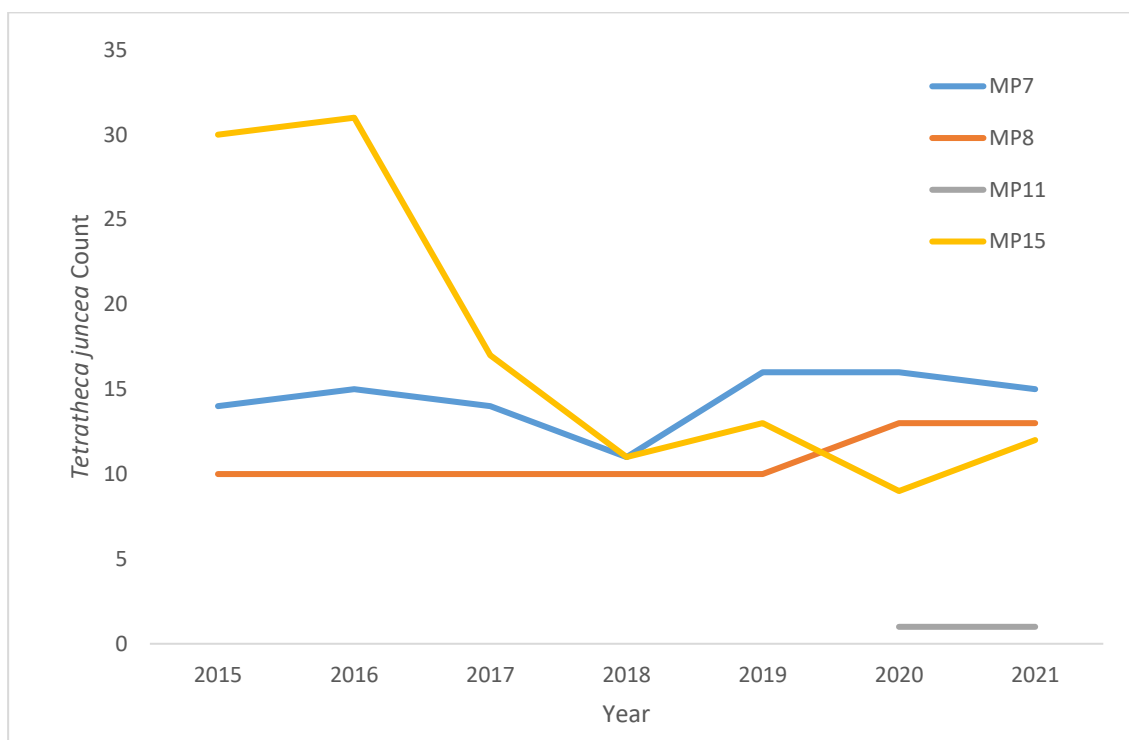


Plate 10 *Tetratheca juncea* abundance at monitoring sites (2015-2021)



Grevillea parviflora* subsp. *parviflora

Monitoring for *G. parviflora* subsp. *parviflora* was completed at three monitoring sites; MP 8, MP 11 and MP 12. A decrease in plant abundance was recorded between 2020 and 2021 at the monitoring points (MP 8: 1 to 0 plants, MP 11: 16 to 10 plants, MP 12 (9 to 7 plants) (see **Plate 11**), however these results continue to fall within the general population results recorded since 2015. Maintenance of the track directly adjacent to MP 12, and subsequent stockpiling of timber within the bounds of the monitoring point, appears to have resulted in the removal of at least three plants recorded the previous year.

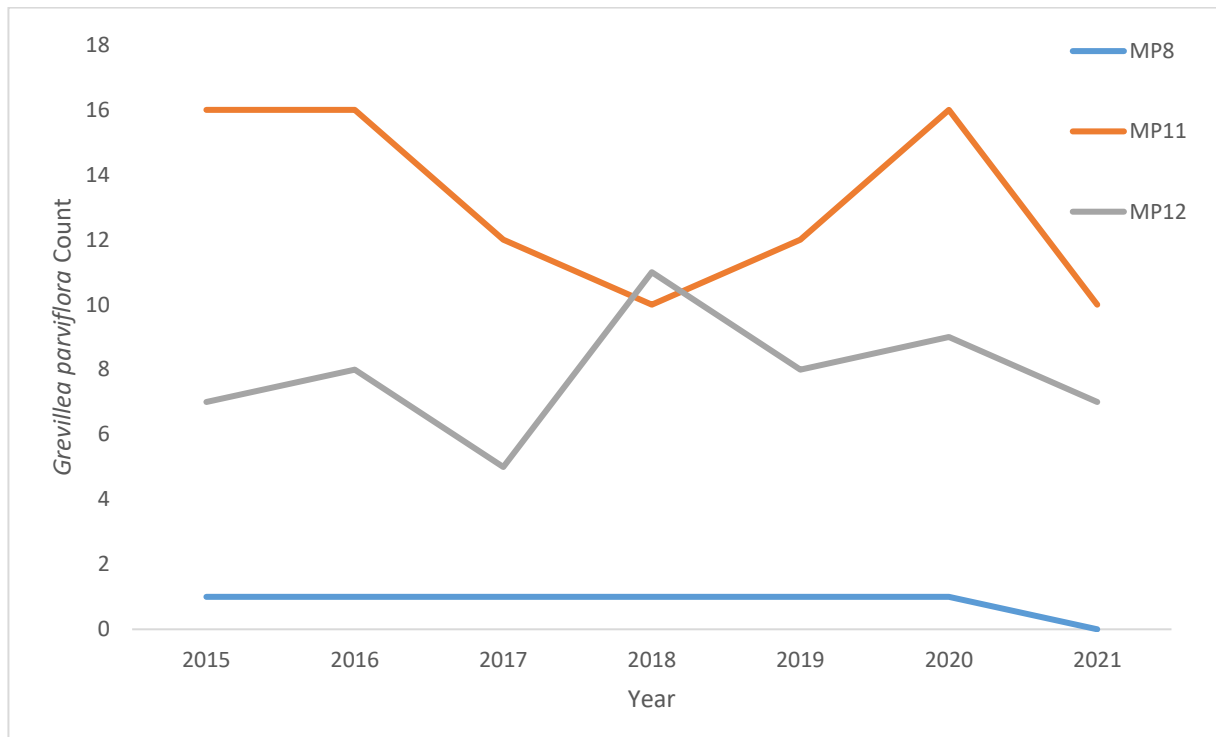


Plate 11 *Grevillea parviflora* subsp. *parviflora* abundance at monitoring sites (2015-2021)

3.3 SITE WALKOVER AND INSPECTION

3.3.1 Weed Infestations

Weed mapping was conducted across the BOA during field surveys on the 20th and 21st of December 2021, within the project disturbance area, within 50 m of the project disturbance area, and along Yalimbah Creek on Lot 12. The resulting weed map (**Figure 5**) illustrates the cover of the most abundant weed species across the site, *Lantana camara* var. *camara* (Lantana) (Priority Weed within the MidCoast LGA). As with previous monitoring events, major infestations occur throughout the site, with the majority of infestations occurring across the northern extent of the BOA, however the extent of this species has expanded in comparison to previous years (**Figure 5**).

One other Priority Weed species was identified in the BOA: *Senecio madagascariensis* (Fireweed). This species only occurs as small discrete patches in a few locations in the BOA.

Notable areas of exotic perennial grasses previously mapped along road and track sides were recorded again in 2021 and are mapped in **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. 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 continues 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 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, especially within the vicinity of MP 3 and MP 4, to protect *Asperula asthenes* individuals. Priority should also be given to controlling infestations alongside waterways where Lantana has become most abundant. 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**. One additional weed species, *Ageratina adenophora* was identified in small, localised communities during the 2021 surveys.

3.3.2 Fencing and Tracks

The layout of existing and required fencing, gates and tracks across the BOA is shown in **Figure 6**. 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. Key fencing requirements within the site include:

- Internal fencing is also required around the existing dwellings on Lot 5 and Lot 14.
- The barbed-wire fence alongside the far northern boundary of Lot 5 requires repair throughout due to the fence having either fallen, lost tension or damage from fallen trees (**Plate 12** and **Figure 6**).
- Fencing alongside the north-eastern boundary of Lot 5 has been removed with the intention of replacing it.
- Fencing is absent along the western boundary of Lot 5 and will need installation
- Fencing along the western boundary of Lot 13 and haul road has been damaged during road works and will repair (see **Plate 13**).

All fencing works are required to be undertaken in accordance with Section 3.2 of the BOAMP.

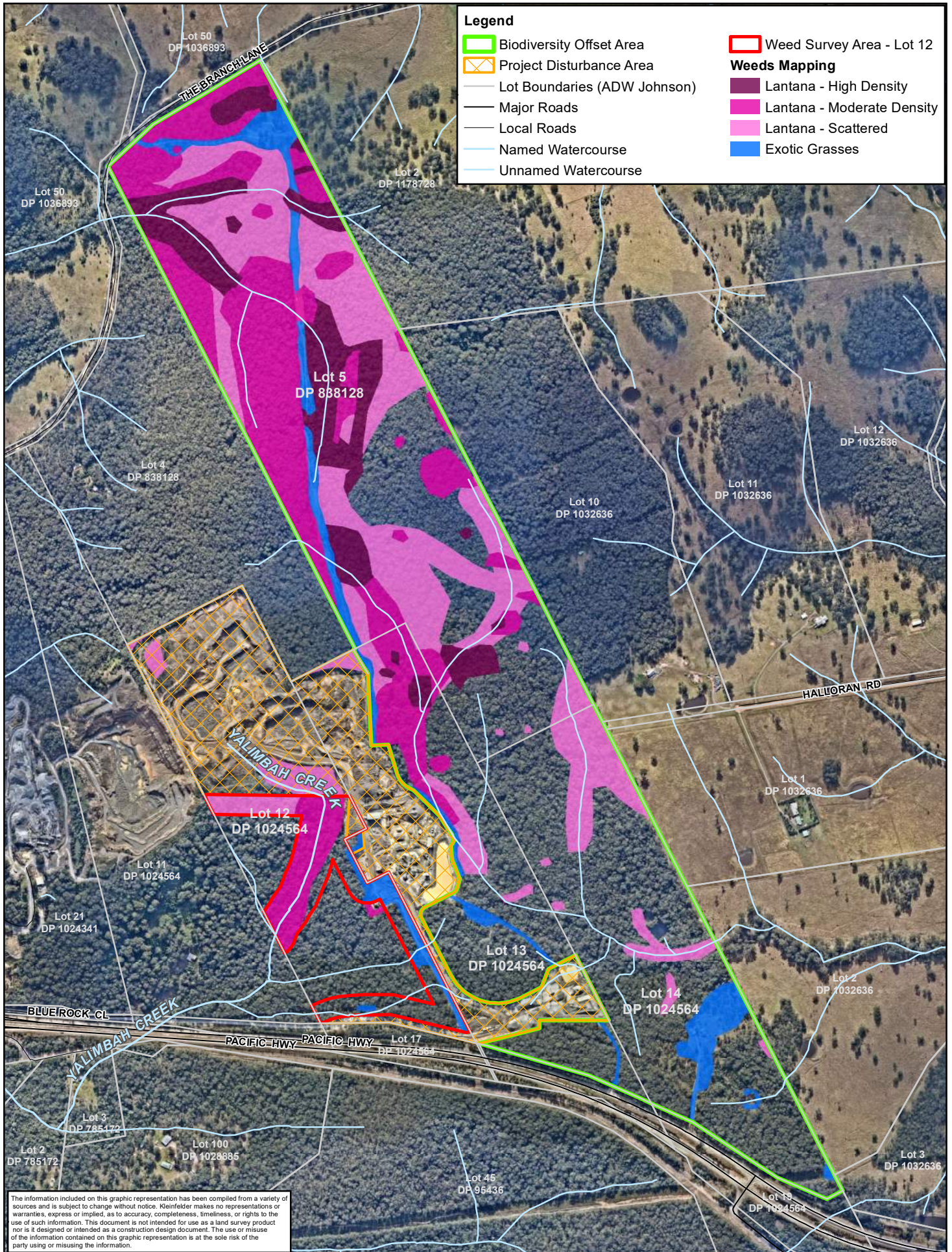
Several redundant sections of tracks within the southern part of the BOA are being successfully rehabilitated following the placement of branches, hollow logs / sections and other organic debris salvaged from the KEQ disturbance area during vegetation clearing. Maintenance is required at an access track to the south of the stockpile area. It has experienced minor erosion but is still traversable. Additional maintenance is recommended at the access tracks along the north-western boundary of Lot 5, that have become overgrown and are no longer accessible by vehicle.



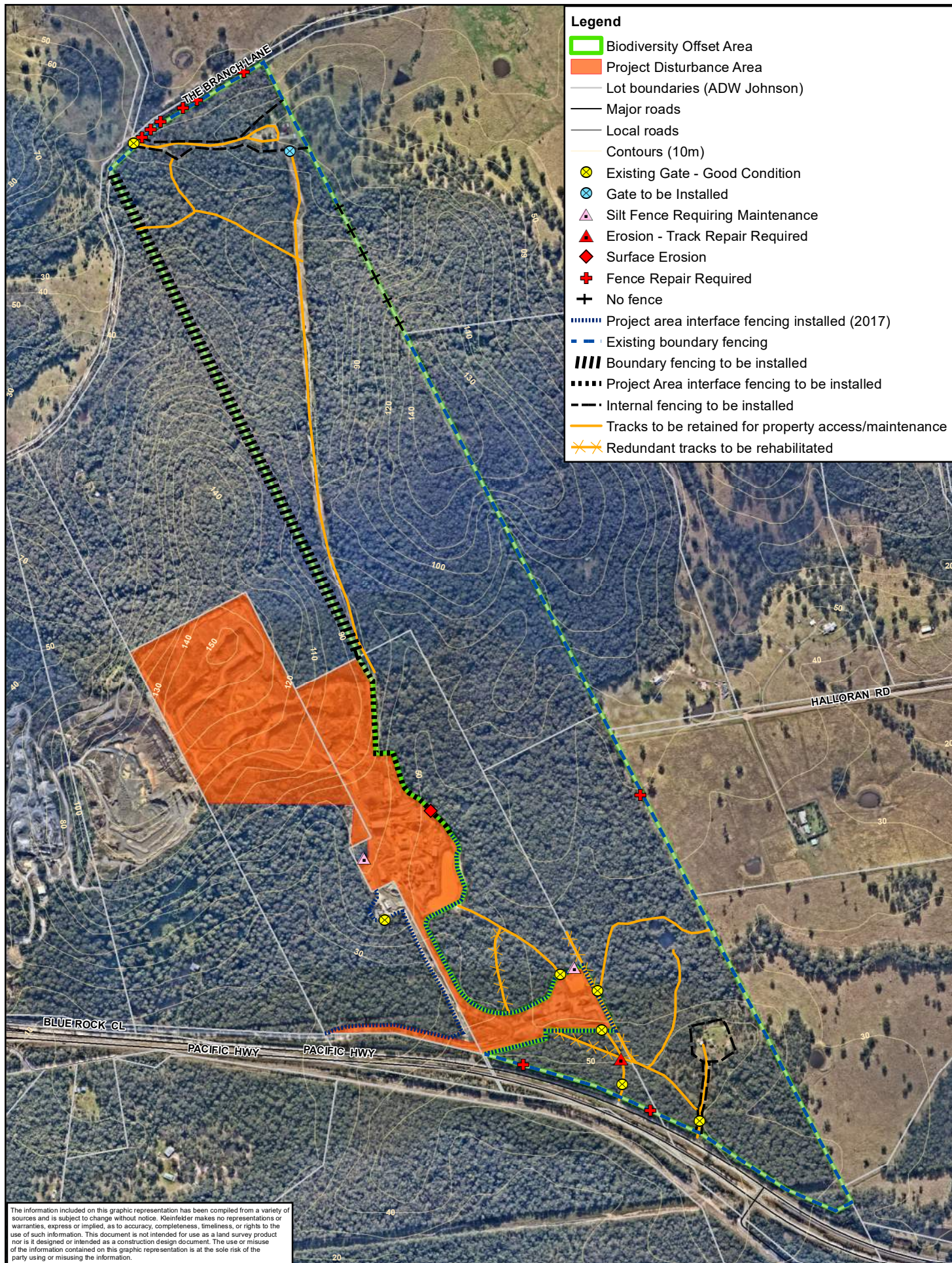
Plate 12: Fallen fence along far northern boundary of Lot 5.



Plate 13: Damaged fence along western boundary of haul road



Metres 0 50 100 200 300 400 500 KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT REFERENCE: 20222184 DATE DRAWN: 2022/01/18 14:00 Version 2 DRAWN BY: G.Joyce DATA SOURCE: NSW DFSI - 2017 ADW Johnson - 2015 Nearmap - 2021	Weed Mapping Karuah East Quarry Pty Ltd 2021 Annual Monitoring Report Karuah East Quarry Project	FIGURE: 5
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0 50 100 200 300 400 500 Metres KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT REFERENCE: 20222184 DATE DRAWN: 2022/01/20 16:18 Version 1 DRAWN BY: G.Joyce DATA SOURCE: NSW DFSI - 2017 ADW Johnson - 2015 Nearmap - 2021	Fencing, Track, Erosion, and Pest Issues Karuah East Quarry Pty Ltd 2021 Annual Monitoring Report Karuah East Quarry Project	FIGURE: 6



3.3.3 Erosion

No areas of major active erosion were identified within the BOA during the 2021 monitoring. Areas of bare ground previously identified on the access tracks within the BOA predominantly appeared to be stable with no substantial active erosion or sedimentation observed. Minor scouring was still evident in several locations along the drainage lines within Lot 5 and within the vicinity of monitoring sites MP 17 and MP 18 in Lot 12, as recorded in the previous survey period. 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.

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. No weed control had taken place within Lot 5 over the previous monitoring round, therefore no change of conditions was observed.

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 extent of the overburden stockpile and the area south east of Dam 1 had failed at the time of the 2018, 2019, 2020 and 2021 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. Many of these areas have begun to stabilise in some areas through the spread of exotic grass species over the disturbed areas, including roadsides and dam walls.

Key erosion and sedimentation issues were observed at three areas surrounding the quarry disturbance area:

- In three locations, the installed sediment fencing was overtopping (observed in 2018, 2019, 2020 and 2021) and, therefore, no longer provided active sediment control (**Figure 6**). It was observed in these locations that some sediment had been deposited within the surrounding environment. The overtopping sediment fencing along the western boundary of the quarry, within Lot 12, and adjacent to monitoring site MP 15 has fallen and is no longer adequately collecting sediment (see **Photo 1**).
- 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. No further changes were noted in 2019, 2020 or 2021. 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.
- It was observed in the 2021 monitoring event that excavated rock and sediment produced by the quarry operations has runoff the eastern boundary of the quarry into the BOA (**Photo 4**). This material forms a layer across this area where it is mixed in with organic material. It is recommended that silt fencing be installed to prevent the further introduction of this material into the BOA.



Photo 1 Sediment fencing down and overtopping within Lot 12.



Photo 4 Excavated rock and sediment that has runoff from the eastern boundary of the quarry into the BOA.



3.3.4 Vertebrate Pests

No feral pests, or evidence thereof, were detected in the 2021 monitoring period. Despite this, feral pigs (*Sus scrofa*) were recorded during the 2020 site inspections along the powerline easement in Lot 5 and in proximity to monitoring site MP 4, supporting previous observations of suspected Feral Pig diggings recorded in the southern half of the BOA area during previous site inspections (**Figure 6**). Karuah East Quarry conducted Feral Pig trapping in Lot 14 in March 2019 and implemented a broader feral animal control baiting programme in the BOA during December 2020.

Additionally, the red fox (*Vulpes vulpes*) has been identified within the BOA and was also targeted in the December 2020 baiting programme. Further trapping is recommended on a scheduled basis to manage the population within the BOA.

3.3.5 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 were stockpiled on the boundaries of the KEQ project area (see **Figure 7**).

In addition to this, a total of 77 hollows and hollow log sections were previously salvaged and set aside for redistribution into the BOA. The location of the hollow logs to be redistributed throughout the BOA is shown on **Figure 7**. Inspections in 2020 indicated that most hollows are unsuitable for reinstallation due to cracks in hollow walls or the requirement to substantially modify the hollow for reinstallation. As such, in July/August 2020, 193 nest boxes were installed to compensate for the loss of 116 hollows and also compensate for the need to reinstall 77 salvaged hollows. It is recommended that the 77 salvaged hollows be redistributed terrestrially within the BOA to provide habitat for terrestrial fauna species.

Tree hollows removed as part of clearing works completed on site in November 2016, May and August 2018, and October and November 2019, have now been sufficiently replaced as per the requirements of the BOAMP.

Further vegetation clearing undertaken in March, June, October, and November 2021 involved the removal of a total of 22 hollows, including ten (10) small hollows (<5 cm), six (6) medium hollows (5-20 cm), and six (6) large hollows (> 20 cm). Replacement of these hollows will require the installation of 22 nest boxes (based on a 1:1 replacement ratio) within the BOA site. The installation of these nest boxes can be undertaken alongside biennial nest box monitoring in August 2022.

Details on nest box installation are covered below.



Nest Boxes

Since 2016 a total of 318 nest boxes have been installed within the Karuah East Quarry BOA. Details of nest boxes installed are outlined in **Table 6**.

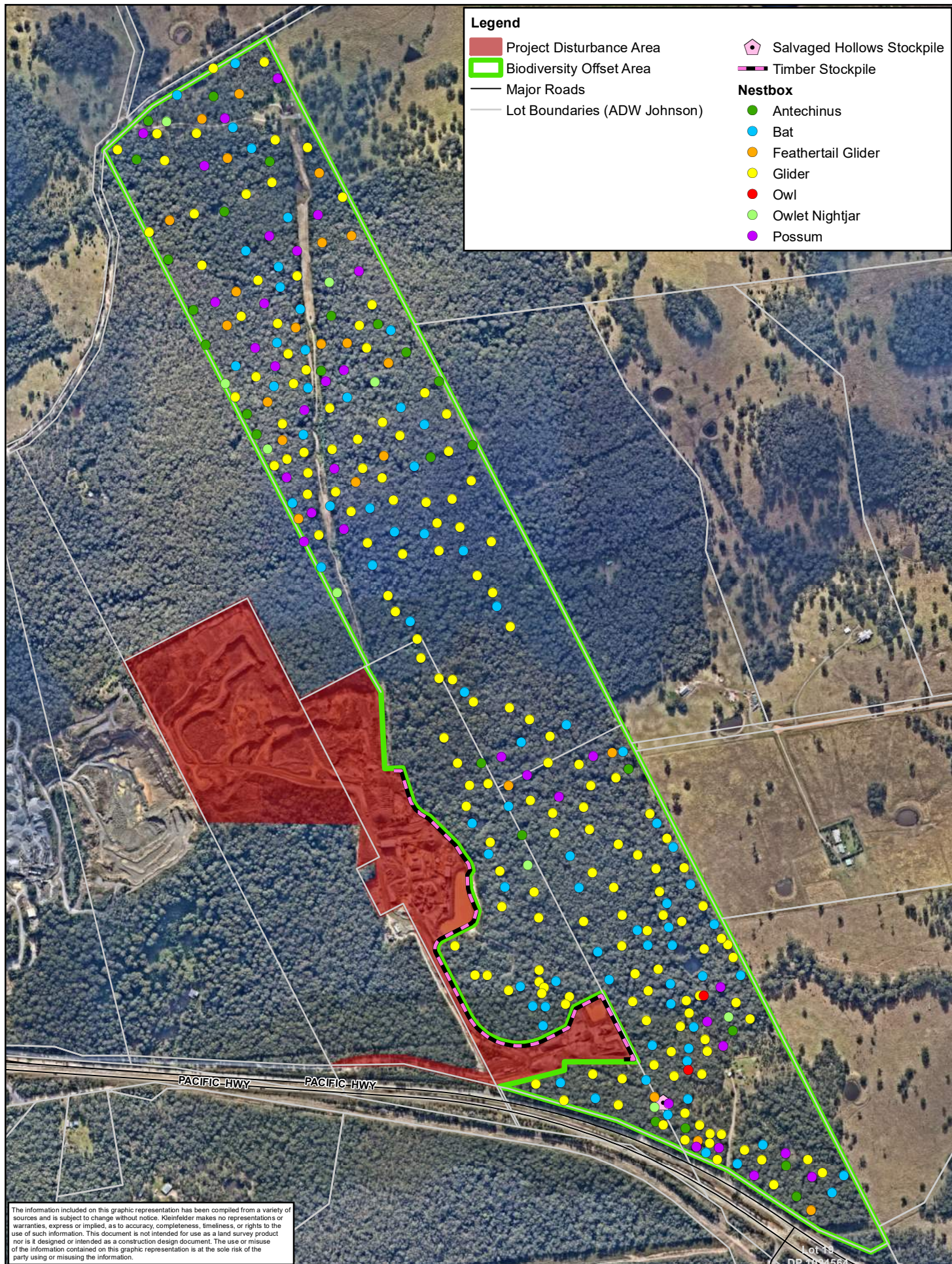
Table 6 Nest box installation details across KEQ BOA (2016-2020)

Installation Date	Installation Details	Box Types Installed
April 2016	30 nest boxes were installed within the BOA in April 2016 as per Section 3.8 of the BOAMP.	20 Glider boxes 10 Microchiropteran bat boxes
February 2018	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 (totaling 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.	62 Glider boxes 31 Microchiropteran bat boxes - Two owl nest boxes
July-August 2020	193 nest boxes were installed within the BOA to replace hollows removed during clearing undertaken on site in May and August 2018 at a ratio 1:1 as per the requirements of the L&RP and the BOAMP.	70 Glider boxes 33 Possum boxes 25 Antechinus boxes 33 Microchiropteran bat boxes 23 Feathertail Glider boxes - Nine Owlet Nightjar boxes

Biennial nest box monitoring was completed by Kleinfelder in 2018 and in 2020, results from these inspections are summarized below in **Table 7**. Nest box monitoring is due to be completed again in 2022.

Table 7 Nest box monitoring results (2018-2020)

Installation Date	Usage Rate	Details
2018 Inspection	2016 Install of 30 nest boxes (2yrs old) = 27% usage.	30 boxes were deemed to be available for use - No boxes recorded as damaged or unusable. - Eight Glider boxes showed signs of use including one being actively occupied by two Sugar Gliders (<i>Petaurus breviceps</i>). - None of the Microchiropteran bat exhibited signs of use during the survey.
2020 Inspection	2016 Install of 30 nest boxes (4yrs old) = 47% usage. 2018 Install of 95 nest boxes (2yrs old) = 28% usage.	122 boxes were deemed to be available for use - Two boxes were found to be damaged and one unusable box (termite infested). 40 Glider boxes showed signs of occupation, this included, three boxes occupied by Sugar Gliders (<i>Petaurus breviceps</i>) and 37 other boxes showing signs of use either from Sugar Gliders, Brown Antechinus (<i>Antechinus stuartii</i>) and Feathertail Gliders (<i>Acrobates pygmaeus</i>). - Almost half of all the glider nest boxes have either been utilised by or contain fauna species (usage rate of 49%). - None of the Microchiropteran bat boxes exhibited signs of use



0 50 100 200 300 400 500 Metres KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT REFERENCE: 20222184 DATE DRAWN: 2022/01/20 15:10 Version 1 DRAWN BY: G.Joyce DATA SOURCE: NSW DFSI - 2017 ADW Johnson - 2015 Nearmap - 2021	Habitat Resources and NestBox Locations Karuah East Quarry Pty Ltd 2021 Annual Monitoring Report Karuah East Quarry Project	FIGURE: 7



4 PERFORMANCE CRITERIA EVALUATION

BOAMP performance criteria and an evaluation of the current status, relevant management actions completed or further works required are detailed below in **Table 8**. 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 were due to be completed before March 2017 to ensure compliance with the relevant performance criteria.

Table 8 Current status of BOAMP performance criteria

Action	Performance Criteria	Current Status (2020)
<i>Fencing, Gates and Signage</i>		
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 Ongoing installation of boundary fencing, gates and signage required. Mostly restricted due to access (e.g. around uncleared areas of the extraction area).
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	Maintain boundary fencing as direct by annual inspection	Maintenance required following 2021 inspection. Repair of boundary fencing, gates and signage is to be undertaken as required.
<i>Access Tracks</i>		
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 2021 monitoring.
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.
<i>Erosion, Sedimentation and Soil Management</i>		
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	The 2020 survey identified areas requiring repair and/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 (2020)
Erosion inspections	Completed annually	Annual inspection completed in December 2021.
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 2021.
Maintenance and weed control	No noxious weeds present within excised areas. No unauthorised disturbance outside of excised areas in the BOA.	The exotic species, <i>Lantana camara</i> is present within the BOA, identified during 2021 monitoring surveys. This species appears to be increasing in abundance and range. Control is recommended to prevent the spread of this species and the potential decline of vegetation integrity of the BOA. No unauthorised disturbance observed outside of excised areas in the BOA during 2021 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, 2018, 2019, 2020 or 2021 monitoring events. 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	The 77 salvaged hollows were determined to be unsuitable for reinstallation. The installation of 193 nest boxes in July/August 2020 compensates for the loss of these hollows and recent clearing works undertaken on site.
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.	Completed. A total of 318 nest boxes have been installed within the BOA. This includes' Thirty nest boxes installed in the southern part of the BOA in April 2015 prior to commencement of clearing, an additional 95 were installed in February 2018, and the installation of 193 nest boxes in July-August 2020 which were required for clearing completed in November 2019. Outstanding – a total of 22 nest boxes will need to be installed within the BOA as replacements for hollows removed under vegetation clearing works undertaken in March, June, October and November 2021.
Nest box monitoring and maintenance	Nest boxes inspected every two years. Repairs / maintenance implemented within 6 months of biennial inspection.	Monitoring of nest box 1-30 was carried in April 2018. Monitoring of boxes 1-125 was carried out in June 2020.
Threatened Flora Translocation		
Tetratheca juncea translocation	Translocation completed by end of year 1 Maintenance and monitoring undertaken in accordance with the TJMP	Refer to Tj Translocation Monitoring Report (Firebird 2018).



Action	Performance Criteria	Current Status (2020)
Weed Control		
Baseline weed mapping	Completed by end of year 1	Baseline assessment completed in October 2015 (Kleinfelder 2015).
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.	Outstanding There has been little change in weed density over the Lot 5 area since the 2018 monitoring round. 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. Additional weed control was undertaken in February 2019. Further dieback was recorded in November 2019, so that only scattered individuals now occur. Weed control has been undertaken along the boundary fence of Lot 12 in February 2019, and along the entire perimeter of Lot 12 in November 2019. Further weed control is recommended to prevent the establishment of Lantana (low density areas) or control established patches (medium/high density areas).
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 2021.
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 control was undertaken in February 2019.
Monitoring	Completed biennially (every two years).	Outstanding 2017 biennially vertebrate pest monitoring required. 1080 baiting was undertaken within Lot 5 during December 2020.
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.
Aerial Fauna Crossing		



Action	Performance Criteria	Current Status (2020)
Installation of aerial fauna crossings	Installed upon completion of Haul Road. 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.	Completed Aerial fauna crossings installed at Karuah Hardrock Quarry in 2019, and KEQ in 2020. Remote Camera monitoring programmes for both crossings are proposed, requiring installation of cameras.

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>Tetratheca 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 2019. An average of 8% decline in threatened flora species at monitoring sites was observed during 2019 survey.

*Criteria relating to revegetation within the project area is outlined in the Landscape and Rehabilitation Management Plan (L&RMP).



5 CONCLUSION

Results from the 2021 KEQ BOA annual monitoring indicate that the vegetation and fauna habitats within the Karuah East Biodiversity Offset Area (BOA) and Lot 12 are in good condition and have remained relatively stable since the previous monitoring event in 2020.

The 2021 monitoring programme has identified several key management actions that are required to be completed, which have been highlighted in **Section 4** of this report. Key results from the 2021 monitoring programme include:

- *Asperula asthenes*, *Tetratheca juncea* and *Grevillea parviflora subsp. parviflora* populations are in good condition. Several populations have increased in size since annual monitoring in 2020, likely due to recent favourable weather conditions. Others have experienced a small decrease but have overall remained relatively stable.
- Key disturbances recorded within the KEQ BOA and Lot 12 include minor sedimentation due to overtopping of a small number of sediment fences, the occurrence of dust on foliage within close proximity to quarry operations, and the runoff of excavated rock into the BOA from the eastern boundary of the quarry operations.
- Weed coverage across the KEQ BOA and Lot 12 has increased – management is required to reduce Lantana cover, especially within the northern portion of the site, adjacent to the powerline easement.
- Maintenance required to repair fencing, sediment fencing and minor localised erosion at a track to the south of the stockpile area.
- No feral pigs, or evidence thereof, were observed during the 2021 monitoring event, however this species was identified near the powerline easement in 2020. Despite not having been identified, it is likely this species persists within the BOA and therefore continued control programmes be carried out.
- A total of 318 nest boxes have been installed to date across the KEQ BOA. Monitoring of nest boxes have been carried out in 2018 and 2020. A further 22 nest boxes will need to be installed to replace hollows removed during vegetation clearing works in 2021. Installation of nest boxes can be completed alongside biennial nest box monitoring which is due to be completed in August 2022.



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APPENDIX A RESULTS

VEGETATION CONDITION ASSESSMENT





Table A1 Vegetation condition and threatened flora monitoring results summary (2021)

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP1	Spotted Gum – Grey Ironbark open forest	- Observed increase in ground cover following drier conditions between 2019-2020 - Midstorey regeneration present. - Moderate cover of fallen logs / timber. - Moderate to dense ground cover. - Low rock cover. Conclusion: This years monitoring identified a significant increase in ground cover in comparison to the previous survey (2020). Groundcover is likely recovering in response to favourable weather conditions following drier conditions between 2019-2020.	- 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. Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2020).	N/A
MP2	Spotted Gum – Grey Ironbark open forest	- Minor dieback of mid-storey species, <i>Bursaria spinosa</i> observed - Increase in ground cover in both 'grass' and 'other' categories within monitoring site: predominantly <i>Themeda triandra</i>. - Moderate cover of fallen logs / timber. - Rocky areas present. - Hollow-bearing trees and one stag present within vicinity of monitoring site. Conclusion: Significant increase in 'grass' and 'other' groundcover, suggesting recovery from drier conditions experienced on site during 2019-2020. No other significant changes in vegetation and habitat condition since the previous survey (2020).	- 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. - Small increase in weed cover within monitoring plot. Heavy <i>Lantana</i> infestation in the gully south west of MP2 remains. Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2020).	N/A



Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP3	Brush Box – Turpentine shrubby open forest	• Increase in vine species abundance within the monitoring plot. • Evidence of minor dieback in shrub stratum, likely due to vine smothering. • Apart from the minor shrub dieback all vegetation strata within the monitoring site in healthy condition. • Canopy and midstory remain stable. • High structural complexity of vegetation. • High fallen timber. • Light-Moderate cover of fallen timber. • Weed cover (<i>Lantana</i> and <i>Tradescantia</i>) within the monitoring site has increased, potentially in response to high rainfall in 2021. Conclusion: Excluding an increase in the abundance of exotic plants, no significant or notable changes in vegetation and habitat condition since the previous survey (2020).	• No evidence of erosion and sedimentation. • No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal. • No signs of recent fire. Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2020).	• There was an increase in number of <i>Asperula asthenes</i> individuals within the monitoring site from 15 in 2020 to 18 in 2021. • Two new <i>Asperula asthenes</i> plants were recorded in 2021. • Five <i>Asperula asthenes</i> plants were recorded flowering during monitoring. • All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition. • The population at MP 3 remains stable since 2015 baseline (16 individuals recorded) and has likely benefited from recent more favourable weather conditions.
MP4	Brush Box – Turpentine shrubby open forest	• Large increase in <i>Doodia aspera</i> abundance within the understorey of the monitoring plot. • Decrease in overall shrub cover, potentially due to vine smothering. • Apart from the minor shrub dieback all vegetation strata within the monitoring site in healthy condition. • Canopy and midstory remain stable. • High structural complexity of vegetation. • High fallen timber. • Weed cover (<i>Lantana</i> and <i>Tradescantia</i>) within the monitoring site remain stable. Conclusion: A notable increase in the abundance of ferns in the understorey, and a reduction in overall shrub cover. No other significant or notable changes in vegetation and habitat condition since the previous survey (2020).	• No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal. • No recent evidence of disturbance from grazing, rubbish dumping, rock / timber removal, or dust. • No signs of recent fire. • Weed abundance remains stable. Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2020).	• There was a decrease in number of <i>Asperula asthenes</i> individuals recorded within the monitoring site, from 40 in 2020 to 32 in 2021. • Nine new <i>Asperula asthenes</i> individuals were recorded in 2021. • Six <i>Asperula asthenes</i> plants were recorded flowering during monitoring. • All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition. • The population at MP 4 remains stable since 2015 baseline (15 individuals recorded) with recent large increase in population likely the result of recent more favourable weather conditions.



Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP5	Blackbutt – Turpentine – Tallowwood shrubby open forest	- No evidence of foliage die-back was observed in the canopy or ground layer - Midstory regeneration present: significant increase in shrub abundance. - Moderate fallen logs / timber. - Moderate/dense ground cover. Conclusion: No significant changes in vegetation and habitat condition since the previous survey (2020).	- 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. Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2020).	N/A
MP6	Blackbutt – Turpentine – Tallowwood shrubby open forest	- Increase in abundance of midstorey species, particularly <i>Callistemon salignus</i>. - Canopy remains in healthy condition. - Canopy and midstory regeneration present. - Moderate level of fallen logs / timber. - Ground cover remains stable. - Lantana has established in low abundance within the monitoring point. Conclusion: No significant changes in vegetation and habitat condition since the previous survey (2020).	- No evidence of erosion and sedimentation. - No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal was observed. - Dust cover observed on foliage. - No signs of recent fire. Conclusion: Dust cover on foliage was observed within the monitoring site in 2020 and again in 2021.	N/A
MP7	Smooth-barked Apple - Red Bloodwood open forest	- Regeneration of foliage in canopy and midstory. - All vegetation strata in healthy condition. - Regrowth vegetation to the north and east (previously cleared). - Moderate litter cover within monitoring site, fallen timber present. - Increase in shrub cover since 2020. - Increase in groundcover recorded within the monitoring site since 2020 (see Appendix B). increase in <i>Gahnia radula</i>. Conclusion: The monitoring point remains stable with signs of regeneration and increasing abundance in several stratum since the previous survey (2020).	- No evidence of erosion and sedimentation. - No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal. - Dust cover observed on foliage. - No signs of recent fire. Conclusion: Dust cover on foliage was observed within the monitoring site in 2020 and again in 2021.	- There was a small decrease in the number of <i>Tetratheca juncea</i> clumps recorded within the monitoring site, from 16 in 2020 to 15 in 2021. - One new <i>Tetratheca juncea</i> clump was recorded in 2021. - Nine <i>Tetratheca juncea</i> plants were recorded flowering during monitoring. - Eight <i>Tetratheca juncea</i> plants were recorded with fruits during monitoring. - All <i>Tetratheca juncea</i> plants within the monitoring site were observed to be in healthy condition. - The <i>Tetratheca juncea</i> population at MP 7 remains stable since 2015 baseline (14 individuals recorded)



Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP8	Smooth-barked Apple - Red Bloodwood open forest	- Changes to groundcover composition, with a decrease in grass groundcover and an increase in 'other' with <i>Ptilotrix deusta</i> recorded higher than in previous years (Appendix B). - Subsequent increase in non-grass groundcover due to misidentified <i>Ptilotrix deusta</i>. - No exotic species identified within this plot. - No dieback of canopy stratum was observed. - Canopy and midstorey regeneration present - Moderate fallen timber - Dense ground cover and midstory - Estimated foliage cover decreased for ground cover Conclusion: Change in groundcover PFC due to mis-identified plant. Minor changes in vegetation and habitat condition since the previous survey (2020).	- 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 Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2020).	- The number of <i>Tetradlea juncea</i> clumps remains stable recorded within the monitoring site, with 13 plants recorded in 2020 and 2021. - One new <i>Tetradlea juncea</i> clump was recorded in 2021. - Five <i>Tetradlea juncea</i> plants were recorded flowering during monitoring. - One <i>Tetradlea juncea</i> plant was recorded with fruits during monitoring. - All <i>Tetradlea juncea</i> plants within the monitoring site were observed to be in healthy condition. - The <i>Tetradlea juncea</i> population at MP 8 has increased slightly since 2015 baseline (10 individuals recorded). - The one <i>Grevillea parviflora</i> subsp. <i>parviflora</i> individual occurring within MP 8 in 2020 was absent during the 2021 monitoring surveys.
MP9	Smooth-barked Apple - Red Bloodwood open forest	- Minor dieback and subsequent reduction in canopy cover. - There was no sign of foliage die-back in the understory. - Dead wood was observed throughout the canopy. - Moderate/high fallen timber. - Moderate ground cover present. Conclusion: Minor changes in vegetation and habitat condition since the previous survey (2020).	- No evidence of erosion and sedimentation. - No recent evidence of disturbance from grazing, pest animals, rock / timber removal, or dust. - No signs of recent fire. - Old track to south. Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2020).	N/A



Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP10	Sydney Peppermint - Smooth-barked Apple shrubby open forest	- Increased PFC in midstorey from <i>Allocasuarina litoralis</i> growth. - All vegetation strata in healthy condition. - Canopy and midstory regeneration present. - Low-moderate fallen timber and moderate litter coverage.. - Moderate to dense ground cover. Conclusion: No major changes in vegetation and habitat condition since the previous survey (2020).	- 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). Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2020).	N/A
MP11	Sydney Peppermint - Smooth-barked Apple shrubby open forest	- No evidence of foliage die-back. - All vegetation strata in healthy condition. - Canopy and midstory regeneration present. - Low fallen timber. - Moderate ground cover. Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2020).	- 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. Conclusion: No recent disturbance was observed since the previous survey (2020).	- There was a decrease in the number of <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants recorded within the monitoring site, from 16 in 2020 to 10 in 2021. - No new <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants were recorded in 2021. - The majority of <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants within the monitoring site were observed to be in healthy condition. - Two <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants were recorded as having moderate dieback. - The <i>Grevillea parviflora</i> subsp. <i>parviflora</i> population at MP 11 has declined since 2015 baseline (16 individuals recorded). - The one <i>Tetratheca juncea</i> clump recorded at MP 11 in 2020 continues to be in a healthy condition with 17 flowers and five fruit.



Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP12	Smooth-barked Apple – Red Bloodwood open forest	- Midstorey reduced compared to surroundings. - Very high levels of fallen timber (from clearing). - Moderate ground cover. - Evidence of regeneration in understorey and midstorey. - There has been a small decrease in estimated foliage cover for the canopy. (Appendix B). Conclusion: Felled timber remains (from previous impact due to fence maintenance), however, no significant changes have occurred to vegetation and habitat condition since the previous survey (2020).	- No evidence of erosion and sedimentation. - No recent evidence of disturbance from pest animals, rubbish dumping, rock / timber removal or dust, however area has been previously subject to clearing due to fence line maintenance. - No signs of recent fire. - Clearing and log stockpiling in order to maintain an adjacent access track has impacted some of the vegetation including at least three <i>Grevillea parviflora</i> individuals. Conclusion: Excluding the maintenance of an adjacent accessway, no evidence of new disturbance was observed since the previous survey (2020).	- There was a small decrease in the number of <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants recorded within the monitoring site, from 9 in 2020 to 7 in 2021. - All <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants within the monitoring site were observed to be in healthy condition. - Four <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants were recorded with flowers in 2020. - One new <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plant was recorded. - The <i>Grevillea parviflora</i> subsp. <i>parviflora</i> population at MP 11 remains stable with surveys completed in 2015 (seven individuals recorded).
MP13	Spotted Gum – Grey Ironbark open forest	- Some dieback in mature <i>Allocasuarina torulosa</i> individuals. - Moderate to high level of dieback observed within the canopy and mid-storey. - Low level of fallen logs / timber. - Moderate to dense ground cover. - Low rock cover. - Substantial dieback in canopy directly adjacent to the monitoring point. Conclusion: Substantial dieback in mature <i>Allocasuarina</i> trees since the previous survey (2020).	- No evidence of erosion and sedimentation. - No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust. - Significant dust settlement recorded here in 2021. - No signs of recent fire. Conclusion: No evidence of new disturbance was observed since the previous survey (2020).	N/A



Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP14	Smooth-barked Apple - Red Bloodwood open forest	- Some dieback of <i>Setaria sphacelata</i>. - All vegetation strata in healthy condition. - Canopy and midstorey regeneration present. - Low fallen/ timber. - Minor reduction in grass groundcover, potentially due to high leaf litter. - Dense ground cover. Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2020).	- No evidence of erosion and sedimentation. - No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal. - No signs of recent fire. - Dust accumulation on foliage from Quarry. - Light cover of exotic grasses around dam to south and along access track. Conclusion: No evidence of new disturbance was observed since the previous survey (2020).	N/A
MP15	Blackbutt - Turpentine - Tallowwood shrubby open forest	- Foliage die-back previously observed in <i>Eucalyptus pilularis</i> not observed during the 2020 monitoring event. - Foliage die-back previously observed in <i>Acacia irrorata</i> observed originally during the 2020 monitoring event. - All vegetation strata in moderately healthy condition. - Moderate fallen timber. - Increased ground cover and leaf litter. - Rocky areas present. Conclusion: Only minor changes in vegetation and habitat condition since the previous survey (2020).	- No evidence of erosion and sedimentation. - There are some edge effects from adjacent clearing. - No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal. - No signs of recent fire. Conclusion: Dust cover on foliage was observed within the monitoring site in 2020 and again in 2021.	- There was an increase in the number of <i>Tetratheca juncea</i> clumps recorded within the monitoring site, from 9 in 2020 to 12 in 2021. - One new <i>Tetratheca juncea</i> clump was recorded in 2021. - Six <i>Tetratheca juncea</i> plants were recorded flowering during monitoring. - Four <i>Tetratheca juncea</i> plants were recorded with fruits during monitoring. - All <i>Tetratheca juncea</i> plants within the monitoring site were observed to be in healthy condition. - The <i>Tetratheca juncea</i> population at MP 15 has declined since 2015 baseline (30 individuals recorded). This decline in the <i>T. juncea</i> at MP 15 is most likely due to the lower than average rainfall during 2019, exacerbated by the location of the monitoring point; upper slopes of exposed hill side.



Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP16	Spotted Gum – Grey Ironbark open forest	- Increased midstorey PFC in response to increase <i>Syncarpia glomulifera</i> growth. - Increased non-grass groundcover in response to increased <i>Doodia aspera</i> abundance. - All vegetation strata in healthy condition. - Canopy and midstory regeneration present. - Moderate fallen timber. - Dense leaf litter and moderate ground cover. - Low rock cover. Conclusion: Some changes in vegetation and habitat condition since the previous survey (2020).	- 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. Conclusion: No evidence of new disturbance was observed since the previous survey (2020).	<i>Asperula asthenes</i> detected within monitoring plot for first time (2021). - Six individual plants identified in 2021. - All six <i>Asperula asthenes</i> plants were recorded flowering during monitoring. - Two <i>Asperula asthenes</i> plants were recorded fruiting during monitoring. - All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition
MP17	Brush Box - Turpentine shrubby open forest	- No evidence of foliage die-back, evidence of midstorey and canopy regeneration. - All vegetation strata in healthy condition. - Abundance of juvenile <i>Backhousia myrtifolia</i> in midstorey, subsequently increasing mid-storey cover. <i>Lantana camara</i> abundance remains stable. - High fallen timber. - Dense ground cover. - Rocky areas along ephemeral creek. Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2020).	- Very minor scouring along creek bank. - No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust. - Stable exotic plant community (<i>Lantana camara</i>). - No signs of recent fire. Conclusion: No evidence of new disturbance was observed since the previous survey (2020).	- There was a decrease in number of <i>Asperula asthenes</i> individuals within the monitoring site from 17 in 2020 to 10 in 2021. - Six <i>Asperula asthenes</i> plants were recorded flowering during monitoring. - All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition. - The population at MP 17 has had a small decrease since 2015 baseline (11 individuals recorded).



Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP18	Brush Box - Turpentine shrubby open forest	• All vegetation strata in healthy condition • Canopy and midstorey regeneration present • Moderate fallen timber • High level of leaf litter present. • Moderate ground cover • Rocky areas along ephemeral creek. • Increase in groundcover estimated foliage cover since the 2020 monitoring event (Appendix B). New growth of <i>Oplismenus imbecillis</i> and <i>Poa labillardierei</i>. Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2020).	• Very minor scouring along creek bank. • No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal. • Minor dust coverage on foliage. • No signs of recent fire. Conclusion: No evidence of new disturbance was observed since the previous survey (2020).	• There was a small decrease in number of <i>Asperula asthenes</i> individuals within the monitoring site from 10 in 2020 to 9 in 2021. • Three new <i>Asperula asthenes</i> plants were recorded in 2021. • Three <i>Asperula asthenes</i> plant was recorded flowering during monitoring. • All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition. • The population at MP 18 has declined slightly since 2015 baseline (13 individuals recorded). Previous years of below average rainfall have likely impacted this population, however with signs of plants reshooting and flowering, as well as plants sighted outside the monitoring point, this population has potential to recover.



APPENDIX B VEGETATION MONITORING DATA



Table B1 Projected Foliage Cover results summary (2015-2021)

Monitoring Site	Dominant Floristics		Projected Foliage Cover (%)						
			2015	2016	2017	2018	2019	2020	2021
MP 1	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%	50%	40%	40%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak) and <i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> (Cheese Tree)	40%	40%	40%	40%	40%	15%	20%
	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%	5%	5%	5%
	Ground (grass)	<i>Imperata cylindrica</i> (Blady Grass), <i>Oplismenus imbecillis</i> (Creeping Beard Grass), <i>Poa labillardierei</i> (Tussock) and <i>Themeda triandra</i> (Kangaroo Grass)	60%	60%	60%	60%	40%	20%	35%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Gonocarpus teucroides</i> (Raspwort), <i>Carex longibrachiata</i> and <i>Adiantum aethiopicum</i> (Common Maidenhair)	50%	50%	50%	50%	50%	20%	30%
	Exotic	<i>Lantana camara</i> (Lantana)	30%	30%	25%	25%	20%	10%	15%
MP 2	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%	40%	40%	35%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak), <i>Bursaria spinosa</i> (Blackthorn) and <i>Exocarpos cupressiformis</i> (Cherry Ballart)	40%	35%	35%	35%	35%	30%	20%
	Shrub	<i>Leucopogon juniperinus</i> (Prickly Beard-heath) and <i>Acacia ulicifolia</i> (Prickly Moses)	5%	5%	5%	5%	5%	10%	5%
	Ground (grass)	<i>Themeda triandra</i> (Kangaroo Grass) and <i>Poa labillardierei</i> (Tussock)	50%	50%	50%	50%	40%	25%	40%
	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%	40%	5%	30%
	Exotic	<i>Lantana camara</i> (Lantana)	5%	5%	1%	1%	1%	0%	2%
MP 3	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%	40%	35%	35%
	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%	60%	40%	40%
	Shrub	<i>Pittosporum multiflorum</i> (Orange Thorn), <i>Diospyros australis</i> (Black Plum) and <i>Bursaria spinosa</i> (Boxthorn)	40%	40%	50%	50%	60%	60%	55%
	Ground (grass)	<i>Oplismenus aemulus</i> (Australian Basket Grass)	<5%	<5%	<5%	<5%	<5%	<5%	<5%



Monitoring Site	Dominant Floristics		Projected Foliage Cover (%)						
			2015	2016	2017	2018	2019	2020	2021
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Carex longebrachiata</i> , <i>Adiantum hispidulum</i> (Rough Maidenhair Fern) and <i>Cissus antarctica</i> (Kangaroo Vine)	90%	90%	90%	90%	90%	65%	70%
	Exotic	<i>Lantana camara</i> (Lantana) and <i>Ageratina riparia</i> (Mistflower)	50%	50%	50%	50%	40%	20%	30%
MP 4	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%	40%	25%	30%
	Midstorey	<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> (Cheese Tree), <i>Livistona australis</i> (Cabbage-tree Palm), <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%	60%	60%	60%
	Shrub	<i>Pittosporum multiflorum</i> (Orange Thorn)	5%	5%	3%	3%	3%	20%	3%
	Ground (grass)	<i>Oplismenus aemulus</i> (Australian Basket Grass)	5%	5%	5%	5%	5%	15%	5%
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Morinda jasminoides</i> (Sweet Morinda) and <i>Carex longebrachiata</i>	90%	90%	90%	90%	90%	20%	70%
	Exotic	<i>Lantana camara</i> (Lantana), <i>Asparagus aethiopicus</i> (Ground Asparagus) and <i>Tradescantia fluminensis</i> (Wandering Jew)	35%	35%	25%	30%	30%	30%	30%
MP 5	Canopy	<i>Eucalyptus pilularis</i> (Blackbutt), <i>E. microcorys</i> (Tallowwood), <i>Angophora costata</i> (Smooth-barked Apple) and <i>E. globoidea</i> (White Stringybark)	40%	40%	40%	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%	60%	40%	40%
	Shrub	<i>Leptospermum polygalifolium</i> (Tantoon), <i>Hibbertia aspera</i> (Rough Guinea Flower), <i>Breynia oblongifolia</i> (Coffee Bush) and <i>Phyllanthus hirtellus</i> (Thyme Spurge)	5%	5%	10%	10%	10%	10%	25%
	Ground (grass)	<i>Entolasia stricta</i> (Wiry Panic) and <i>Oplismenus imbecillis</i> (Creeping Beard Grass)	60%	60%	60%	60%	60%	40%	35%
	Ground (other)	<i>Doryanthes excelsa</i> (Gynea Lily), <i>Pteridium esculentum</i> (Common Bracken), <i>Ptilothrix deusta</i> and <i>Lomandra longifolia</i> (Spiny-headed Mat-rush)	50%	50%	50%	50%	50%	50%	50%
	Exotic	<i>Lantana camara</i> (Lantana)	-	-	-	-	-	-	-
MP 6	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%	50%	45%	45%
	Midstorey	<i>Melaleuca styphelioides</i> (Prickly-leaved Tea Tree), <i>Allocasuarina torulosa</i> (Forest Oak), <i>Acmena smithii</i> (Lilly Pilly), <i>Callistemon sallignus</i> (Willow Bottlebrush) and <i>Backhousia myrtifolia</i> (Grey Myrtle), <i>Acacia</i> sp.	60%	60%	50%	55%	30%	20%	35%



Monitoring Site	Dominant Floristics		Projected Foliage Cover (%)						
			2015	2016	2017	2018	2019	2020	2021
	Shrub	<i>Hibbertia aspera</i> (Rough Guinea Flower), <i>Breynia oblongifolia</i> (Coffee Bush) and <i>Zieria smithii</i> (Sandfly Zieria)	<5%	<5%	<5%	5%	1%	5%	10%
	Ground (grass)	<i>Imperata cylindrica</i> (Blady Grass), <i>Calochlaena dubia</i> (Rainbow Fern), <i>Oplismenus imbecillis</i> (Creeping Beard Grass) and <i>Poa labillardierei</i> (Tussock)	20%	20%	20%	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%	30%	30%	30%
	Exotic	<i>Lantana camara</i> (Lantana)	-	-	-	-	-	-	2%
MP 7	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%	35%	40%	40%
	Midstorey	<i>Allocasuarina littoralis</i> (Black She-oak), <i>Leptospermum polygalifolium</i> (Tantoon) and <i>Allocasuarina torulosa</i> (Forest Oak)	40%	40%	40%	40%	40%	40%	40%
	Shrub	<i>Pultenaea euchila</i> (Orange Pultenaea)	5%	5%	5%	5%	5%	5%	10%
	Ground (grass)	<i>Themeda triandra</i> (Kangaroo Grass) and <i>Entolasia stricta</i> (Wiry Panic)	50%	50%	50%	50%	40%	25%	25%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Ptilothrix deusta</i> and <i>Gahnia radula</i>	70%	60%	60%	60%	60%	35%	40%
	Exotic	<i>Setaria sphacelata</i> (South African Pigeon Grass)	5%	5%	5%	5%	2%	2%	1%
MP 8	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%	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%	30%	40%	40%
	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%	15%	15%	15%
	Ground (grass)	<i>Entolasia stricta</i> (Wiry Panic) and <i>Themeda triandra</i> (Kangaroo Grass)	50%	50%	50%	50%	40%	40%	15%
	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%	50%	40%	50%
	Exotic	Nil	-	-	-	-	-	-	-
MP 9	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%	40%	40%	35%



Monitoring Site	Dominant Floristics		Projected Foliage Cover (%)						
			2015	2016	2017	2018	2019	2020	2021
	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%	50%	40%	40%
	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%	7%	7%	10%
	Ground (grass)	<i>Imperata cylindrica</i> (Blady Grass), <i>Rhytidosperra pallidum</i> (Red-anther Wallaby Grass), <i>Entolasia stricta</i> (Wiry Panic) and <i>Themeda triandra</i> (Kangaroo Grass)	30%	30%	40%	40%	40%	30%	30%
	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%	40%	40%	40%
	Exotic	Nil	-	-	-	-	-	-	-
MP 10	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%	35%	40%	40%
	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%	10%	10%	15%
	Shrub	<i>Pultenaea euchila</i> (Orange Pultenaea), <i>Leptospermum polygalifolium</i> (Tantoon), <i>Pultenaea paleacea</i> (Chaffy Bush-pea) <i>Polyscias sambucifolia</i> (Elderberry Panax) and <i>Acacia ulicifolia</i> (Prickly Moses)	5%	5%	5%	5%	5%	3%	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%	30%	40%	30%
	Ground (other)	<i>Gahnia radula</i> , <i>Doryanthes excelsa</i> (Gynea Lily), <i>Lomandra longifolia</i> (Spiny-headed Mat-rush) and <i>Ptilothrix deusta</i>	60%	60%	60%	60%	50%	40%	50%
	Exotic	Nil	-	-	-	-	-	-	-
MP 11	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%	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%	40%	40%	45%
	Shrub	<i>Pultenaea euchila</i> (Orange Pultenaea) and <i>Boronia pinnata</i>	5%	5%	5%	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%	30%	25%	25%
	Ground (other)	<i>Xanthorrhoea latifolia</i> , <i>Pteridium esculentum</i> (Common Bracken) and <i>Ptilothrix deusta</i> , <i>Doryanthes excelsa</i> (Gynea Lily)	60%	60%	60%	60%	50%	40%	40%
	Exotic	Nil	-	-	-	-	-	-	-



Monitoring Site	Dominant Floristics		Projected Foliage Cover (%)						
			2015	2016	2017	2018	2019	2020	2021
MP 12	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%	40%	35%	30%
	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%	30%	15%	15%
	Shrub	<i>Pultenaea euchila</i> (Orange Pultenaea), <i>Boronia pinnata</i> and <i>Banksia spinulosa</i> (Hairpin Banksia)	10%	10%	10%	5%	10%	5%	5%
	Ground (grass)	<i>Themeda triandra</i> (Kangaroo Grass), <i>Entolasia stricta</i> (Wiry Panic), and <i>Austrostipa</i> sp.	40%	40%	40%	30%	30%	20%	20%
	Ground (other)	<i>Xanthorrhoea latifolia</i> and <i>Ptilothrix deusta</i>	40%	40%	40%	30%	30%	10%	15%
	Exotic	<i>Senecio madagascariensis</i> (Fireweed)	-	-	-	-	-	-	0.5%
MP 13	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%	50%	25%	25%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest Oak), <i>Syncarpia glomulifera</i> (Turpentine) and <i>Callistemon salignus</i> (Willow Bottlebrush)	40%	40%	40%	40%	40%	10%	10%
	Shrub	<i>Hibbertia aspera</i> (Rough Guinea Flower), <i>Pultenaea euchila</i> (Orange Pultenaea), <i>Breynia oblongifolia</i> (Coffee Bush) and <i>Leptospermum polygalifolium</i> (Tantoon)	5%	5%	5%	5%	5%	2%	3%
	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%	70%	60%	60%
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Doryanthes excelsa</i> (Gynea Lily), <i>Lepidosperma laterale</i> , <i>Patersonia sericea</i> and <i>Lomandra multiflora</i> (Many-flowered Mat-rush)	30%	30%	40%	40%	40%	30%	30%
	Exotic	Nil	-	-	-	-	-	-	-
MP 14	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%	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%	25%	25%	25%
	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%	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%	80%	80%	75%



Monitoring Site	Dominant Floristics		Projected Foliage Cover (%)						
			2015	2016	2017	2018	2019	2020	2021
	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%	30%	30%	30%
	Exotic	<i>Setaria sphacelata</i> (South African Pigeon Grass)	5%	5%	5%	5%	2%	2%	1%
MP 15	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%	45%	45%	40%
	Midstorey	<i>Allocasuarina torulosa</i> (Forest She-oak) and <i>Acacia irrorata</i> (Green Wattle)	20%	20%	15%	15%	15%	15%	10%
	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%	10%	10%	15%
	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%	25%	25%	25%
	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%	50%	50%	55%
	Exotic	<i>Lantana camara</i> (Lantana)	5%	5%	1%	1%	1%	1%	1%
MP 16	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%	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%	30%	30%	35%
	Shrub	<i>Leucopogon juniperinus</i> (Prickly Beard-heath) and <i>Acacia floribunda</i> (White Sally Wattle)	10%	10%	10%	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%	30%	25%	25%
	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%	30%	20%	35%
	Exotic	<i>Lantana camara</i> (Lantana)	30%	30%	30%	40%	30%	30%	30%
MP 17	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%	40%	45%	45%
	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%	50%	50%	55%



Monitoring Site	Dominant Floristics		Projected Foliage Cover (%)						
			2015	2016	2017	2018	2019	2020	2021
	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%	5%	5%	5%
	Ground (grass)	<i>Poa labillardierei</i> (Tussock), <i>Themeda triandra</i> (Kangaroo Grass) <i>Entolasia marginata</i> (Bordered Panic) and <i>Oplismenus imbecillis</i> (Creeping Beard Grass).	40%	40%	40%	40%	40%	25%	20%
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Gymnostachys anceps</i> (Settlers' Twine) and <i>Calochlaena dubia</i> (Rainbow Fern)	50%	50%	50%	50%	50%	65%	65%
	Exotic	<i>Lantana camara</i> (Lantana)	10%	15%	15%	15%	15%	15%	15%
MP 18	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%	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%	25%	25%	25%
	Shrub	<i>Acacia maidenii</i> (Maiden's Wattle) and <i>Denhamia silvestris</i> (Narrow-leaved Orangebark), <i>Persoonia linearis</i> (Narrow-leaved Geebung)	5%	5%	5%	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%	40%	15%	20%
	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%	40%	30%	35%
	Exotic	<i>Lantana camara</i> (Lantana)	10%	15%	15%	15%	15%	15%	15%



APPENDIX C RESULTS

THREATENED FLORA MONITORING





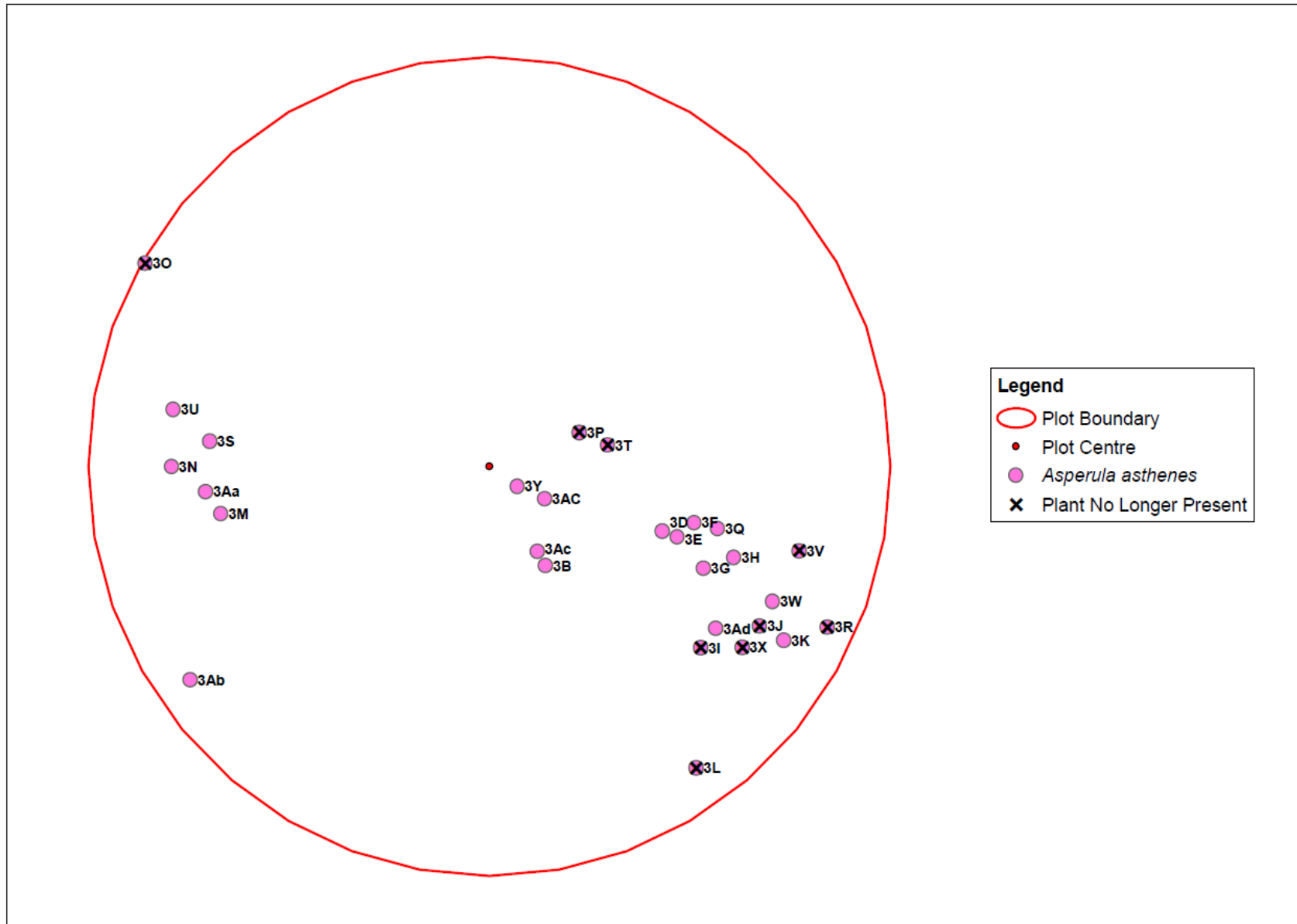
Biodiversity Offset Area Monitoring Sites

Monitoring Point 3 *Asperula asthenes* monitoring results

ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
3A	160	140	30 x 25	70 x 40	10 x 5	30 x 10	-	-			merged with 3C
3B	280	150	20 x 25	-	5 x 5	-	-	-	60 x 60	Flowers / Fruit Present	
3C	160	120	40 x 30	40 x 30	170 x 90	200 x 50	110 x 110	110x110	130 x 100	Flowers	large clumps
3D	460	110	50 x 20	30 x 20	-	-	-	-	10 x 20	Flowers	
3E	500	110	55 x 30	30 x 30	45 x 40	5 x 5	-	-	10 x 10	Flowers / Fruit	
3F	530	105	50 x 10	30 x 30	60 x 20	60 x 20	80 x 60	100x60	100 x 60	Flowers / Fruit	
3G	590	115	25 x 35	25 x 40	170 x 80	-	10 x 5	10x5	20 x 20	Flowers	
3H	650	110	20 x 20	40 x 20	-	100 x 100	60 x 40	20x40	60 x 40	Flowers	new shoots
3I	690	130	40 x 25	30 x 20	-	-	-	-	-		
3J	780	120	35 x 20	20 x 20	-	80 x 50	-	-	-		
3K	850	120	30 x 30	30 x 30	60 x 15	-	10 x 5	-	30 x 10	Flowers / buds	small clump
3L	900	145	35 x 45	20 x 10	-	-	-	10x10	-		
3M	680	260	40 x 35	40 x 35	25 x 30	40 x 20	60 x 40	40x2	20 x 5	Flowers	
3N	790	270	30 x 25	30 x 20	-	-	120 x 50	20x6	10 x 10	Flowers	
3O	990	300	55 x 25	-	-	20 x 5	-	50x30	-		
3P	240	90	40 x 20	40 x 15	40 x 15	40 x 20	150 x 90	-	-		
3Q	590	105	-	40 x 10	-	-	-	50x30	40 x 10	Flowers	



ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
3R	930	115	-	30 x 30	-	-	-	-	-		
3S	700	275	-	20 x 30	5 x 5	-	-	-	20 x 20	Flowers	
3T	300	80	-	-	5 x 25	-	-	-	-		
3U	800	280	-	-	30 x 20	50 x 20	30 x 30	30x30	50 x 20	Flowers	
3V	800	105	-	-	-	5 x 5	-	-	-		
3W	780	115	-	-	-	80 x 50	80 x 30	40x30	10 x 40	Flowers	New shoots
3X	770	125	-	-	-	5 x 5	-	-	-		
3Y	85	125	-	-	-	-	40 x 60	30x10	-		
3Z	780	280	-	-	-	-	-	20x20	-		
3AA	710	265	-	-	-	-	-	10x10	30 x 30	No Flowers	
3AB	910	235	-	-	-	-	-	30x30	60 x 30	Flowers / Fruit	New shoots
3AC	910	235	-	-	-	-	-	-	30 x 30	Flowers	New clump
3AD	910	235	-	-	-	-	-	-	40 x 40	Flowers	New clump



Monitoring Point 3 *Asperula asthenes* monitoring results



Monitoring Point 4 ***Asperula asthenes* monitoring results**

ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
4A	160	195	30 x 20	30 x 20	5 x 5	-	-	-	30 x 20		new shoots
4B	620	215	55 x 20	45 x 25	-	20 x 10	-	-	30 x 30		
4C	660	215	30 x 15	30 x 30	-	5 x 5	-	10x5	100 x 30		
4D	630	220	20 x 20	20 x 20	-	20 x 10	45 x 45	45x45	-		
4E	760	220	65 x 20	40 x 20	10 x 5	-	10 x 5	10x5	-		
4F	810	210	70 x 45	70 x 40	10 x 5	-	-	-	-		
4G	940	205	40 x 15	50 x 10	30 x 10	5 x 10	70 x 50	40x40	20 x 20	flowers	
4H	740	205	50 x 30	50 x 30	20 x 10	40 x 30	50 x 40	50x40	10 x 10	-	
4I	740	200	80 x 15	60 x 40	-	5 x 10	-	-	-		
4J	110	325	80 x 30	60 x 30	70 x 10	10 x 70	100 x 80	40x20	-		
4K	890	25	30 x 30	40 x 30	60 x 60	-	-	-	-		
4L	920	20	55 x 35	50 x 25	50 x 30	5 x 3	-	-	-		
4M	210	105	115 x 30	90 x 40	90 x 10	-	-	-	10 x 10	-	
4N	840	185	110 x 30	100 x 40	50 x 10	40 x 30	40 x 25	15x10	5 x 5	-	one shoot
4O	590	70	40 x 25	50 x 50	80 x 5	-	-	-	-		
4P	850	235	-	20 x 20	40 x 2	-	-	-	-		
4Q	680	355	-	20 x 30	180 x 80	60 x 20	50 x 20	5x5	-		
4R	155	270	-	-	20 x 5	50 x 10	100 x 40	20x10	-		
4S	590	80	-	-	10 x 15	-	-	-	-		



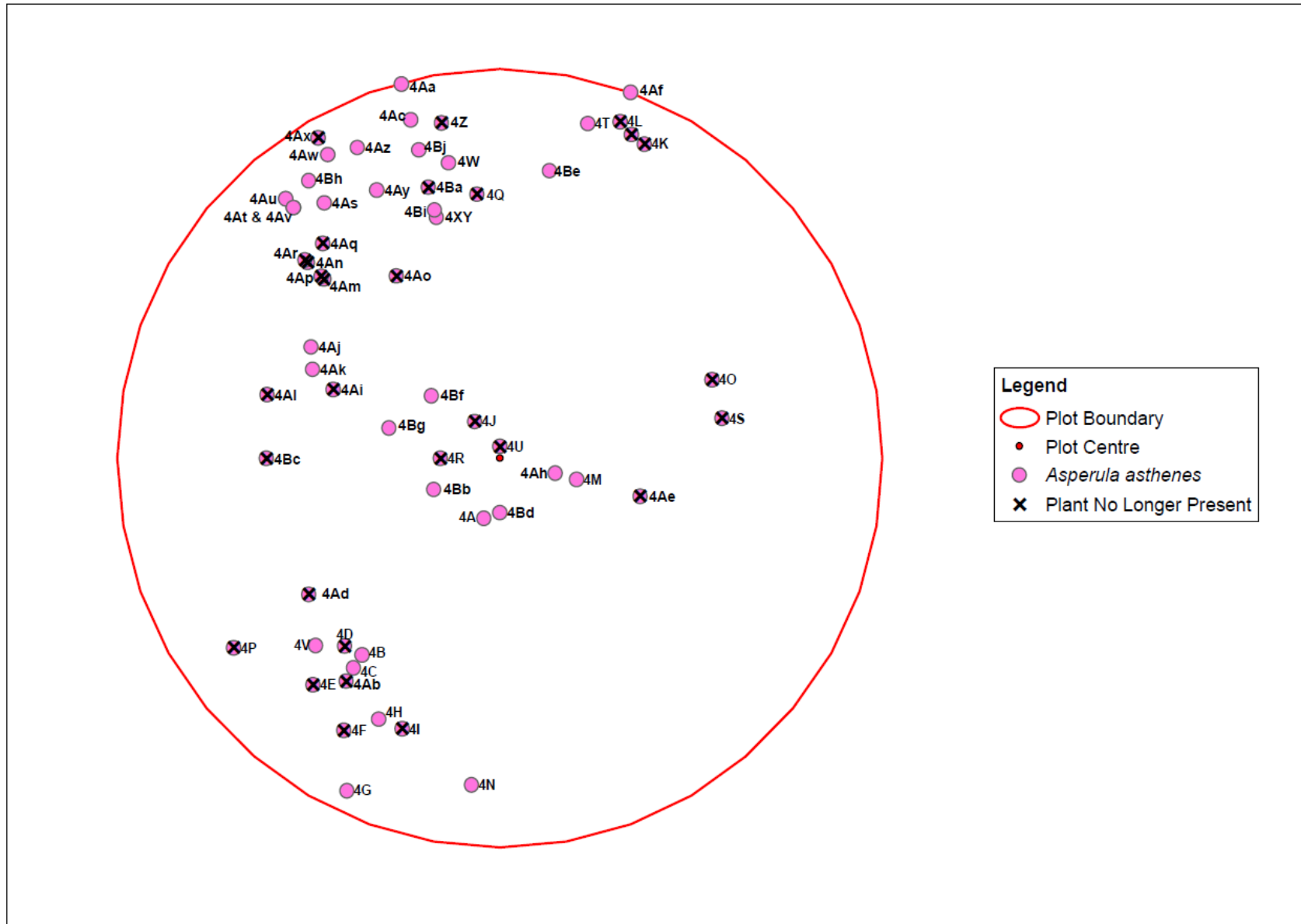
ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
4T	890	15	-	-	10 x 5	-	10 x 5	10x5	20 x 5	-	
4U	30	0	-	-	20 x 10	-	-		-		
4V	680	225	-	-	80 x 50	-	-		10 x 10	-	
4W	770	350	-	-	-	20 x 5	50 x 40	20x5	30 x 50	-	many stems
4X	640	345	-	-	-	50 x 20	80 x 60	15x5	30 x 15	flowers	
4Y	600	345	-	-	-	50 x 20	-	30x15	-		merged with 4X
4Z	875	350	-	-	-	30 x 5	70 x 30	30x10	-		
4Aa	995	345	-	-	-	10 x 10	80 x 50	10x10	30 x 10	-	
4Ab	700	215	-	-	-	10 x 5	-	-	-		
4Ac	900	345	-	-	-	-	10 x 5	10x5	20 x 20	flowers	
4Ad	610	235	-	-	-	-	35 x 20	-	-		
4Ae	380	105	-	-	-	-	10 x 5	-	-		
4Af	1000	20	-	-	-	-	55 x 30	5x10	50 x 60	flowers	
4AG	900	22.5	-	-	-	-	-	20x5	-		
4AH	150	105	-	-	-	-	-	20x20	20 x 20	-	
4AI	470	292	-	-	-	-	-	55x30	-		
4AJ	570	300	-	-	-	-	-	20x20	5 x 5	-	
4AK	540	295	-	-	-	-	-	45x45	-		
4AL	630	285	-	-	-	-	-	50x30	-		
4AM	650	315	-	-	-	-	-	45x15	-		same as AAP
4AN	710	315	-	-	-	-	-	210x15	-		
4AO	540	330	-	-	-	-	-	5x5	-		



ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
4AP	660	315	-	-	-	-	-	30x30	-		
4AQ	720	320	-	-	-	-	-	10x5	-		
4AR	720	315	-	-	-	-	-	15x10	-		
4AS	800	325	-	-	-	-	-	5X10	-		
4AT	840	320	-	-	-	-	-	50X30	10 x 20		
4AU	870	320	-	-	-	-	-	30X45	10 x 10		
4AV	840	320	-	-	-	-	-	60X60	40 x 40		
4AW	900	330	-	-	-	-	-	5X5	5 x 5		
4AX	950	330	-	-	-	-	-	30X10	-		
4AY	760	335	-	-	-	-	-	40X30	40 x 40		
4AZ	880	335	-	-	-	-	-	40x20	20 x20		
4BA	720	345	-	-	-	-	-	10X10	-		
4BB	190	245	-	-	-	-	-	10X10	40 x 15	flowers	new growth
4BC	610	270	-	-	-	-	-	50X10	-		
4BD	140	180	-	-	-	-	-	-	10 x 10		new
4BE	750	10	-	-	-	-	-	-	10 x 30		new
4BF	240	312	-	-	-	-	-	-	20 x 20		new
4BG	285	295	-	-	-	-	-	-	10 x 5		new
4BH	300	285	-	-	-	-	-	-	5 x 5		new
4BI	790	325	-	-	-	-	-	-	20 x 10		new
4BJ	870	325	-	-	-	-	-	-	10 x 15		new
4BK	660	345	-	-	-	-	-	-	10 x 20	flowers	new



ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
4BL	820	345	-	-	-	-	-		10 x 10		new



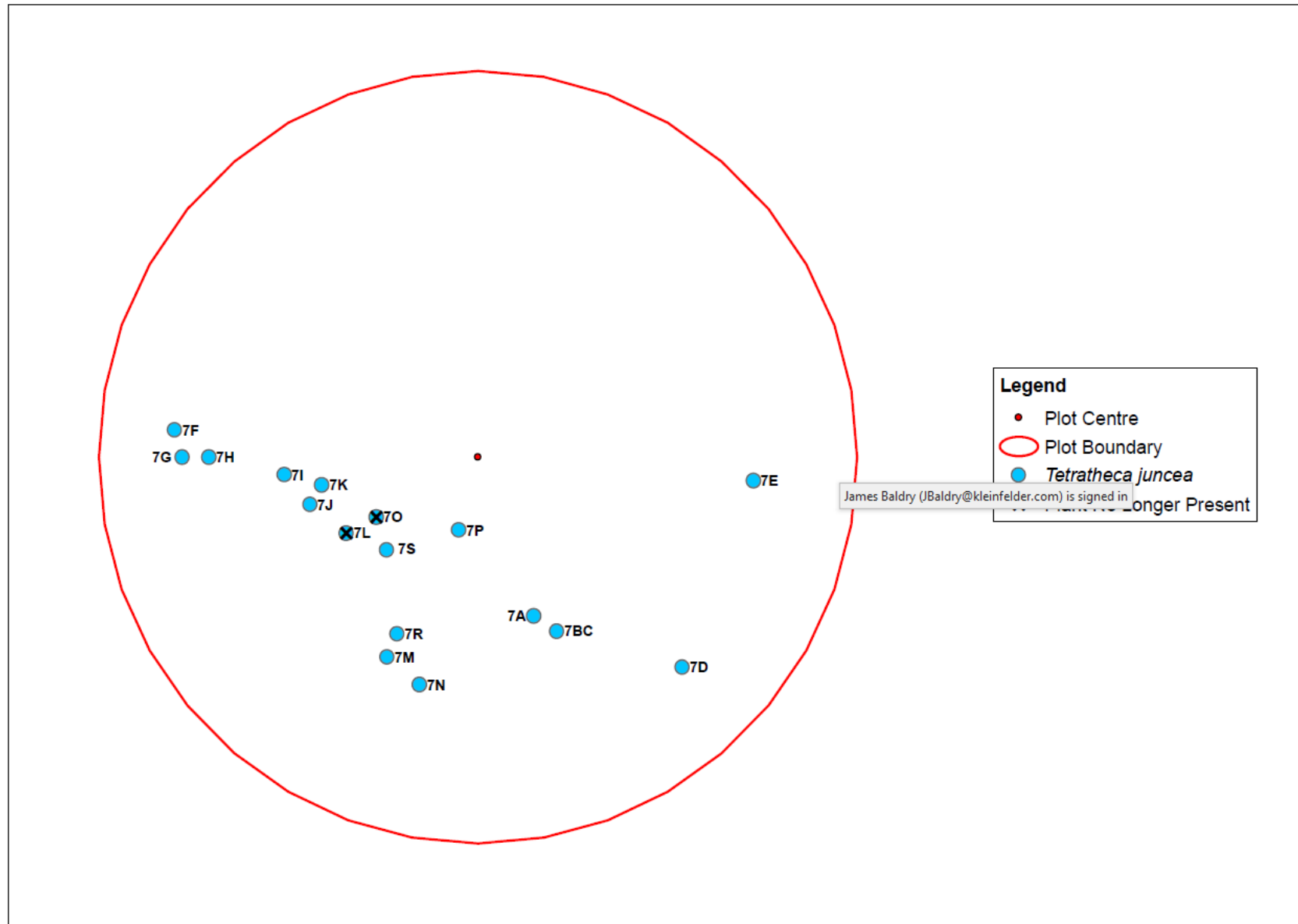
Monitoring Point 4

Asperula asthenes monitoring results



Monitoring Point 7 - *Tetradlea juncea* monitoring results

ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present		Comments
			2015	2016	2017	2018	2019	2020	2021	Flowers	Fruits	
7A	480	160	70x40	60x40	60x50	10x60	70x40	20x30	25 x 30	3	0	
7B	470	155	5x 5	10x5	-	10x10	30x20	30x20	-			merged with 7C
7C	500	155	35x15	40x15	70x30	60x30	50x20	70x40	55 x 40	12	1	
7D	800	135	50x20	60x40	90x50	70x40	10x10	10x10	45 x 30	2	0	
7E	730	95	60x50	90x40	100x70	100x50	110x80	30x60	30 x 60	4	0	
7F	800	275	60x10	70x20	20x5	-	40x30	40x20	20 x 20	2	0	
7G	780	270	40x40	40x40	60x20	-	130x80	100x65	60 x 15	0	0	
7H	710	270	50x10	50x10	90x20	100x50	70x80	50x20	60 x 5	1	0	
7I	510	265	30x10	30x10	20x5	-	20x5	20x5	20 x 25	0	0	
7J	460	255	40x20	40x30	90x30	100x50	90x60	80x60	70 x 40	1	0	
7K	420	260	70x45	80x40	70x70	100x80	120x85	120x60	60 x 40	12	1	
7L	400	240	45x10	50x10	55x10	20x10	25x10	25x10	-			
7M	570	205	110x70	110x70	110x80	60x20	80x130	30x10	15 x 5	0	0	
7N	610	195	45x35	45x35	35x50	80x30	40x25	20x10	25 x 20	0	0	
7O	310	240	-	20x20	20x15	-	-	-	-			
7P	700	195	-	-	-	-	80x60	60x20	50 x 5	0	0	
7R	505	205	-	-	-	-	30x40	30x40	35 x 20	0	0	
7S	340	225	-	-	-	-	-	-	5 x 5	0	0	new clump



Monitoring Point 7 - *Tetratheca juncea* monitoring results

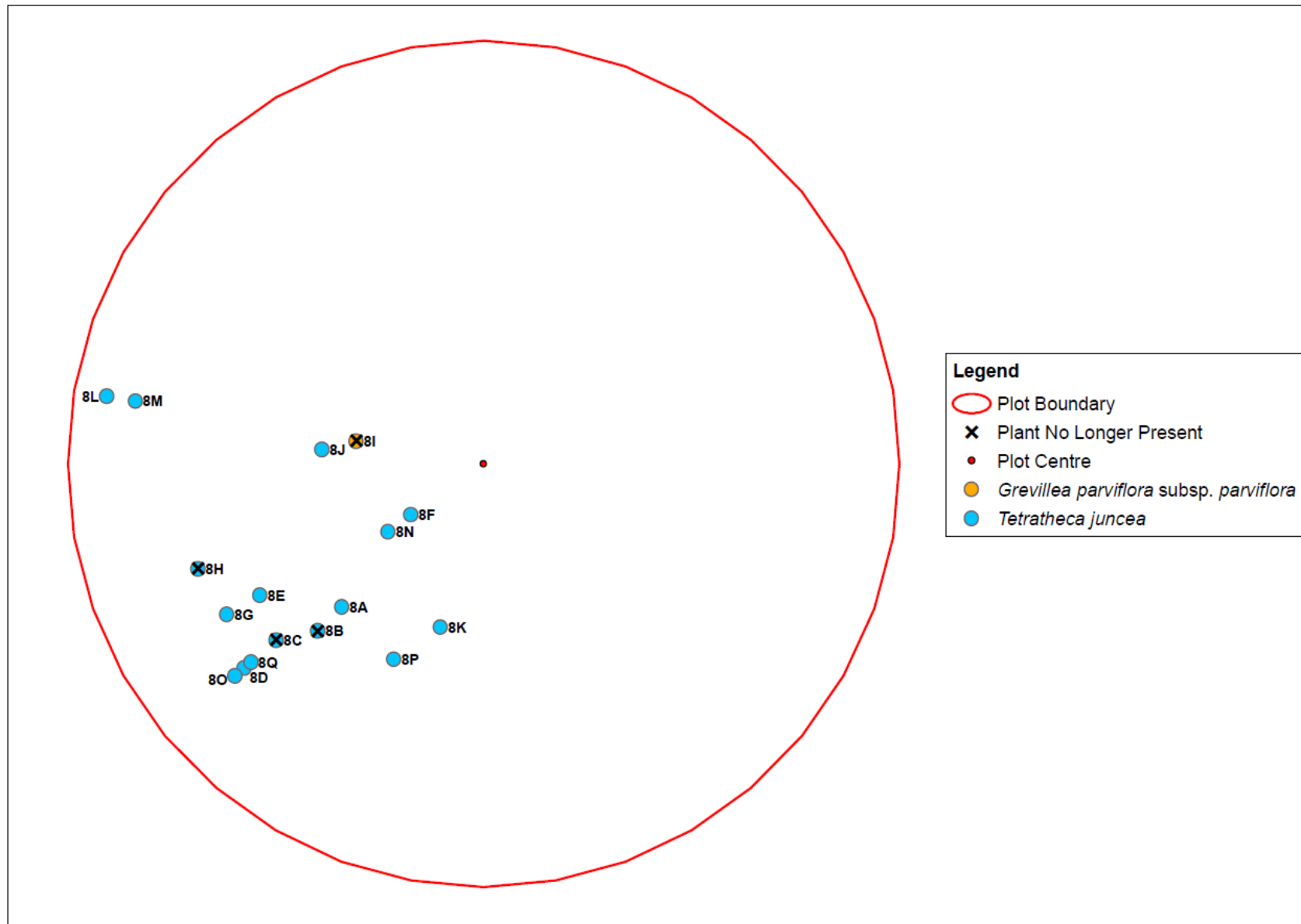


Monitoring Point 8 – *Tetralthea juncea* and *Grevillea parviflora* monitoring results

ID	Species	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present		Comments
				2015	2016	2017	2018	2019	2020	2021	Flowers	Fruits	
8A	<i>Tetralthea juncea</i>	210	235	110x70	110x80	130x80	80x110	110x50	60x30	30 x 30	1	2	
8B	<i>Tetralthea juncea</i>	480	225	40x 30	60x 30	90x 20	80x 20	50x 50	60x60	-			Absent
8C	<i>Tetralthea juncea</i>	560	225	120x110	120x100	-	-	-	-	-			Absent
8D	<i>Tetralthea juncea</i>	650	230	110x110	110x110	120x60	45x 10	30x5	60x60	45 x 30	5	0	New Shoots
8E	<i>Tetralthea juncea</i>	750	230	65x30	65x30	40x80	60x30	50x 20	40x20	25 x 5	0	0	New Shoots
8F	<i>Tetralthea juncea</i>	620	240	80x30	90x30	120x50	120x40	60x 30	20x10	30 x 10	0	0	
8G	<i>Tetralthea juncea</i>	710	240	100x50	100x50	80x50	100x50	-	-	5 x 5	0	0	New Shoots
8H	<i>Tetralthea juncea</i>	730	250	60x50	60x50	100x40	-	90x 30	90x30	-			Absent
8I	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	310	280	30	30	30	70	60	60x70	-			Absent
8J	<i>Tetralthea juncea</i>	390	275	50x 10	50x 10	65x 10	60x 20	60x20	30x20	25 x 15	0	0	New Shoots
8K	<i>Tetralthea juncea</i>	400	195	60x20	60x20	90x90	170x50	130x60	130x100	75 x 40	20	0	New Shoots
8L	<i>Tetralthea juncea</i>	920	280	-	-	70x 70	70x 80	100x90	100x30	40 x 5	0	0	New Shoots



ID	Species	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present		Comments
				2015	2016	2017	2018	2019	2020	2021	Flowers	Fruits	
8M	<i>Tetradletha juncea</i>	850	280	-	-	-	40x20	-	20x10	20 x 5	0	0	
8N	<i>Tetradletha juncea</i>	280	235	-	-	-	-	50x 20	20x10	20 x 5	1	0	
8O	<i>Tetradletha juncea</i>	780	230	-	-	-	-	-	50x40	25 x 15	0	0	
8P	<i>Tetradletha juncea</i>	510	205	-	-	-	-	-	100x40	60 x 40	1	0	
8Q	<i>Tetradletha juncea</i>	730	230	-	-	-	-	-	-	5 x 10	0	0	New Clump



Monitoring Point 8 – *Tetratheca juncea* and *Grevillea parviflora* monitoring results

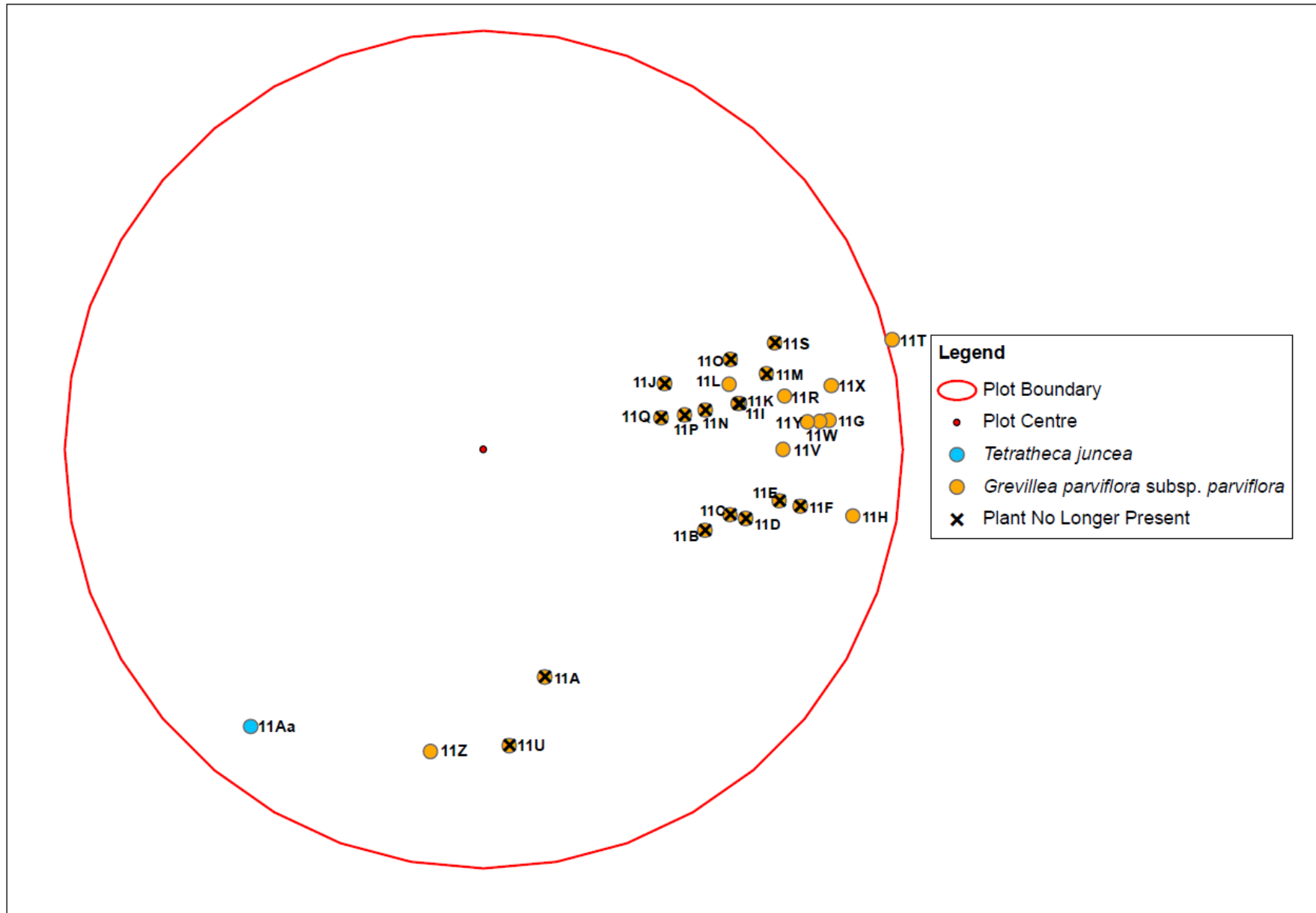


Monitoring Point 11 - *Grevillea parviflora* monitoring results

ID	Species	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present		Comments
				2015	2016	2017	2018	2019	2020	2021	Flowers	Fruits	
11A	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	560	165	90	90	50	45	60	60	-	0	0	Absent
11B	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	565	110	20	45	-	-	-	18	-	0	0	Absent
11C	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	610	105	55	-	-	-	-	-	-	0	0	Absent
11D	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	650	105	100	65	-	-	-	-	-	0	0	Absent
11E	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	720	100	75	75	41	-	-	-	-	0	0	Absent
11F	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	770	100	20	10	-	-	-	-	-	0	0	Absent
11G	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	830	85	110	110	80	100	90	95	90	0	0	No fruit, no flowers. Dieback
11H	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	900	100	60	60	30	65	70	80	70	0	0	No fruit, no flowers. Dieback
11I	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	620	80	50	50	60	60	55	55	-	0	0	Absent
11J	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	460	70	45	35	40	-	-	-	-	0	0	Absent
11K	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	620	80	40	40	40	40	-	-	-	0	0	Absent
11L	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	610	75	45	55	55	65	65	70	70	0	0	No fruit, no flowers
11M	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	700	75	65	70	65	75	80	-	-	0	0	Absent
11N	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	540	80	35	40	45	45	40	-	-	0	0	Absent
11O	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	630	70	20	30	-	-	-	-	-	0	0	Absent
11P	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	490	80	45	70	50	30	30	30	-	0	0	Absent
11Q	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	430	80	-	20	60	-	-	-	-	0	0	Absent
11R	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	730	80	-	-	-	65	65	40	30	0	0	No fruit, no flowers
11S	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	740	70	-	-	-	-	20	20	-	0	0	Absent
11T	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	1010	75	-	-	-	-	80	95	95	0	0	No fruit, no flowers



ID	Species	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present		Comments
				2015	2016	2017	2018	2019	2020	2021	Flowers	Fruits	
11U	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	710	175	-	-	-	-	40	37	-	0	0	Absent
11V	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	715	90	-	-	-	-	-	55	60	0	0	No fruit, no flowers
11W	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	800	85	-	-	-	-	-	65	60	0	0	No fruit, no flowers
11X	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	840	80	-	-	-	-	-	60	85	0	0	No fruit, no flowers
11Y	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	770	85	-	-	-	-	-	25	55	0	0	No fruit, no flowers
11Z	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	720	190	-	-	-	-	-	55	55	0	0	No fruit, no flowers
11AA	<i>Tetratheca juncea</i>	865	220	-	-	-	-	-	75x50	80 x 50	17	5	New growth

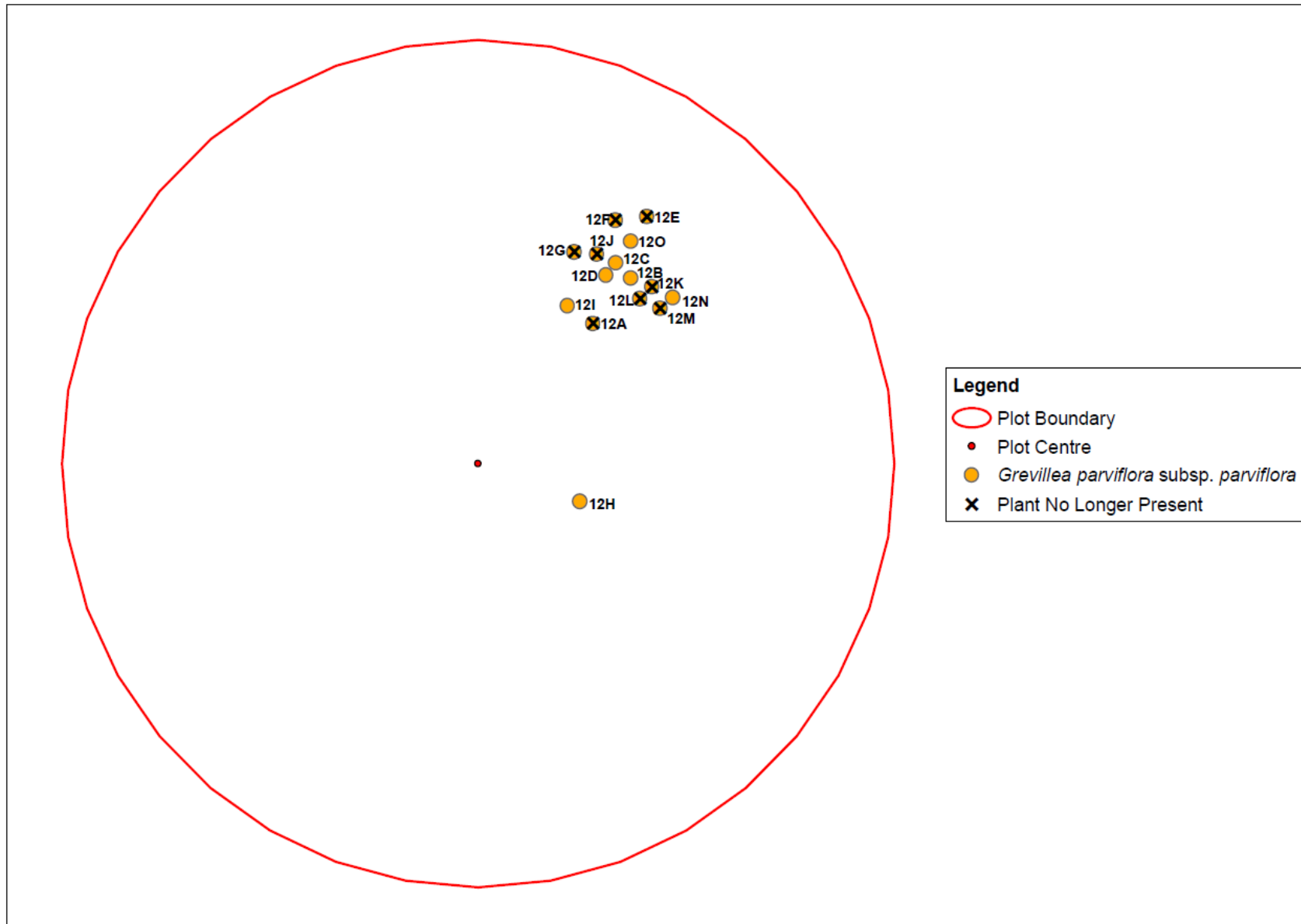


Monitoring Point 11 - *Grevillea parviflora* and *Tetratheca juncea* monitoring results



Monitoring Point 12 - *Grevillea parviflora* monitoring results

ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
12A	430	40	80	80	80	50	-	-	-		
12B	570	40	80	90	60	25	50	55	75	Flowers and buds	
12C	580	35	65	70	-	50	45	55	50		No flowers, herbivory and dieback
12D	540	35	20	25	40	30	-	70	100	Flowers and buds	
12E	710	35	25	30	-	-	-	-	-		
12F	660	30	25	25	-	-	-	-	-		
12G	550	25	50	50	40	10	-	-	-		
12H	260	110	-	25	55	70	78	78	30	Flowers	
12I	430	30	-	-	-	50	60	60	70	Flowers and buds	
12J	570	30	-	-	-	25	-	-	-		
12K	590	45	-	-	-	60	50	70	-		Likely cleared from track maintenance
12L	550	45	-	-	-	30	50	60	-		
12M	570	50	-	-	-	55	65	75	-		Likely cleared from track maintenance
12N	610	50	-	-	-	-	40	60	15		No flowers. No fruit.
12O	640	35	-	-	-	-	-	-	20		New, No flowers. No fruit. 2 stems



Monitoring Point 12 - *Grevillea parviflora* monitoring results



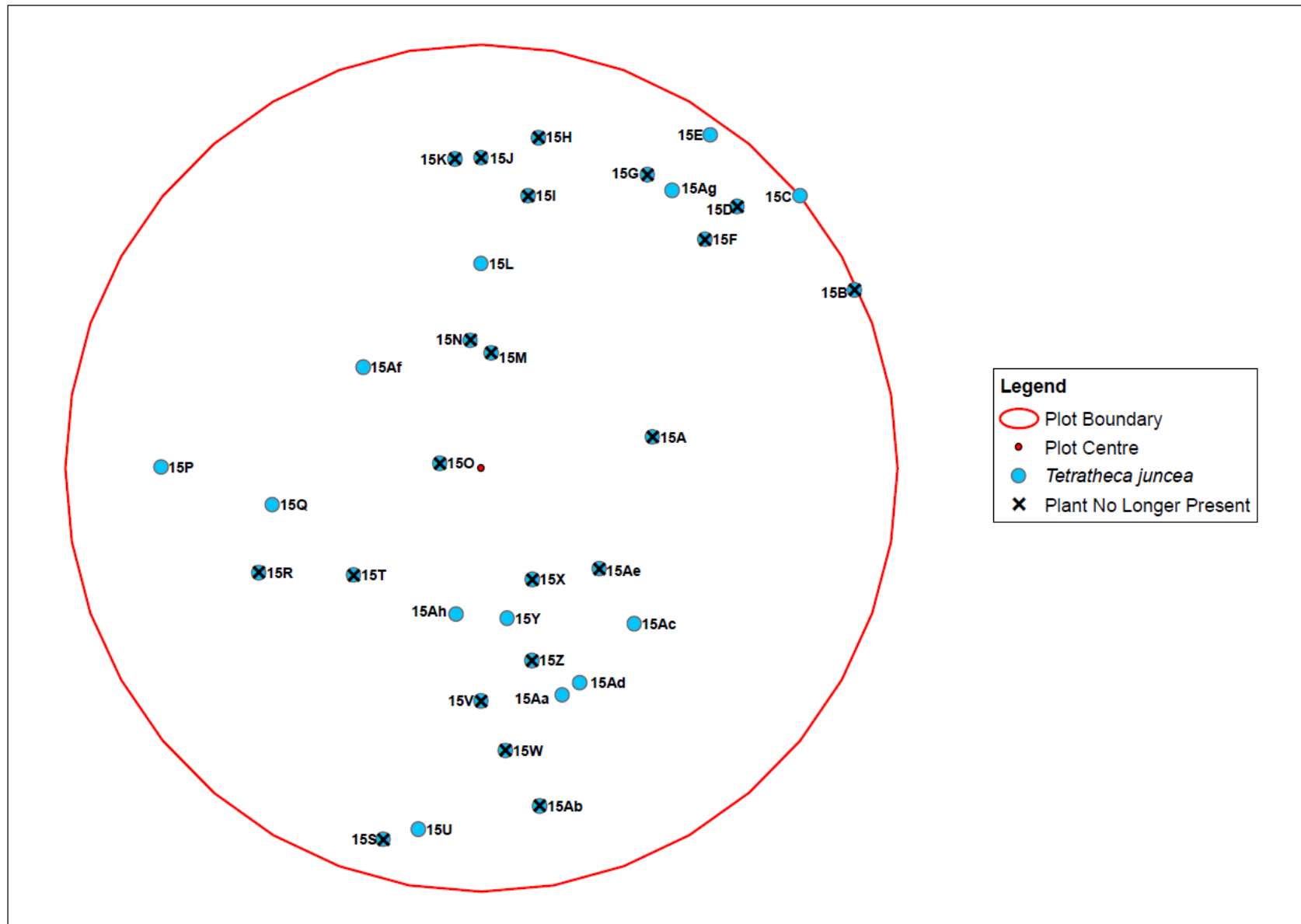
Lot 12 Monitoring Sites

Monitoring Point 15 - *Tetradlea juncea* monitoring results

ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present		Comments
			2015	2016	2017	2018	2019	2020	2021	Flowers	Fruits	
15A	420	80	20 x 10	30 x 10	-	-	-	-	-			Absent
15B	990	65	5 x 5	10 x 5	-	-	-	-	-			Absent
15C	1000	50	50 x 50	60 x 40	100 x 30	-	-	-	50 x 30	1	1	
15D	870	45	40 x 40	40 x 40	65 x 20	-	-	-	-			Absent
15E	960	40	75 x 20	80 x 20	90 x 20	-	40x20	40x30	30 x 30	0	0	
15F	780	45	30 x 15	40 x 15	40 x15	30x40	30x20	-	-			Absent
15G	800	35	40 x 25	50 x 25	40 x 20	-	-	-	-			Absent
15H	790	10	5 x 5	10 x 5	-	-	-	-	-			Absent
15I	620	10	60 x 30	60 x 30	-	-	-	-	-			Absent
15J	730	0	20 x 30	40 x 20	40 x 10	-	-	-	-			Absent
15K	730	355	50 x 20	40 x 20	-	-	-	-	-			Absent
15L	480	0	30 x 10	30 x 10	15 x 10	30x20	40x20	30x20	20 x 30	1	4	
15M	270	5	40 x 10	50 x 10	-	50x20	40x30	-	-			Absent
15N	300	355	40 x 10	40 x 10	50 x 10	-	-	-	-			Absent
15O	100	275	20 x 5	20 x 40	-	-	-	-	-			Absent
15P	770	270	60 x 20	50 x 30	50 x 30	40x10	40x10	40x20	40 x 10	0	0	
15Q	510	260	60 x 50	70 x 50	90 x 50	90x30	50x40	80x50	40 x 30	0	2	
15R	590	245	70 x 50	70 x 50	80 x 15	-	10x10	-	-			Absent
15S	910	195	20 x 10	20 x 10	-	-	-	-	-			Absent



ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present		Comments
			2015	2016	2017	2018	2019	2020	2021	Flowers	Fruits	
15T	400	230	30 x 10	30 x 10	-	-	-	-	-			Absent
15U	870	190	10 x 10	30 x 10	30 x 5	70x20	100x30	90x70	60 x 60	1	0	
15V	550	180	30 x 15	40 x 20	40 x 10	-	-	-	-			Absent
15W	670	175	5 x 5	10 x 5	-	-	-	-	-			Absent
15X	290	155	40 x 10	40 x 10	30 x 5	-	-	-	-			Absent
15Y	360	170	5 x 5	30 x 5	-	20x5	-	-	10 x 5	0	0	
15Z	470	165	30 x 40	50 x 30	60 x 70	60x20	40x20	-	-			Absent
15AA	570	170	25 x 20	50 x 20	20 x 50	80x20	40x40	-	-			Merged with 15AD
15AB	810	170	5 x 5	10 x 5	-	-	-	-	-			Absent
15AC	520	135	40 x 10	50 x 15	15 x 50	40x30	60x10	50x30	30 x 20	6	2	
15AD	560	160	20 x 30	20 x 30	-	-	40x30	50x30	50 x 30	0	0	
15AE	370	130	-	20 x 10	-	-	-	-	-			Absent
15AF	370	310	-	-	-	10x10	50x30	60x40	30 x 40	1	0	
15AG	800	35	-	-	-	-	-	20x20	20 x 10	0	0	
15AH	350	190	-	-	-	-	-	-	50 x 40	2	0	New clump

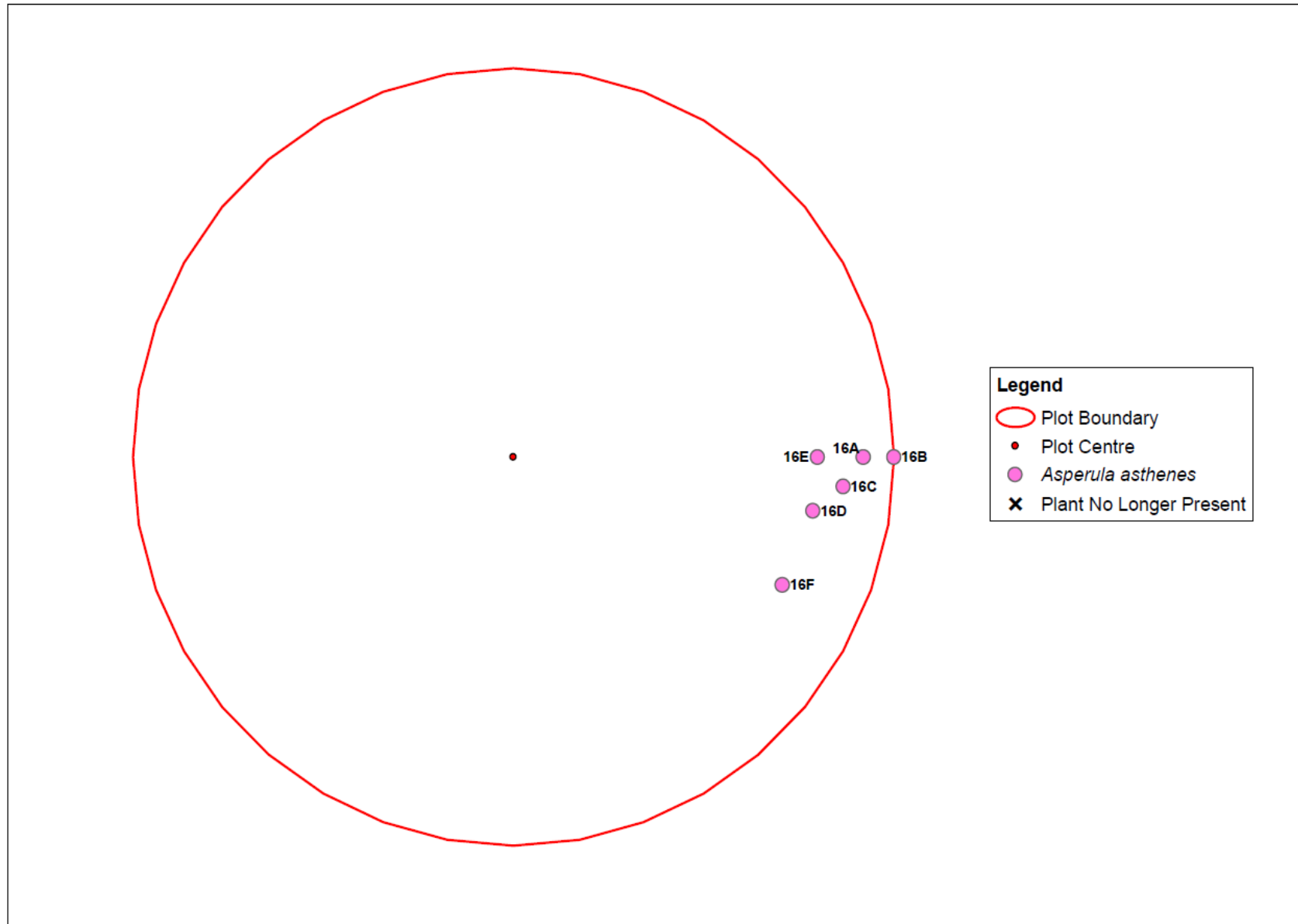


Karuah East Quarry Biodiversity Offset Area 2021 Annual Monitoring Report
Kleinfelder



Monitoring Point 16 - *Asperula asthenes* monitoring results

ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
16A	920	90	-	-	-	-	-	-	50 x 40	Flowers and fruit	-
16B	1000	90	-	-	-	-	-	-	60 x 50	Flowers	-
16C	870	95	-	-	-	-	-	-	30 x 60	Flowers	-
16D	920	100	-	-	-	-	-	-	40 x 40	Flowers	-
16E	800	90	-	-	-	-	-	-	20 x 30	Flowers	-
16F	780	115	-	-	-	-	-	-	60 x 50	Flowers and fruit	-



Monitoring Point 16 - *Asperula asthenes* monitoring results

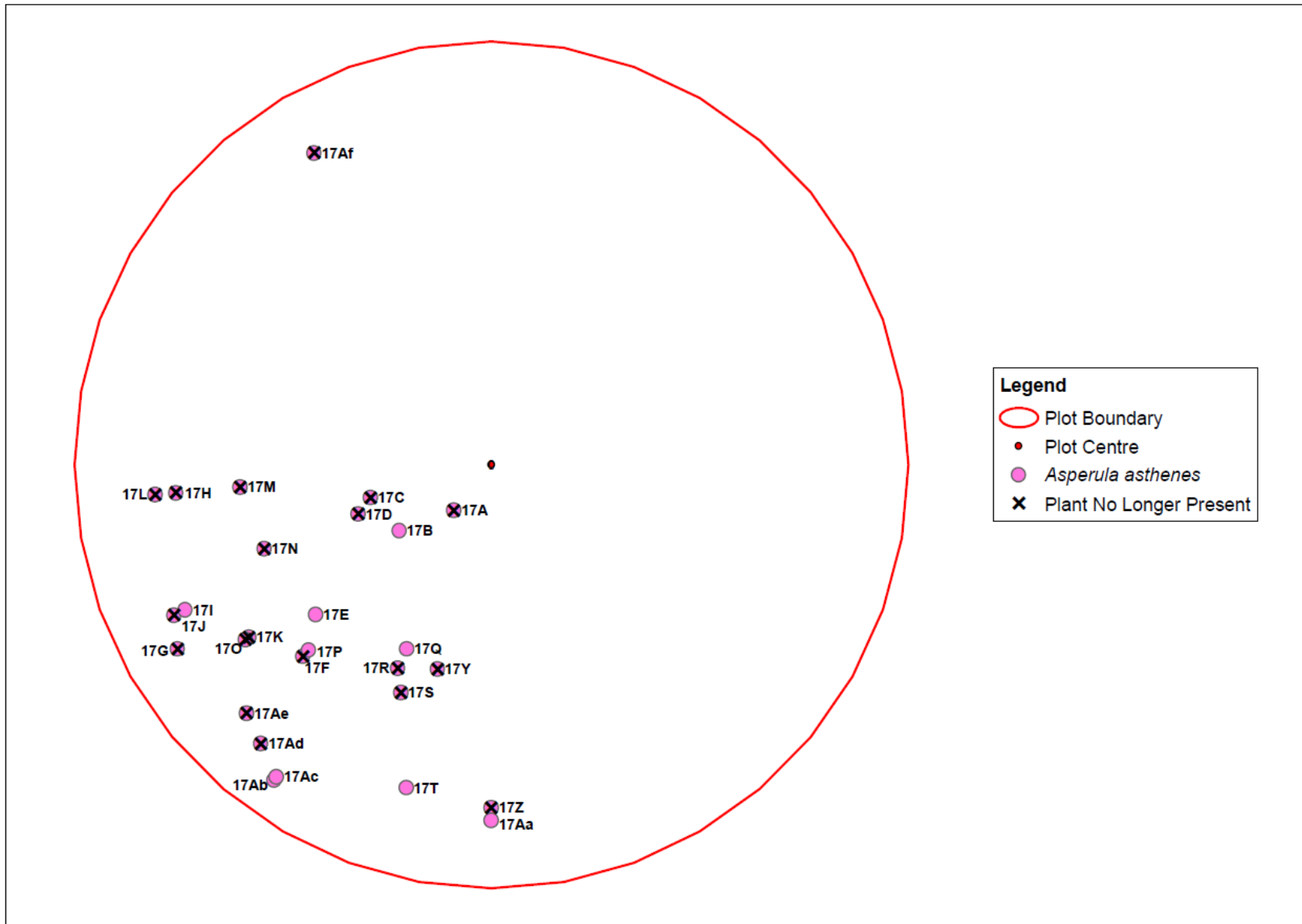


Monitoring Point 17 - *Asperula asthenes* monitoring results

ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
17A	140	220	20 x 5	20 x 5		-	-	-	-		Absent
17B	270	235	35 x 15	20 x 10	-	-	-	-	40 x 40	Flowers and buds	
17C	300	255	40 x 5	30 x 5	-	-	-	-	-		Absent
17D	340	250	5 x 5	10 x 5	-	-	-	-	-		Absent
17E	550	230	80 x 80	80 x 80	-	70x90	70x30	50x50	25 x 10	No flowers, no fruit	
17F	640	225	20 x 25	20 x 25	30 x 5	30x60	20x10	20x10	-		Absent
17G	870	240	20 x 10	20 x 10	-	-	-	-	-		Absent
17H	760	265	90 x 35	90 x 35	-	-	-	-	-		Absent
17I	810	245	35 x 20	25 x 10	-	-	-	-	5 x 5	No flowers, no fruit	New shoots
17J	840	245	40 x 60	40 x 50	-	-	-	-	-		Absent
17K	710	235	20 x 5	20 x 10	30 x 10	130x55	20x10	-	-		Absent
17L	810	265	-	-	-	10x5	-	-	-		Absent
17M	605	265	-	-	-	5x5	15x15	-	-		Absent
17N	580	250	-	-	-	10x5	10x5	-	-		Absent
17O	720	235	-	-	-	-	10x5	-	-		Absent
17P	620	225	-	-	-	-	20x10	-	10 x 10	Flowers and buds	
17Q	480	205	-	-	-	-	-	35x10	15 x 10	Flowers	
17R	530	205	-	-	-	-	-	30x20	-		Absent
17S	580	220	-	-	-	-	-	30x10	-		Absent
17T	490	195	-	-	-	-	-	40x30	30 x 20	No flowers, no fruit	
17V	500	195	-	-	-	-	-	5x5	-		Absent



ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
17W	760	215	-	-	-	-	-	5x10	-	Buds	
17X	740	210	-	-	-	-	-	20x20	-		Absent
17Y	740	195	-	-	-	-	-	5x5	-		Absent
17Z	810	180	-	-	-	-	-	10x10	50 x 40	No flowers, no fruit	
17AA	840	180	-	-	-	-	-	20x10	20 x 10	Flowers and buds	
17AB	910	215	-	-	-	-	-	10x5	40 x 30	Flowers and buds	
17AC	215	900	-	-	-	-	-	5x5	5 x 10	Buds	
17AD	220	860	-	-	-	-	-	10x5	-		Absent
17AE	225	830	-	-	-	-	-	10x10	-		Absent
17AF	330	850	-	-	-	-	-	10x5	-		Absent



Monitoring Point 17 - *Asperula asthenes* monitoring results

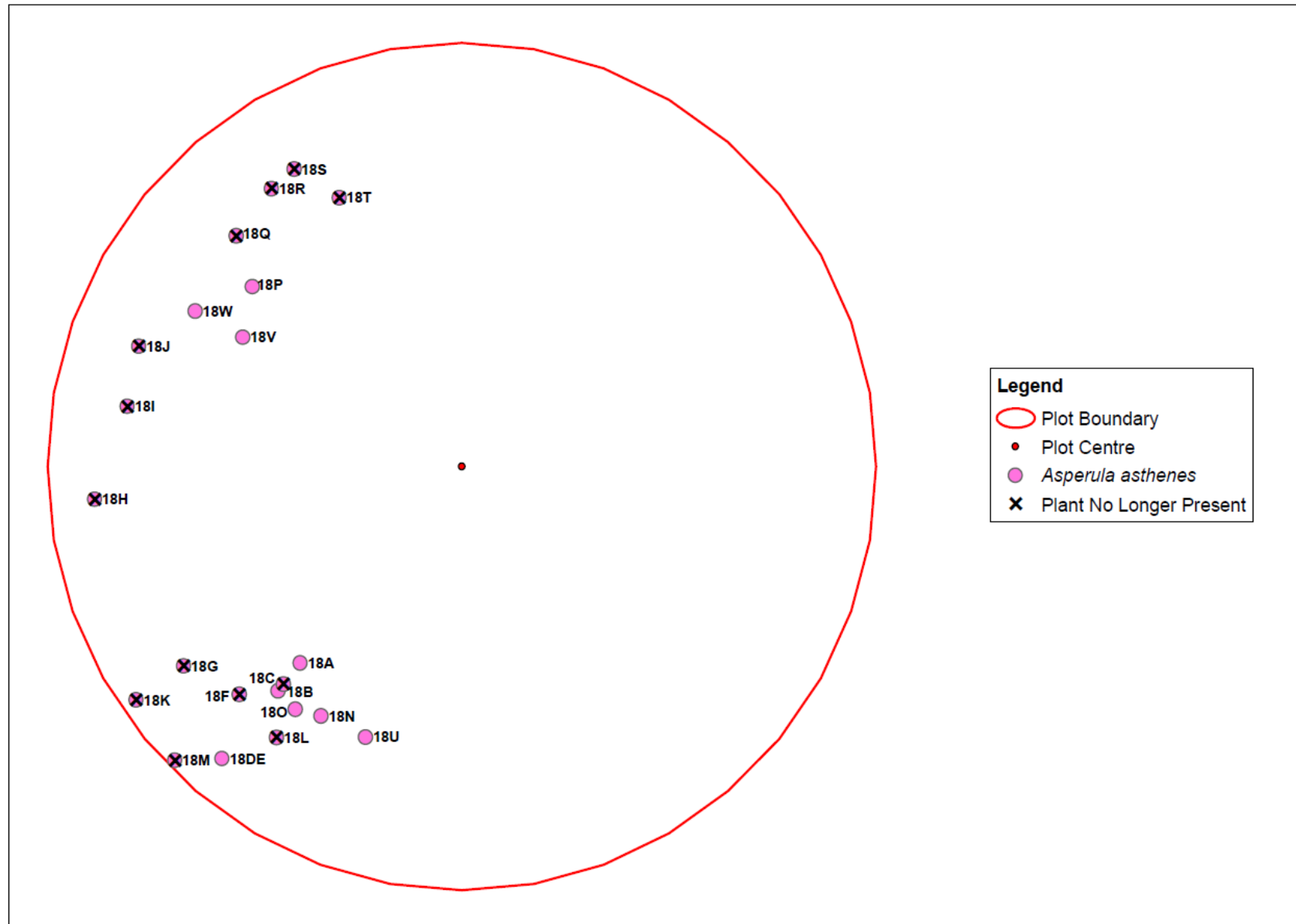


Monitoring point 18 - *Asperula asthenes* monitoring results

ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
18A	610	220	40 x 30	40 x 30	-	-	-		30 x 10		No fruit or flowers
18B	690	220	100 x 60	100 x 50	-	-	-		15 x 15		No fruit or flowers
18C	670	225	30 x 20	30 x 20	-	-	-		-		Absent
18D	880	215	20 x 40	20 x 40	-	-	-		-		Merged with 18E
18E	900	220	100 x 90	90 x 90	10 x 5	-	10 x 5	10 x 5	5 x 10		
18F	760	225	70 x 80	70 x 90	-	-	-		-		Absent
18G	820	235	70 x 30	70 x 40	10 x 5	-	-		-		Absent
18H	890	265	5 x 10	20 x 10	-	-	-		-		Absent
18I	820	280	30 x 40	30 x 30	-	-	-		-		Absent
18J	830	290	55 x 30	50 x 30	5 x 5	-	5 x 5	1x1	-		Absent
18K	960	235	50 x 10	40 x 15	-	-	-	5x5	-		Absent
18L	780	215	10 x 10	20 x 20	-	-	-		-		Absent
18M	980	225	30 x 10	20 x 10	-	-	-		-		Absent
18N	680	210	-	-	40 x 10	60x10	75x50	70x70	60 x 50		No fruit or flowers
18O	700	215	-	-	-	70x16	30x20	30x30	25 x 40	Flowers	
18P	660	310	-	-	-	10x26	45x15	10x10	10 x 10	Flowers + fruit	
18Q	770	315	-	-	-	60x21	-	25x10	-		Absent
18R	800	325	-	-	-	-	-	10x10	-		Absent
18S	810	330	-	-	-	-	-	10x15	-		Absent
18T	700	335	-	-	-	-	-	10x10	-		Absent



ID	Distance	Bearing	Clump Size (cm)							Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020	2021		
18U	680	200	-	-	-	-	-	-	30 x 30		New, no fruit or flowers
18V	610	300	-	-	-	-	-	-	10 x 10	Flowers	New
18W	740	300	-	-	-	-	-	-	10 x15		New, no fruit or flowers



Monitoring point 18 - *Asperula asthenes* monitoring results



APPENDIX D

PHOTO MONITORING





Appendix D.1 Biodiversity Offset Area Monitoring Sites

Monitoring Point 1 (MP 1)

MP 1 2015



MP 1 2017



MP 1 2018



MP 1 2019





MP 1 2020



MP 1 2021





Monitoring Point 2 (MP 2)

MP 2 2015



MP 2 2017



MP 2 2018



MP 2 2019



MP 2 2020



MP 2 2021





Monitoring Point 3 (MP 3)

MP 3 2015



MP 3 2017



MP 3 2018



MP 3 2019

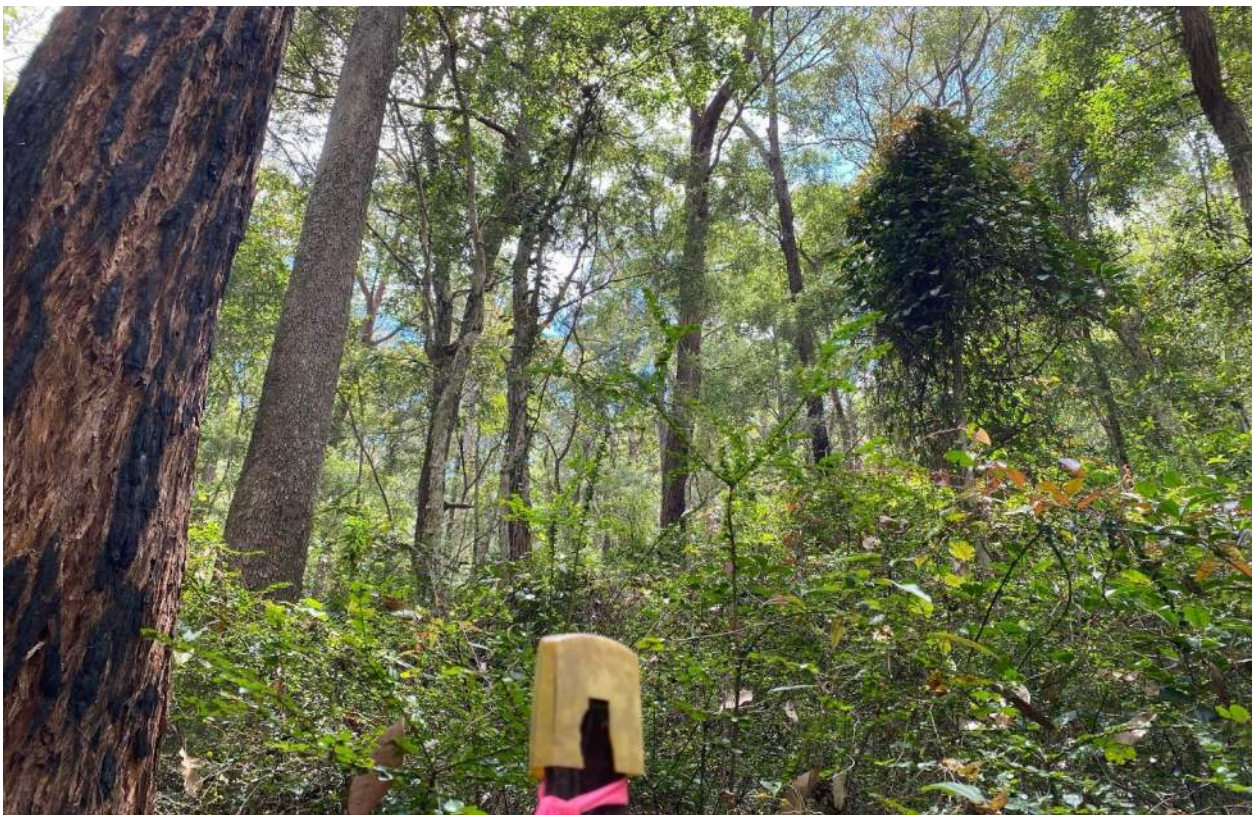




MP 3 2020



MP 3 2021





Monitoring Point 4 (MP 4)

MP 4 2015



MP 4 2017





MP 4 2018



MP 4 2019

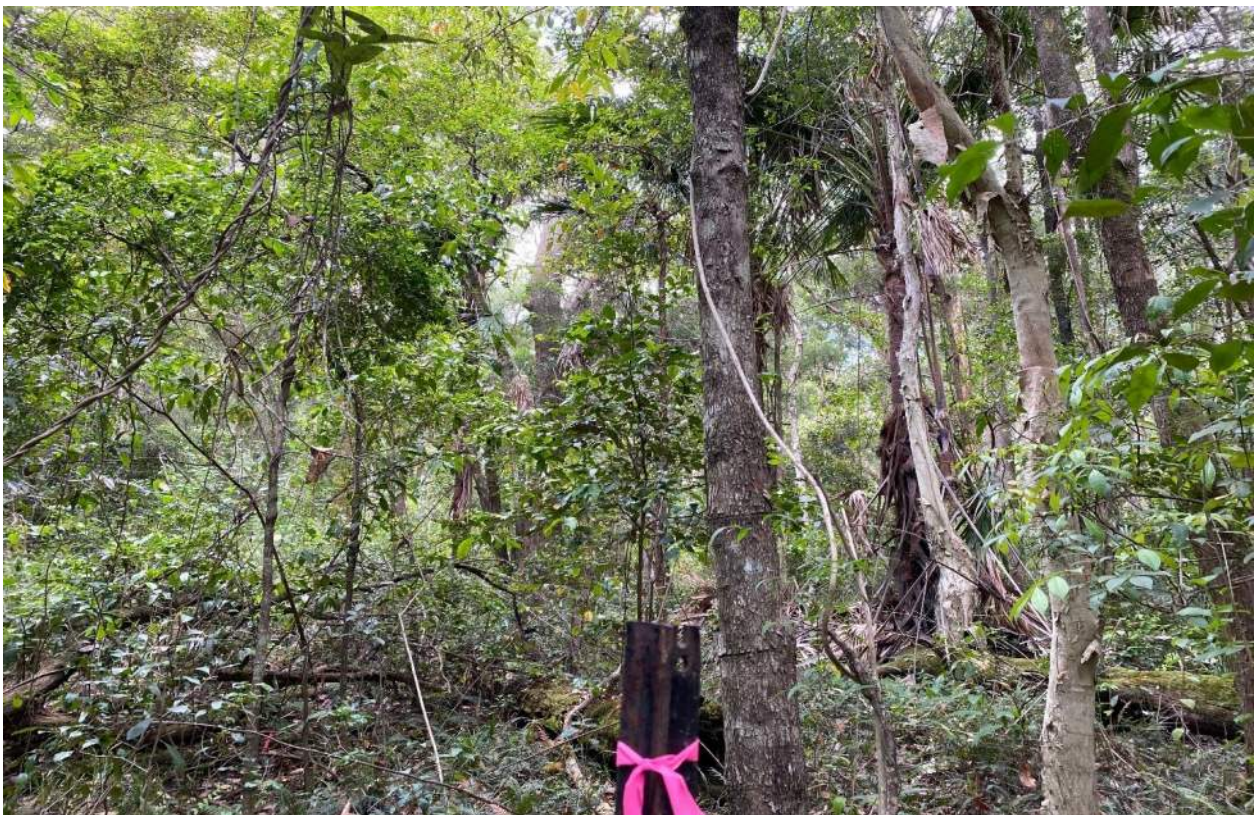




MP 4 2020



MP 4 2021





Monitoring Point 5 (MP 5)

MP 5 2015



MP 5 2017





MP 5 2018



MP 5 2019





MP 5 2020



MP 5 2021





Monitoring Point 6 (MP 6)

MP 6 2015



MP 6 2017



MP 6 2018



MP 6 2019



MP 6 2020



MP 6 2021





Monitoring Point 7 (MP 7)

MP 7 2015



MP 7 2017



MP 7 2018



MP 7 2019



MP 7 2020



MP 7 2021





Monitoring Point 8 (MP 8)

MP 8 2015



MP 8 2017





MP 8 2018



MP 8 2019





MP 8 2020



MP 8 2021



Monitoring Point 9 (MP 9)

MP 9 2015



MP 9 2017





MP 9 2018



MP 9 2019



MP 9 2020



MP 9 2021





Monitoring Point 10 (MP 10)

MP 10 2015



MP 10 2017



MP 10

2018



MP 10

2019



MP 10

2020



MP 10 2021





Monitoring Point 11 (MP 11)

MP 11 2016



MP 11 2017





MP 11 2018



MP 11 2019





MP 11

2020



MP 11

2021





Monitoring Point 12 (MP 12)

MP 12 2015



MP 12 2017





MP 12

2018



MP 12

2019





MP 12

2021





Monitoring Point 13 (MP 13)

MP 13 2015



MP 13 2017





MP 13

2018



MP 13

2019





MP 13

2021



Monitoring Point 14 (MP 14)

MP 14 2015



MP 14 2017



MP 14 2018



MP 14 **2019**





MP 14

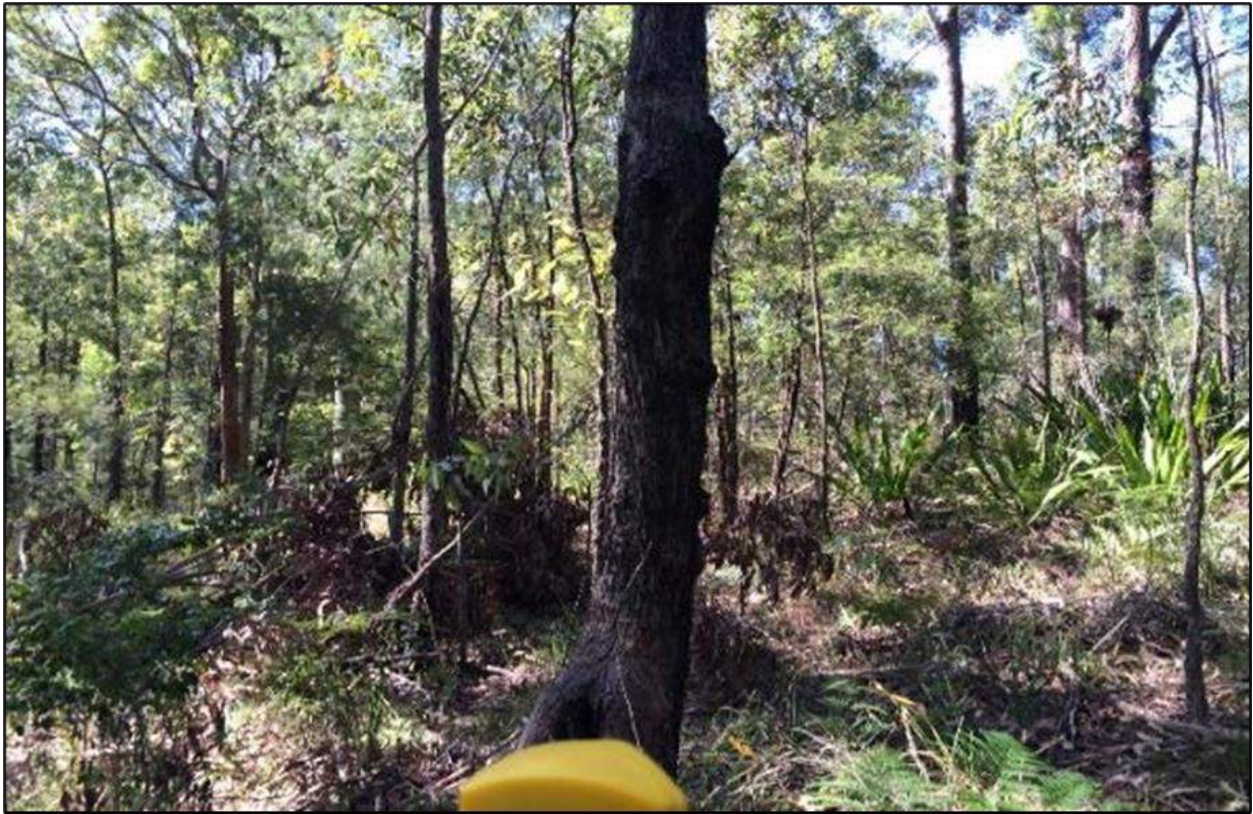
2021





Monitoring Point 15 (MP 15)

MP 15 2015



MP 15 2017



MP 15

2018



MP 15

2019





MP 15

2021





Monitoring Point 16 (MP 16)

MP 16 2015



MP 16 2017



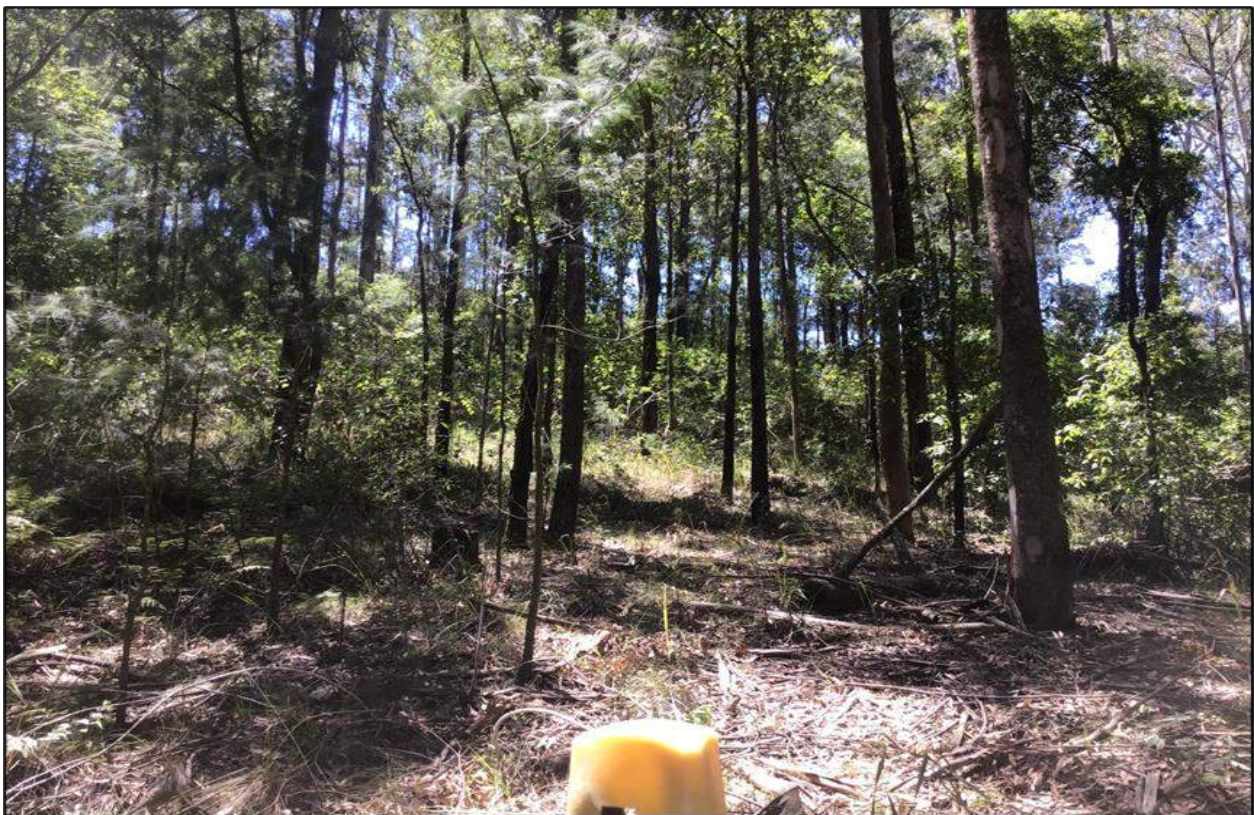
MP 16

2018



MP 16

2019





MP 16

2021





Monitoring Point 17 (MP 17)

MP 17 2015

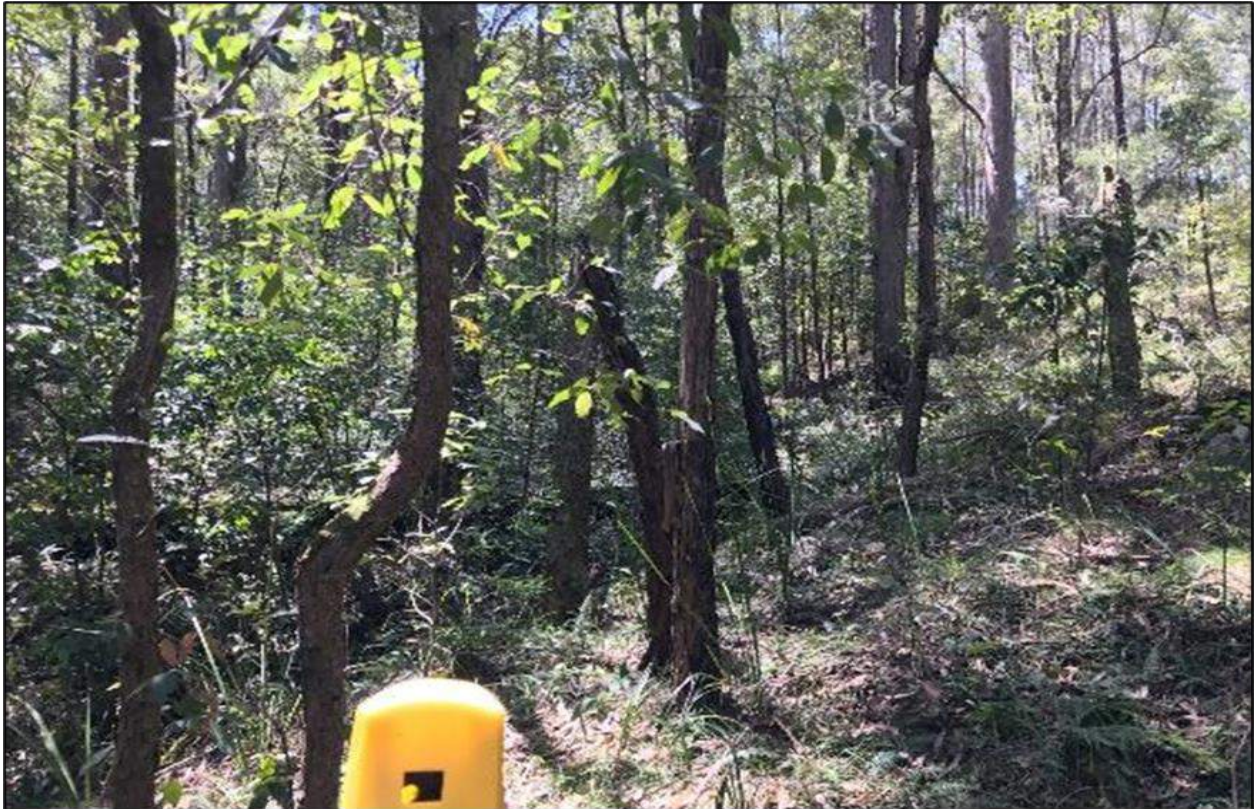


MP 17 2017





MP 17 2018



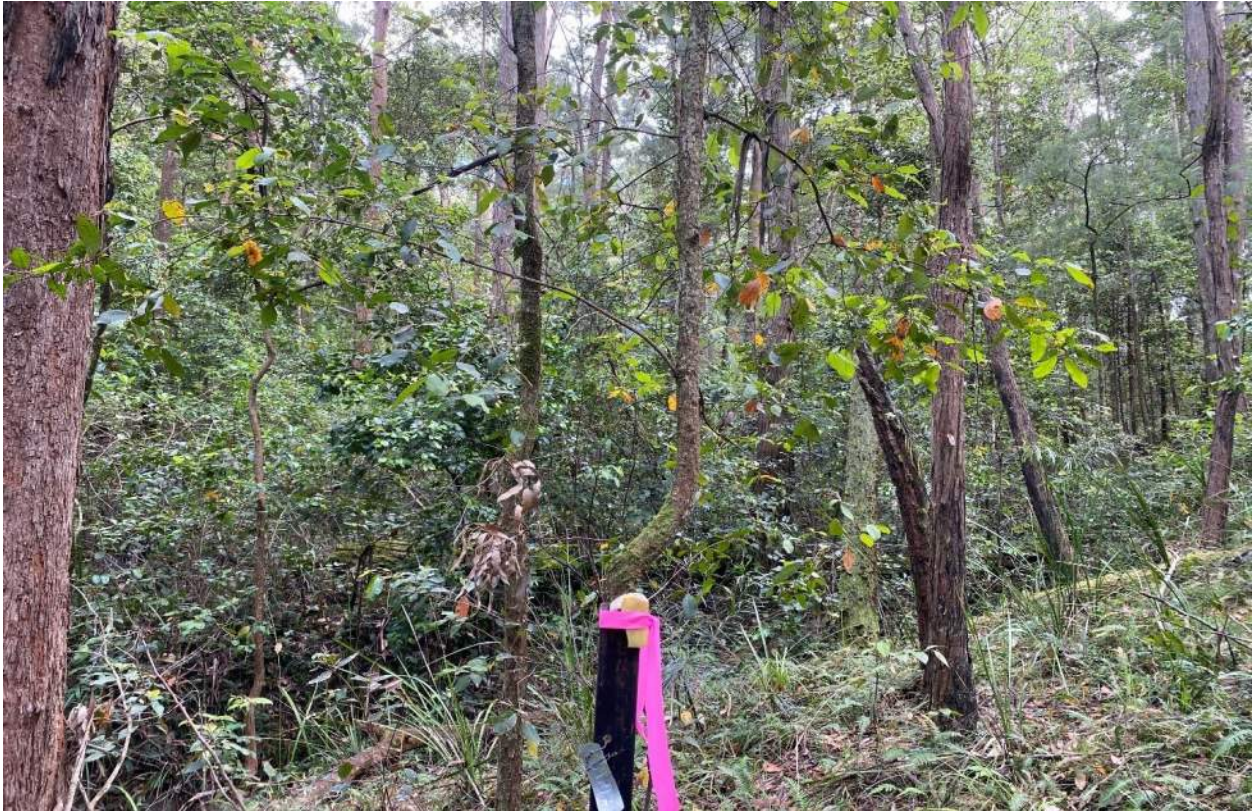
MP 17 2019





MP 17

2021





Monitoring Point 18 (MP 18)

MP 18 2015



MP 18 2016





MP 18

2017



MP 18

2019





MP 18

2021





APPENDIX E EXOTIC SPECIES RECORDED WITHIN OFFSET AREA





Table E1 Exotic species recorded on site (2015-2021)

Name	Qualification	Title/Experience
<i>Ageratina adenophora</i>	Crofton Weed	-
<i>Ageratina riparia</i>	Mistflower	-
<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 F STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Daniel O'Brien	BEnvSciMgnt	Senor Ecologist	Report Review
David Martin	MSc	Ecologist	Flora Surveys
Mark Dean	BEnvSc&Mgt	Ecologist	Field Surveys
Ben Stewart	MMSc&Mgt	Ecologist	Field Surveys
James Baldry	MConsBio	Ecologist	Field Surveys, Report Writing
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS and figure preparation



APPENDIX G LICENSING

Kleinfelder employees involved in the current study are licensed or approved under the *Biodiversity Conservation Act 2016* (License Number: SL100730, Expiry: 31 March 2022) 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.



23 March 2021
Document No: NCA21L123587

Attention: Joel Fleming
Karuah East Quarry Pty Ltd
Blue Rock Close
Karuah NSW 2324

Delivered by email: jf@hunterquarries.com.au

Subject: Karuah East Quarry Habitat Tree Removal Supervision March 2021.

On the 17 March 2021 Kleinfelder ecologist, Mark Dean, supervised the felling of habitat trees within the Karuah East Quarry disturbance area. The habitat trees had been previously identified by Kleinfelder ecologists during the 2016 pre-clearance surveys.

A total of 8 habitat trees (hollow-bearing trees and dead stags) were felled within a 0.9 ha area (**Figure 1**) in the northern portion of the approved disturbance area. A total of three small, three medium and three large hollows were identified within the trees felled.

In accordance with the vegetation clearing protocols, the trees were soft-felled and once the trees had been felled, they were inspected for fauna and the number/size of hollows were recorded (**Table 1**). No fauna species were found to be present in any of the hollows although evidence of use was noted within three of the hollows. Evidence included old glider bowls, bird nests and a possible Common Brushtail Possum nest.

Table 1: Details of habitat trees, hollows recorded, and fauna sighted/captured and released in the course of the clearing operations on 17 March 2021.

Habitat Tree	Number and Size of Recorded Hollows			Comments
	Small (<5 cm)	Medium (5 cm – <20 cm)	Large (>20 cm)	
1	2	-	-	
2	1	-	-	
3	-	1	-	Old Glider Bowl
4	-	1	2	Old bird nest
5	-	1	1	Possible Brushtail Possum Nest
6	-	-	-	
7	-	-	-	

Habitat Tree	Number and Size of Recorded Hollows			Comments
	Small (<5 cm)	Medium (5 cm – <20 cm)	Large (>20 cm)	
8	-	-	-	
Totals	3	3	3	Total: 9 hollows

If you have any questions, please do not hesitate to contact me.

Sincerely,



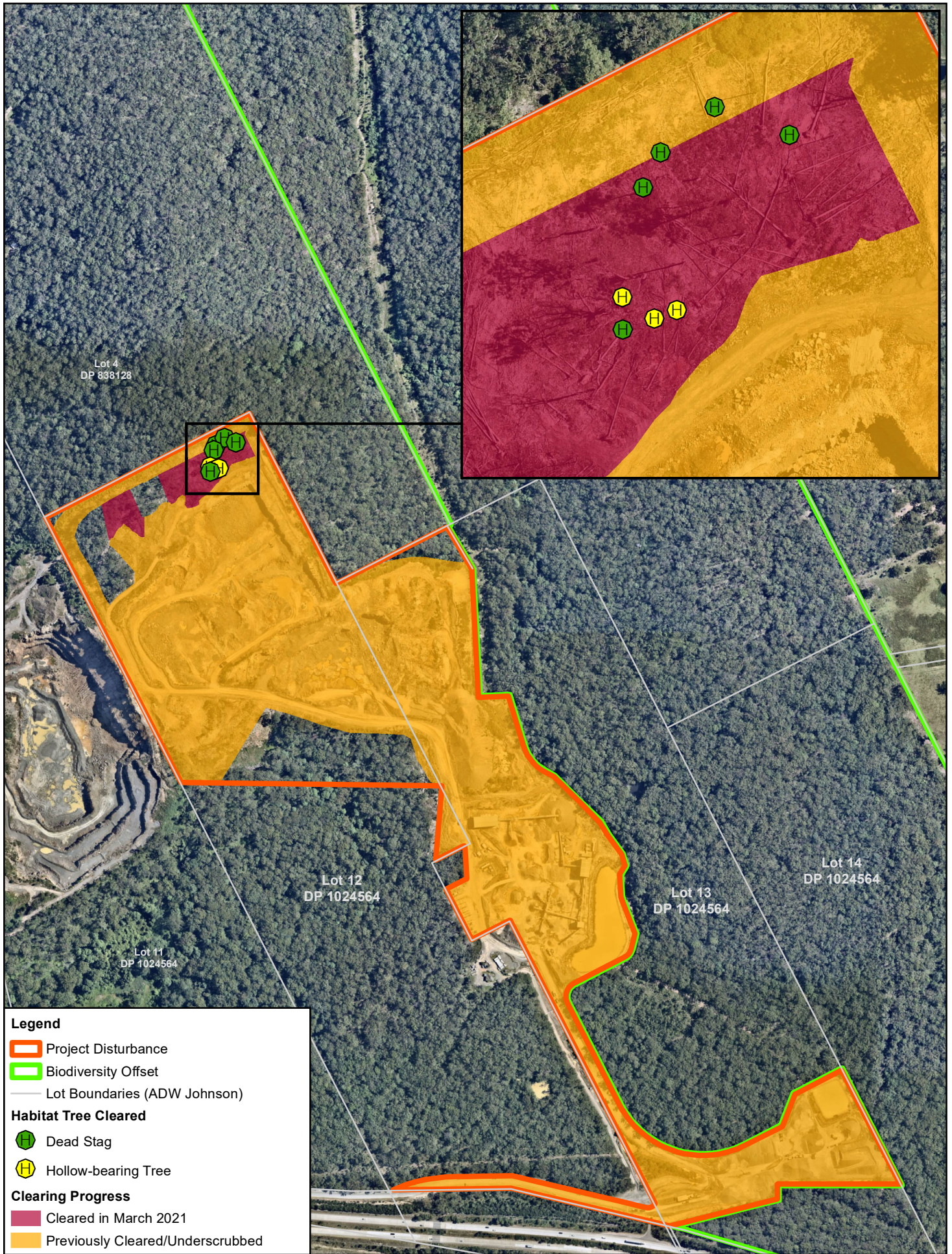
Mark Dean BEnvSc&Mgmt

Ecologist

Mdean@kleinfelder.com

Mobile: 0455381346

Kleinfelder Australia Pty Ltd



Legend

- Project Disturbance
- Biodiversity Offset
- Lot Boundaries (ADW Johnson)

Habitat Tree Cleared

- H Dead Stag
- H Hollow-bearing Tree

Clearing Progress

- Cleared in March 2021
- Previously Cleared/Underscrubbed

Metres
0 25 50 100 150 200 250



PROJECT REFERENCE: 20214329

DATE DRAWN: 2021/03/23 16:47/Version 1

DRAWN BY: G.Joyce

DATA SOURCE:

LPI - 2015
ADW Johnson - 2015
Nearmap - 2021

Current Extent of Clearing within the Karuah East Quarry Project Area

Karuah East Quarry Pty Ltd
Vegetation Clearing Completion Report
Karuah East Quarry Project

FIGURE:

1

3 June 2021

Document No: NCA21L126480

Attention: Joel Fleming

Karuah East Quarry Pty Ltd

Blue Rock Close

Karuah NSW 2324

Delivered by email: jf@hunterquarries.com.au

Subject: Karuah East Quarry Habitat Tree Removal Supervision June 2021.

On the 2 June 2021 Kleinfelder ecologist, Mark Dean, supervised the felling of habitat trees within the Karuah East Quarry disturbance area. The habitat trees had been previously identified by Kleinfelder ecologists during the 2016 pre-clearance surveys.

A total of 5 habitat trees (hollow-bearing trees and dead stags) were felled within a 0.18 ha area (**Figure 1**) in the northern portion of the approved disturbance area. A total of four small, one medium and one large hollow were identified within the trees felled.

In accordance with the vegetation clearing protocols, the trees were soft-felled and once the trees had been felled, they were inspected for fauna and the number/size of hollows were recorded (**Table 1**). No fauna species were found to be present in any of the hollows although evidence of use was noted within one of the hollows. Evidence included bird nesting materials within an upright hollow in a dead stag.

Table 1: Details of habitat trees, hollows recorded, and fauna sighted/captured and released in the course of the clearing operations on 02 June 2021.

Habitat Tree	Number and Size of Recorded Hollows			Comments
	Small (<5 cm)	Medium (5 cm – <20 cm)	Large (>20 cm)	
1	1	-	-	
2			1	bird nesting material
3	1	1		
4	1			
5	1			
Totals	4	1	1	Total: 6 hollows

If you have any questions, please do not hesitate to contact me.

Sincerely,



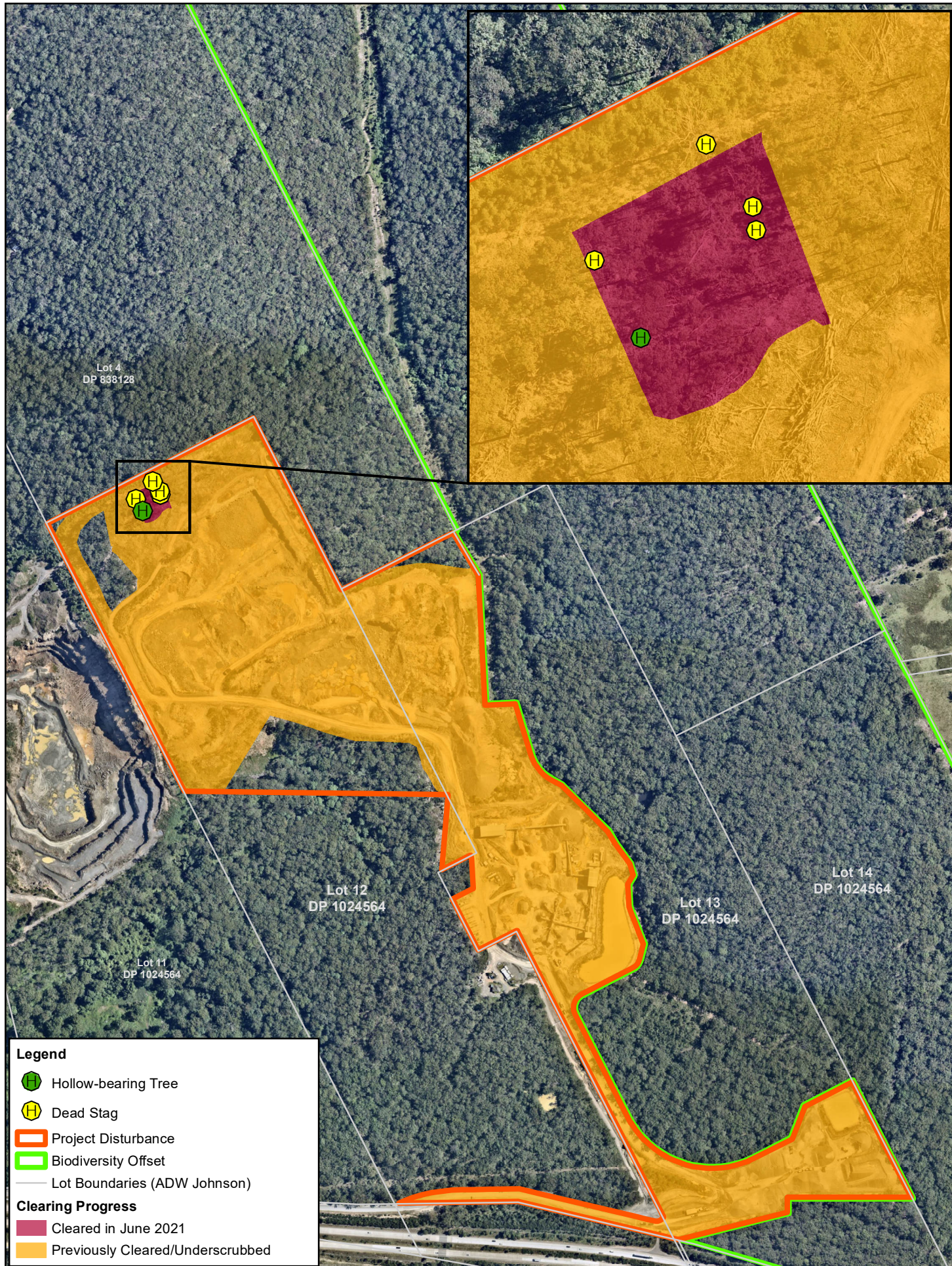
Mark Dean BEnvSc&Mgmt

Ecologist

Mdean@kleinfelder.com

Mobile: 0455381346

Kleinfelder Australia Pty Ltd



Legend

- Hollow-bearing Tree
- Dead Stag

- Project Disturbance
- Biodiversity Offset
- Lot Boundaries (ADW Johnson)

Clearing Progress

- Cleared in June 2021
- Previously Cleared/Underscrubbed

Metres
0 25 50 100 150 200 250



PROJECT REFERENCE: 20190337

DATE DRAWN: 2021/06/03 12:12/Version 1

DRAWN BY: G.Joyce

DATA SOURCE:

LPI - 2015
ADW Johnson - 2015
Nearmap - 2021

Current Extent of Clearing within the Karuah East Quarry Project Area

Karuah East Quarry Pty Ltd
Vegetation Clearing Completion Report
Karuah East Quarry Project

FIGURE:

1

APPENDIX 6 – Water Monitoring Data



Periodic Groundwater Monitoring April 2021

Hunter Quarries – Karuah & Karuah East

Project: P1446

Written by: Jake Duck (Environmental Scientist)

Reviewed by: Malcolm Adrien (Environmental Services Manager)

Email: office@huntercivilab.com.au

Client: Hunter Quarries

9 April 2021**Prepared for:****Hunter Quarries**

1 Andersite Road

Karuah NSW 2324

Ph: 0447 044 646

Email: joel.fleming@hunterquarries.com.au**Prepared by****Hunter Civilab**

ABN 50 103 355 531

3/62 Sandringham Avenue

PO Box 3127

Thornton NSW 2322

Ph: (02) 4966 1844

Email: office@huntercivilab.com.auWeb: huntercivilab.com.au**Project Details**

Site Address:	Hunter Quarries – Karuah & Karuah East	
Project Type:	Periodic Groundwater Monitoring	
Project no	Report type	Report no
P1446	GWM	1

We confirm that the following report has been produced for Hunter Quarries – Karuah & Karuah East, based on the described methods and conditions within.

For and on behalf of **Hunter Civilab**,

**Malcolm Adrien**

Environmental Services Manager

Table of Contents

1	Introduction	3
1.1	Background	3
1.2	Objectives.....	4
2	Site Works	4
2.1	Quality Assurance / Quality Control.....	4
3	Conclusion.....	5

Annex List:

Annex A – Site Features Plan

Annex B – Field sheet

Annex C – Laboratory Reports

Annex D – Calibration Certificate

1 Introduction

1.1 Background

Hunter Civilab were engaged by Hunter Quarries Pty Ltd (Hunter Quarries) to undertake groundwater monitoring across Hunter Quarries Karuah and Karuah East operations (herein referred to as the site). It is understood groundwater monitoring is a requirement under Section 3.2 of the Statement of Commitments (NSW Government 2013) and Section 8.2 of the Water Management Plan (SLR 2015) for quarrying operations across the site. A site locality figure is presented as Figure 1, Annex A.

The Statement of Commitments identifies monitoring of groundwater will occur bi-annually. Bi-annual analyses comprise:

- pH
- Electrical Conductivity
- Total Dissolved Solids
- Alkalinity
- Total nitrogen
- Total Phosphorus
- Calcium
- Magnesium
- Sodium
- Potassium
- Chloride
- Sulphate
- Carbonate
- Bicarbonate
- Total Petroleum Hydrocarbon (TPH)
- BTEX (benzene, toluene, ethyl benzene, xylene)

Annual analyses include the bi-annual suite supplemented with:

- Nitrate
- Total Kjeldahl Nitrogen
- Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Zinc, Nickel, Manganese, Mercury)
- Total Iron
- Filterable Iron
- Total Petroleum Hydrocarbon (TPH)
- Polycyclic Aromatic Hydrocarbon (PAH)
- Organophosphorus pesticides
- Phenoxy acid herbicides

The Assessment works were undertaken in accordance with services agreement Q2018_032, dated 4th April 2018.

1.2 Objectives

The objective of this engagement was to complete groundwater monitoring in accordance with Hunter Quarries monthly monitoring requirements.

2 Site Works

A Hunter Civilab environmental scientist experienced in groundwater sampling visited the site on the 1st April 2021. Core elements of the works completed include:

- 1) Measurement of standing water level (SWL) and well depth and calculation of well volume;
- 2) Purging of groundwater using a disposable bailer and measurement of physical parameters including:
 - Temperature;
 - Dissolved oxygen (DO);
 - Electric Conductivity (EC);
 - pH; and
 - Oxido-reduction potential (ORP).
- 3) Purging generally continued until physical parameters stabilised and stabilisation was considered an indicator that purge water was representative of groundwater (i.e. the well was ready to be sampled);
- 4) Samples were collected using a disposable bailer and bottles / vials specific to requested analyses; and
- 5) Transport of samples under chain of custody and submission to the sub-contracted NATA accredited laboratory.

Field sheets recording measurement of physical parameters during purging and sampling details are presented as Annex B. Analytical results are presented within laboratory reports presented as Annex C. Equipment calibration certificate is presented as Annex D.

2.1 Quality Assurance / Quality Control

Quality assurance measures for sampling within this assessment were adopted to provide confidence in the analytical results to support determinations on material categorization and to facilitate satisfaction of project specific objectives. Adopted measures included complimentary regimes of field and laboratory-based quality assurance techniques and quality control sampling/analyses. Quality assurance measures, results and implications for data quality associated with this assessment are broadly defined within the following categories:

- sample collection, storage transport and analysis;
- laboratory quality control procedures and results; and
- the occurrence of apparently unusual and anomalous results.

Sampling was completed by a suitably qualified scientist experienced in contaminated site assessments and in accordance with Hunter Civilab Standard Operating Procedures (SOPs). Disposable nitrile gloves were worn during sampling and changed between locations. Bailers were replaced between monitoring locations. Samples were stored in bottles and vials provided by the NATA accredited laboratory sub-contracted to complete analysis (SGS) and were specific to targeted analytes. Samples were labelled with unique identifiers referencing the monitoring well ID and date of sampling. Samples were stored on ice and transported under chain of custody to the laboratory and then analysed according to NATA accredited test methods.

Tabulated assessments of laboratory quality control samples are presented within laboratory reports presented as Annex C.

3 Conclusion

Hunter Civilab were engaged by Hunter Quarries to undertake periodic groundwater monitoring in accordance with a Statement of Commitments for operation of Karuah and Karuah East Quarries. The works described here-in are considered to address commitments to groundwater monitoring for this period.

For and on behalf of

Hunter Civilab Pty Ltd

A handwritten signature in blue ink, appearing to read "Jake Duck".

Jake Duck
Environmental Scientist

A handwritten signature in blue ink, appearing to read "Malcolm Adrien".

Malcolm Adrien
Environmental Services Manager

LIMITATIONS

This report has been prepared in accordance with normal industry practice and per the scope of work outlined within this report. This report is limited by time, cost and other constraints associated with the terms of Hunter Civilab's commercial engagement. Hunter Civilab does not warrant the suitability of the site for any purpose and this report is limited to assessment of specified environmental conditions associated with the subject site. Lack of identification in the report of any hazardous or toxic materials on the subject site should not be interpreted as a guarantee that such materials do not exist on the site.

Conclusions and recommendations made in this report are based on interpretation of the limited amount of information presented here-in. Hunter Civilab assumes no responsibility or liability for errors in data obtained from such sources, regulatory agencies or any other external sources, or from occurrences outside the scope of this project.

Hunter Civilab have prepared this report for the use of Hunter Quarries Pty Ltd. Unless otherwise specifically agreed reliance on this report is limited to Hunter Quarries Pty Ltd and Hunter Civilab accepts no liability for the use of this report by any other party to the extent permitted by law.

REFERENCES

NSW Government Department of Planning and Infrastructure (2013) *Appendix 6, Statement of Commitments*

SLR (2015) *Karuah East Quarry Project Water Management Plan*



Annex A



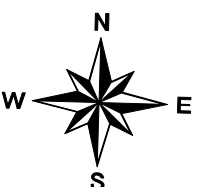
Notes:
(1) The scale bar is approximate.
(2) Base layer sourced from NearMaps (2020)

**Figure 1 - Site Locality and
Well Locations**

Legend

 Groundwater Well

Scale (m)
0 50 100





Annex B

Groundwater Sampling Sheet



Date: 1/4/2021

Client: Hunter Quarries

Site: Karuah

Project Ref: P1446

Sampler: JD

WELL ID
MW208

Equipment

 Puring equipment type / ID: ☒ Bailer ☐ Peristaltic ☐ Micropurge

Water Quality Meter ID: YSI Pro DSS 20F162071

Interface Probe ID: 3954

Well Gauging and Purge Volume Calculations (For Bailer Only)

Total well depth (m BTOC)	21.1	
Standing Water Level (m BTOC)	20.72	
Water Column (m)	0.38	
Well Volume (L)	1	Conversion factor for 50mm well (well casing only) = 1.96 Conversion factor for 100mm well (well casing only) = 7.85
Product Thickness (m)	---	
Volume removed (L)		

Water Quality Parameters

Starting Purge Time: 8:10:00 AM		Ending Purge Time:				Pump Intake (mBTOC): N/A		
Litres	Time	Drawdown <10cm	Temp (C) ± 0.5	DO (mg/L) ± 0.3 mg/L	EC (µS/cm) ± 3%	pH ± 0.1	ORP (mV) ± 10mV	Comments
-	-		-		-	-	-	Well dry, insufficient water for purging/ sampling

 Sample Time: - No. of containers used: n/a Was the well dry purged ☐ Y ☐ N

QA/QC Checklist

Did Field Parameters Stabilise? ☐ Y ☐ N ☒ N/A
 Are air bubbles present in Vials? ☐ Y ☐ N ☒ N/A
 Was Sample for metals field filtered? ☐ Y ☐ N ☒ N/A
 Duplicate Sample Collected? ☐ Y ☐ N
 Rinsate Blank Collected? ☐ Y ☐ N

Duplicate Sample ID(s): N/A

Rinsate Blank ID: N/A

Groundwater Sampling Sheet



Date: 1/4/2021

Client: Hunter Quarries

Site: Karuah

Project Ref: P1446

Sampler: JD

WELL ID
MW303

Equipment

 Puring equipment type / ID: ☒ Bailer ☐ Peristaltic ☐ Micropurge

Water Quality Meter ID: YSI Pro DSS 20F162071

Interface Probe ID: 3954

Well Gauging and Purge Volume Calculations (For Bailer Only)

Total well depth (m BTOC)	35.9	
Standing Water Level (m BTOC)	30.93	
Water Column (m)	4.97	
Well Volume (L)	10	Conversion factor for 50mm well (well casing only) = 1.96 Conversion factor for 100mm well (well casing only) = 7.85
Product Thickness (m)	---	
Volume removed (L)		

Water Quality Parameters

Starting Purge Time: 9.10am		Ending Purge Time: 9:34am		Pump Intake (mBTOC):				
Litres	Time	Drawdown <10cm	Temp (C) ± 0.5	DO (mg/L) ± 0.3 mg/L	EC (µS/cm) ± 3%	pH ± 0.1	ORP (mV) ± 10mV	Comments
4	9.15		18.6	11.06	1271	6.16	31.3	
7	9.2		18.4	10.93	2521	5.76	-98.7	
10	9.29		18.4	11.15	2160	5.76	-29.7	
13	9.31		18.4	11.09	2293	5.75	-43.8	
15	9.34		18.4	10.9	2397	5.75	-28.3	

Sample Time: 9.35am

No. of containers used: 5

 Was the well dry purged? ☐ Y ☒ N

QA/QC Checklist

Did Field Parameters Stabilise? ☒ Y ☐ N ☐ N/A
 Are air bubbles present in Vials? ☐ Y ☒ N ☐ N/A
 Was Sample for metals field filtered? ☒ Y ☐ N ☐ N/A
 Duplicate Sample Collected? ☐ Y ☒ N
 Rinsate Blank Collected? ☐ Y ☒ N

Duplicate Sample ID(s): N/A

Rinsate Blank ID: N/A

Groundwater Sampling Sheet



Date: 1/4/2021

Client: Hunter Quarries

Site: Karuah

Project Ref: P1446

Sampler: JD

WELL ID
MW205

Equipment

 Puring equipment type / ID: ☒ Bailer ☐ Peristaltic ☐ Micropurge

Water Quality Meter ID: YSI Pro DSS 20F162071

Interface Probe ID: 3954

Well Gauging and Purge Volume Calculations (For Bailer Only)

Total well depth (m BTOC)	38.47	
Standing Water Level (m BTOC)	17.54	
Water Column (m)	20.93	
Well Volume (L)	41	Conversion factor for 50mm well (well casing only) = 1.96 Conversion factor for 100mm well (well casing only) = 7.85
Product Thickness (m)	---	
Volume removed (L)		

Water Quality Parameters

Starting Purge Time: 10:58am		Ending Purge Time: 11:21am		Pump Intake (mBTOC): N/A				
Litres	Time	Drawdown <10cm	Temp (C) ± 0.5	DO (mg/L) ± 0.3 mg/L	EC (µS/cm) ± 3%	pH ± 0.1	ORP (mV) ± 10mV	Comments
3	11.01		19.3	10.21	2795	11.88	154.2	
8	11.06		19.2	10.25	2734	7.74	109.5	
10	11.09		19.0	10.28	2682	7.59	116.1	
13	11.14		19.2	10.16	2702	7.52	123.8	
15	11.15		19.1	10.2	2698	6.82	113.1	
16	11.18		19.1	10.18	2710	6.80	107.6	
17	11.2		19.0	10.15	2689	6.81	119.2	
18	11.21		19.1	10.16	2714	6.79	118.9	

Sample Time: 11:22am

No. of containers used: 5

 Was the well dry purged? ☐ Y ☒ N

QA/QC Checklist

Did Field Parameters Stabilise? ☒ Y ☐ N ☐ N/A
 Are air bubbles present in Vials? ☐ Y ☒ N ☐ N/A
 Was Sample for metals field filtered? ☒ Y ☐ N ☐ N/A
 Duplicate Sample Collected? ☐ Y ☒ N
 Rinsate Blank Collected? ☐ Y ☒ N

Duplicate Sampe ID(s): N/A

Rinsate Blank ID: N/A

Groundwater Sampling Sheet



Date: 1/4/2021

Client: Hunter Quarries

Site: Karuah

Project Ref: P1446

Sampler: JD

WELL ID
MW207

Equipment

 Puring equipment type / ID: ☒ Bailer ☐ Peristaltic ☐ Micropurge

Water Quality Meter ID: YSI Pro DSS 20F162071

Interface Probe ID: 3954

Well Gauging and Purge Volume Calculations (For Bailer Only)

Total well depth (m BTOC)	28.63	
Standing Water Level (m BTOC)	7.4	
Water Column (m)	21.23	
Well Volume (L)	42	Conversion factor for 50mm well (well casing only) = 1.96 Conversion factor for 100mm well (well casing only) = 7.85
Product Thickness (m)	---	
Volume removed (L)		

Water Quality Parameters

Starting Purge Time: 11:40:00 AM			Ending Purge Time: 12:09:00 PM			Pump Intake (mBTOC): N/A		
Litres	Time	Drawdown <10cm	Temp (C) ± 0.5	DO (mg/L) ± 0.3 mg/L	EC (µS/cm) ± 3%	pH ± 0.1	ORP (mV) ± 10mV	Comments
3	11.46		19.7	10.35	2889	6.38	21	
6	11.54		19.0	10.52	2791	6.34	25.7	
9	11.58		18.9	10.1	2805	6.33	20.3	
11	12.05		18.9	10.5	2798	6.32	23.5	
12	12.07		18.8	10.7	2781	6.30	22.7	
13	12.09		18.8	10.1	2788	6.31	20.32	

Sample Time: 12:10:00 PM

No. of containers used: 5

 Was the well dry purged? ☐ Y ☒ N

QA/QC Checklist

Did Field Parameters Stabilise? ☒ Y ☐ N ☐ N/A
 Are air bubbles present in Vials? ☐ Y ☒ N ☐ N/A
 Was Sample for metals field filtered? ☒ Y ☐ N ☐ N/A
 Duplicate Sample Collected? ☐ Y ☒ N
 Rinsate Blank Collected? ☐ Y ☒ N

Duplicate Sampe ID(s): N/A

Rinsate Blank ID: N/A



Annex C

Karuah East Quarry Pty Ltd
PO Box 3284
THORNTON NSW 2324

Attention: Joel Flemming

Project:	RCA ref 12078-1457/WATER/0		
Date:	16/04/2021		
Client reference:	Water Sampling		
Received date:	1/04/2021	Number of samples:	3
Client order number:	N/A	Testing commenced:	1/04/20201

CERTIFICATE OF ANALYSIS

1 ANALYTICAL TEST METHODS

ANALYSIS	METHOD	UNITS	ANALYSING LABORATORY	NATA ANALYSIS/ NON NATA
pH	ENV-LAB006*	pH	RCA Laboratories - Environmental	NATA
Conductivity	ENV-LAB010	µS/cm	RCA Laboratories - Environmental	NATA
Total Dissolved Solids	ENV-LAB020*	mg/L	RCA Laboratories - Environmental	NATA
Volatile Organic Carbons (BTEX)	AN433/AN434	µg/L	SGS Environmental	NATA
Volatile Petroleum Hydrocarbons (TRH)	AN433/AN434/AN410	µg/L	SGS Environmental	NATA
Total Recoverable Hydrocarbons (TRH)	AN403	µg/L	SGS Environmental	NATA
Polynuclear Aromatic Hydrocarbons (PAH)	AN420	µg/L	SGS Environmental	NATA
OP Pesticides	AN400/AN420	µg/L	SGS Environmental	NATA
Acid Herbicides	AN420	µg/L	SGS Environmental	NATA
Chloride	AN425	mg/L	SGS Environmental	NATA
Total Sulphate	AN425	mg/L	SGS Environmental	NATA
Nitrate Nitrogen	AN425	mg/L	SGS Environmental	NATA
Total Alkalinity	AN135	mg/L	SGS Environmental	NATA
Nitrite Nitrogen	AN277/WC250.312	mg/L	SGS Environmental	NATA
Total Oxidised Nitrogen	AN277/WC250.312	mg/L	SGS Environmental	NATA
Total Kjeldahl Nitrogen	AN281/AN292	mg/L	SGS Environmental	NATA
Total Phosphorus	AN279/AN293	mg/L	SGS Environmental	NATA
Filterable Reactive Phosphorus	AN278	mg/L	SGS Environmental	NATA
Dissolved Metals (Ca, Mg, K, Na and Hardness)	AN320/AN321	mg/L	SGS Environmental	NATA
Dissolved Trace Metals	AN318	µg/L	SGS Environmental	NATA
Dissolved Mercury	AN311/AN312	mg/L	SGS Environmental	NATA
Total Iron	AN022/AN318	µg/L	SGS Environmental	NATA

* The analytical procedures used by RCA Laboratories - Environmental are based on established internationally recognised procedures such as APHA and Australian Standards.

** Indicates NATA accreditation does not cover the performance of this service.

2 RESULTS

ANALYSIS	UNITS	MW 205	MW207	MW303
Sample Number	-	042112078011	042112078012	042112078013
Date Sampled	-	1/04/2021	1/04/2021	11/04/2021
Sampled By	-	Client	Client	Client
pH Value	pH unit	6.73	6.45	5.82
Conductivity	µS/cm	3350	3070	2910
Total Dissolved Solids	mg/L	1869	1663	1674
Hydroxide Alkalinity as CaCO ₃	mg/L	<1	<1	<1
Carbonate Alkalinity as CaCO ₃	mg/L	<1	<1	<1
Biarbonate Alkalinity as CaCO ₃	mg/L	289	188	88
Total Alkalinity as CaCO ₃	mg/L	289	188	88
Benzene	µg/L	<1	<1	<1
Toluene	µg/L	<2	<2	<2
Ethylbenzene	µg/L	<2	<2	<2
m/p-xylene	µg/L	<2	<2	<2
o-xylene	µg/L	<2	<2	<2
Total Xylenes	µg/L	<2	<2	<2
Total BTEX	µg/L	<1	<1	<1
TRH C6-C9	µg/L	<20	<20	<20
TRH C10-C14	µg/L	<50	<50	<50
TRH C15-C28	µg/L	160	<100	200
TRH C29-C36	µg/L	<50	50	<50
TRH C10-C36 sum	µg/L	160	50	200
Total Recoverable Hydrocarbons - NEPM 2013 Fractions				
C6 - C10 Fraction	µg/L	<20	<20	<20
C6 - C10 Fraction minus BTEX (F1)	µg/L	<20	<20	<20
>C10 - C16 Fraction	µg/L	<100	<100	<100
>C16 - C34 Fraction	µg/L	180	130	160
>C34 - C40 Fraction	µg/L	<100	<100	<100

ANALYSIS	UNITS	MW 205	MW207	MW303
>C10 - C40 Fraction (sum)	µg/L	<100	<100	<100
>C10 - C16 Fraction minus Naphthalene (F2)	-	<100	<100	<100
Naphthalene	µg/L	<1.0	<1.0	<1.0
Acenaphthylene	µg/L	<1.0	<1.0	<1.0
Acenaphthene	µg/L	<1.0	<1.0	<1.0
Fluorene	µg/L	<1.0	<1.0	<1.0
Phenanthrene	µg/L	<1.0	<1.0	<1.0
Anthracene	µg/L	<1.0	<1.0	<1.0
Fluoranthene	µg/L	<1.0	<1.0	<1.0
Pyrene	µg/L	<1.0	<1.0	<1.0
Benz(a)anthracene	µg/L	<1.0	<1.0	<1.0
Chrysene	µg/L	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	µg/L	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	<1.0	<1.0	<1.0
Benzo(a)pyrene	µg/L	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	µg/L	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	µg/L	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	µg/L	<1.0	<1.0	<1.0
Sum of polycyclic aromatic hydrocarbons	µg/L	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ (zero)	µg/L	<0.5	<0.5	<0.5
Dichlorvos	µg/L	<0.5	<0.5	<0.5
Demeton-S-methyl	µg/L	<0.5	<0.5	<0.5
Monocrotophos	µg/L	<2.0	<2.0	<2.0
Dimethoate	µg/L	<0.5	<0.5	<0.5
Diazinon	µg/L	<0.5	<0.5	<0.5
Chlorpyrifos-methyl	µg/L	<0.5	<0.5	<0.5
Parathion-methyl	µg/L	<2.0	<2.0	<2.0
Malathion	µg/L	<0.5	<0.5	<0.5
Fenthion	µg/L	<0.5	<0.5	<0.5
Chlorpyrifos	µg/L	<0.5	<0.5	<0.5

ANALYSIS	UNITS	MW 205	MW207	MW303
Parathion	µg/L	<2.0	<2.0	<2.0
Pirimphos-ethyl	µg/L	<0.5	<0.5	<0.5
Chlorfenvinphos	µg/L	<0.5	<0.5	<0.5
Bromophos-ethyl	µg/L	<0.5	<0.5	<0.5
Fenamiphos	µg/L	<0.5	<0.5	<0.5
Prothiofos	µg/L	<0.5	<0.5	<0.5
Ethion	µg/L	<0.5	<0.5	<0.5
Carbophenothion	µg/L	<0.5	<0.5	<0.5
Azinphos Methyl	µg/L	<0.5	<0.5	<0.5
4-Chlorophenoxy acetic acid	µg/L	<10	<10	<10
2,4-DB	µg/L	<10	<10	<10
Dicamba	µg/L	<10	<10	<10
Mecoprop	µg/L	<10	<10	<10
MCPA	µg/L	<10	<10	<10
2,4-DP	µg/L	<10	<10	<10
2,4-D	µg/L	<10	<10	<10
Triclopyr	µg/L	<10	<10	<10
Silvex (2,4,5-TP/Fenoprop)	µg/L	<10	<10	<10
2,4,5-T	µg/L	<10	<10	<10
MCPB	µg/L	<10	<10	<10
Picloram	µg/L	<10	<10	<10
Clopyralid	µg/L	<10	<10	<10
Fluroxypyr	µg/L	<10	<10	<10
2,6-D	µg/L	<10	<10	<10
2,4,6-T	µg/L	<10	<10	<10
Chloride	mg/L	881	915	879
Sulphate, SO ₄	mg/L	125	90	54
Nitrate Nitrogen, NO ₃ -N	mg/L	4.68	0.01	0.52
Nitrite Nitrogen, NO ₂ as N	mg/L	0.03	<0.01	<0.01
Total Oxidised Nitrogen, NO _x -N	mg/L	0.34	0.02	0.06
Total Kjeldahl Nitrogen	mg/L	0.6	0.4	0.8

ANALYSIS	UNITS	MW 205	MW207	MW303
Total Nitrogen (calc)	mg/L	5.3	0.4	1.3
Total Phosphorus	mg/L	0.09	0.55	0.56
Filterable Reactive Phosphorus	mg/L	0.06	<0.01	<0.01
Calcium, Ca	mg/L	68	40	51
Magnesium, Mg	mg/L	47	52	51
Sodium, Na	mg/L	511	500	425
Potassium, K	mg/L	6	2	7
Arsenic, As	mg/L	<0.001	0.004	0.013
Cadmium, Cd	mg/L	<0.0001	<0.0001	0.0023
Chromium, Cr	mg/L	0.002	0.013	0.005
Copper, Cu	mg/L	0.002	0.012	0.012
Lead, Pb	mg/L	0.03	0.018	0.053
Nickel, Ni	mg/L	0.221	0.442	1.56
Zinc, Zn	mg/L	0.002	0.009	0.013
Manganese, Mn	mg/L	0.024	0.07	0.15
Iron, Fe	mg/L	1.07	19	15.8
Mercury	mg/L	<0.0001	<0.0001	<0.0001
Dissolved Iron	mg/L	<0.05	2.04	4.99

NATA Scope of Accreditation does not cover the sampling of surface and ground waters by the client or by RCA.

Analysis on samples is on an as received basis.

Appendix 1

Internal Laboratory Analysis Report and
Chain of Custody Documentation

CERTIFICATE OF ANALYSIS

1 ANALYTICAL TEST METHODS

ANALYSIS	METHOD	UNITS	ANALYSING LABORATORY	NATA ANALYSIS / NON NATA
pH	ENV-LAB006*	pH	RCA Laboratories - Environmental	NATA
Conductivity	ENV-LAB010	µS/cm	RCA Laboratories - Environmental	NATA
Total Dissolved Solids	ENV-LAB020*	mg/L	RCA Laboratories - Environmental	NATA

* The analytical procedures used by RCA Laboratories - Environmental are based on established internationally recognised procedures such as APHA and Australian Standards.

** Indicates NATA accreditation does not cover the performance of this service.

2 RESULTS

ANALYSIS	UNITS	MW 205	MW207	MW303
Sample Number	-	042112078011	042112078012	042112078013
Date Sampled	-	1/04/2021	1/04/2021	11/04/2021
Sampled By		Client	Client	Client
pH Value	pH unit	6.73	6.45	5.82
Conductivity	µS/cm	3350	3070	2910
Total Dissolved Solids	mg/L	1869	1663	1674

NATA Scope of Accreditation does not cover the sampling of surface and ground waters by the client or by RCA.

Analysis on samples is on an as received basis.

3 QUALITY CONTROL RESULTS

Water Quality Control Sample Results

DATE	ANALYSIS	METHOD	UNITS	QUALITY CONTROL STANDARD VALUE	QUALITY CONTROL ACCEPTANCE CRITERIA	QUALITY CONTROL STANDARD RESULT
1/04/2021	pH	ENV-LAB006	pH	7.00	6.95 - 7.05	704
1/04/2021	Conductivity	ENV-LAB010	µS/cm	1413	1385 - 1441	1416
9/04/2021	Total Dissolved Solids	ENV-LAB020	mg/L	35	31.5 – 38.5	37

Water Duplicate Analysis Results

SAMPLE NUMBER	DATE	ANALYSIS	METHOD	UNITS	LOR	SAMPLE RESULT	SAMPLE DUPLICATE RESULT
042112078004	1/04/2021	pH	ENV-LAB006	pH	-	6.84	6.85
042112078004	1/04/2021	Conductivity	ENV-LAB010	µS/cm	1	294	293
0421120478002	9/04/2021	Total Dissolved Solids	ENV-LAB020	mg/L	5	262	274

Please contact the undersigned if you have any queries.

Yours sincerely



Laura Schofield
Environmental Laboratory Manager
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental



Neena Tewari
Senior Environmental Microbiologist
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental

RCA Internal Quality Review

General

1. Laboratory QC results for Method Blanks, Duplicates and Laboratory Control Samples are included in this QC report where applicable. Additional QC data maybe available on request.
2. RCA QC Acceptance / Rejection Criteria are available on request.
3. Proficiency Trial results are available on request.
4. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
5. When individual results are qualified in the body of a report, refer to the qualifier descriptions that follow.
6. Samples were analysed on an 'as received' basis.
7. Sampled dates in this report are those listed on the COC or sample jars; if no sample dates are noted, the date the samples are received at the laboratory have been used.
8. All soil results are reported on a dry basis, unless otherwise stated. (ACID SULPHATE SOILS)
9. This report replaces any interim results previously issued.

Holding Times.

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample

Receipt Acknowledgment.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

##NOTE: pH duplicates are reported as a range NOT as RPD

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR: RPD must lie between 0-30%

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Glossary

UNITS

mg/kg: milligrams per Kilogram

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100ml: Organisms per 100 millilitres

NTU: Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/L: milligrams per Litre

TERMS

Dry Where moisture has been determined on a solid sample the result is expressed on a dry basis.

LOR Limit of Reporting.

RPD Relative Percent Difference between two Duplicate pieces of analysis can be obtained upon request.

QCS Quality Control Sample - reported as value recovery

Method Blank In the case of solid samples these are performed on laboratory certified clean sands.

In the case of water samples these are performed on de-ionised water.

Duplicate A second piece of analysis from the same sample and reported in the same units as the result to show comparison.

Batch Duplicate A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.

USEPA United States Environment Protection Authority

APHA American Public Health Association

COC Chain of Custody

CP Client Parent - QC was performed on samples pertaining to this report

NCP Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

< indicates less than

> Indicates greater than

ND Not Detected

Appendix 2

External Laboratory Reports and Chain of Custody Documents

CERTIFICATE OF ANALYSIS

Work Order	: ES2112134	Page	: 1 of 8
Amendment	: 1		
Client	: ROBERT CARR & ASSOCIATES P/L	Laboratory	: Environmental Division Sydney
Contact	: MS LAURA SCHOFIELD	Contact	: Grace White
Address	: PO BOX 175	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
	CARRINGTON NSW, AUSTRALIA 2294		
Telephone	: +61 02 49029200	Telephone	: +61 2 8784 8555
Project	: 12078	Date Samples Received	: 01-Apr-2021 16:08
Order number	: ---	Date Analysis Commenced	: 03-Apr-2021
C-O-C number	: ---	Issue Date	: 22-Apr-2021 14:33
Sampler	: ---		
Site	: ---		
Quote number	: SYBQ/400/18		
No. of samples received	: 3		
No. of samples analysed	: 3		



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Alex Rossi	Organic Chemist	Sydney Organics, Smithfield, NSW
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Franco Lentini	LCMS Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Rassem Ayoubi	Senior Organic Chemist	Sydney Organics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a,h)anthracene (1.0), Benzo(g,h,i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- Amendment (19/04/21: This report has been amended and re-released to allow the reporting of additional analytical data, specifically method EG030T for all sample .
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				MW205 P1446	MW207 P1446	MW303 P1446	----	----
Sampling date / time				01-Apr-2021 00:00	01-Apr-2021 00:00	01-Apr-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2112134-001	ES2112134-002	ES2112134-003	-----	-----
				Result	Result	Result	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	289	188	88	----	----
Total Alkalinity as CaCO3	----	1	mg/L	289	188	88	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	125	90	54	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	881	915	879	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	68	40	51	----	----
Magnesium	7439-95-4	1	mg/L	47	52	51	----	----
Sodium	7440-23-5	1	mg/L	511	500	425	----	----
Potassium	7440-09-7	1	mg/L	6	2	7	----	----
EG020F: Dissolved Metals by ICP-MS								
Iron	7439-89-6	0.05	mg/L	<0.05	2.04	4.99	----	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.004	0.013	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0023	----	----
Chromium	7440-47-3	0.001	mg/L	0.002	0.013	0.005	----	----
Copper	7440-50-8	0.001	mg/L	0.002	0.012	0.012	----	----
Nickel	7440-02-0	0.001	mg/L	0.002	0.009	0.013	----	----
Lead	7439-92-1	0.001	mg/L	0.030	0.018	0.053	----	----
Zinc	7440-66-6	0.005	mg/L	0.024	0.070	0.150	----	----
Manganese	7439-96-5	0.001	mg/L	0.221	0.442	1.56	----	----
Iron	7439-89-6	0.05	mg/L	1.07	19.0	15.8	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	0.03	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	4.68	0.01	0.52	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	4.71	0.01	0.52	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				MW205 P1446	MW207 P1446	MW303 P1446	----	----
Sampling date / time				01-Apr-2021 00:00	01-Apr-2021 00:00	01-Apr-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2112134-001	ES2112134-002	ES2112134-003	-----	-----
Result				Result	Result	Result	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.6	0.4	0.8	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	5.3	0.4	1.3	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.09	0.55	0.56	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.06	<0.01	<0.01	----	----
EN055: Ionic Balance								
∅ Total Anions	----	0.01	meq/L	33.2	31.4	27.7	----	----
∅ Total Cations	----	0.01	meq/L	29.6	28.1	25.4	----	----
∅ Ionic Balance	----	0.01	%	5.70	5.65	4.28	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	<2.0	<2.0	----	----
Dimethoate	60-51-5	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Diazinon	333-41-5	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	<2.0	<2.0	----	----
Malathion	121-75-5	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Fenthion	55-38-9	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Parathion	56-38-2	2.0	µg/L	<2.0	<2.0	<2.0	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Prothiofos	34643-46-4	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Ethion	563-12-2	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Carbophenothion	786-19-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----

QUALITY CONTROL REPORT

Work Order : **ES2112134**

Page : 1 of 11

Amendment : **1**

Client : **ROBERT CARR & ASSOCIATES P/L**

Laboratory : Environmental Division Sydney

Contact : MS LAURA SCHOFIELD

Contact : Grace White

Address : PO BOX 175
CARRINGTON NSW, AUSTRALIA 2294

Address : 277-289 Woodpark Road Smithfield NSW Australia 2164

Telephone : +61 02 49029200

Telephone : +61 2 8784 8555

Project : 12078

Date Samples Received : 01-Apr-2021

Order number : ----

Date Analysis Commenced : 03-Apr-2021

C-O-C number : ----

Issue Date : 22-Apr-2021

Sampler : ----

Site : ----

Quote number : SYBQ/400/18

No. of samples received : 3

No. of samples analysed : 3



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This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Alex Rossi	Organic Chemist	Sydney Organics, Smithfield, NSW
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Franco Lentini	LCMS Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Rassem Ayoubi	Senior Organic Chemist	Sydney Organics, Smithfield, NSW

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 3601546)									
ES2112092-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	149	155	4.44	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	149	155	4.44	0% - 20%
ES2112061-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	32	31	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	32	31	0.00	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3601448)									
ES2112083-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.00	No Limit
ES2112134-001	MW205 P1446	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	125	125	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3601449)									
ES2112083-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	10	10	0.00	0% - 50%
ES2112134-001	MW205 P1446	ED045G: Chloride	16887-00-6	1	mg/L	881	938	6.27	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 3602374)									
ES2111365-005	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	5	5	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	1	1	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	288	289	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	6	6	0.00	No Limit
ES2111823-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	5	5	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	4	4	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	12	12	0.00	0% - 50%
		ED093F: Potassium	7440-09-7	1	mg/L	1	1	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3602375)									



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3602375) - continued									
ES2112061-001	Anonymous	EG020A-F: Iron	7439-89-6	0.05	mg/L	0.12	0.12	0.00	No Limit
ES2112172-002	Anonymous	EG020A-F: Iron	7439-89-6	0.05	mg/L	0.55	0.51	6.82	0% - 50%
EG020T: Total Metals by ICP-MS (QC Lot: 3603986)									
ES2111789-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.035	0.035	0.00	0% - 20%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
ES2111823-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.027	0.027	0.00	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.30	0.31	3.84	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3603987)									
ES2112134-003	MW303 P1446	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.0023	0.0026	13.2	0% - 20%
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.013	0.014	0.00	0% - 50%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.005	0.006	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.012	0.013	0.00	0% - 50%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.053	0.052	2.56	0% - 20%
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	1.56	1.56	0.198	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.013	0.012	8.53	0% - 50%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.150	0.150	0.00	0% - 20%
		EG020A-T: Iron	7439-89-6	0.05	mg/L	15.8	15.9	0.964	0% - 20%
EW2101413-009	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.027	0.024	12.3	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.34	0.36	3.21	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3630996)									
EM2106519-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EM2106519-009	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3601450)									
ES2112083-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2112134-001	MW205 P1446	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.03	0.03	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3607057)									
ES2112017-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.10	<0.10	0.00	No Limit
ES2111801-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3607054)									
ES2111729-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.2	1.2	0.00	No Limit
ES2112084-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.7	2.4	11.7	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3607056)									
ES2112134-003	MW303 P1446	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.8	0.8	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3607055)									
ES2111729-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.67	0.66	2.50	0% - 20%
ES2112084-002	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.22	0.22	0.00	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 3601451)									
ES2112095-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2112134-001	MW205 P1446	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.06	0.07	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3602661)									
ES2111823-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
ES2111954-004	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3602661)									
ES2111823-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
ES2111954-004	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 3602661)									
ES2111823-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.00	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
ES2111954-004	Anonymous	EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
		EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.00	No Limit
			106-42-3						



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP080: BTEXN (QC Lot: 3602661) - continued									
ES2111954-004	Anonymous	EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QC Lot: 3604363)									
EM2105538-001	Anonymous	EP202-SL: 4-Chlorophenoxy acetic acid	122-88-3	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: 2,4-DB	94-82-6	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Dicamba	1918-00-9	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Mecoprop	93-65-2	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: MCPA	94-74-6	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: 2,4-DP	120-36-5	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: 2,4-D	94-75-7	10	µg/L	29	29	0.00	No Limit
		EP202-SL: Triclopyr	55335-06-3	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Silvex (2,4,5-TP/Fenoprop)	93-72-1	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: 2,4,5-T	93-76-5	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: MCPB	94-81-5	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Picloram	1918-02-1	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Clopyralid	1702-17-6	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Fluroxypyr	69377-81-7	10	µg/L	<10	<10	0.00	No Limit
EM2105538-011	Anonymous	EP202-SL: 4-Chlorophenoxy acetic acid	122-88-3	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: 2,4-DB	94-82-6	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Dicamba	1918-00-9	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Mecoprop	93-65-2	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: MCPA	94-74-6	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: 2,4-DP	120-36-5	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: 2,4-D	94-75-7	10	µg/L	27	28	4.33	No Limit
		EP202-SL: Triclopyr	55335-06-3	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Silvex (2,4,5-TP/Fenoprop)	93-72-1	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: 2,4,5-T	93-76-5	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: MCPB	94-81-5	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Picloram	1918-02-1	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Clopyralid	1702-17-6	10	µg/L	<10	<10	0.00	No Limit
		EP202-SL: Fluroxypyr	69377-81-7	10	µg/L	<10	<10	0.00	No Limit



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
ED037P: Alkalinity by PC Titrator (QCLot: 3601546)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	102	81.0	111
				----	50 mg/L	97.7	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3601448)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	94.1	82.0	122
				<1	500 mg/L	110	82.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 3601449)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	50 mg/L	97.1	80.9	127
				<1	1000 mg/L	101	80.9	127
ED093F: Dissolved Major Cations (QCLot: 3602374)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	96.6	80.0	114
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	102	90.0	116
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	100	82.0	120
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	95.8	85.0	113
EG020F: Dissolved Metals by ICP-MS (QCLot: 3602375)								
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	87.8	82.0	112
EG020T: Total Metals by ICP-MS (QCLot: 3603986)								
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	101	82.0	114
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.9	84.0	112
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	99.4	86.0	116
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	98.3	83.0	118
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	99.6	85.0	115
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	101	85.0	113
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	99.8	84.0	116
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	96.3	79.0	117
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	99.3	85.0	117
EG020T: Total Metals by ICP-MS (QCLot: 3603987)								
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.6	82.0	114
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	101	84.0	112
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	101	86.0	116
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	97.7	83.0	118
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	100	85.0	115
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	101	85.0	113
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	96.3	84.0	116
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	101	79.0	117



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result		LCS	Low	High
EG020T: Total Metals by ICP-MS (QCLot: 3603987) - continued								
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	102	85.0	117
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3630996)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	99.2	77.0	111
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3601450)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	102	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3607057)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	95.0	91.0	113
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3607054)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	82.8	69.0	101
				<0.1	1 mg/L	82.0	70.0	118
				<0.1	5 mg/L	89.1	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3607056)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	84.5	69.0	101
				<0.1	1 mg/L	91.2	70.0	118
				<0.1	5 mg/L	90.4	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3607055)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	88.5	71.0	101
				<0.01	0.442 mg/L	90.1	72.0	108
				<0.01	1 mg/L	95.9	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3601451)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	101	85.0	117
EP068B: Organophosphorus Pesticides (OP) (QCLot: 3602835)								
EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	5 µg/L	86.0	65.6	114
EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	5 µg/L	99.1	63.7	113
EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	5 µg/L	23.1	19.7	48.0
EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	5 µg/L	85.3	69.5	110
EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	5 µg/L	85.8	71.1	110
EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	5 µg/L	87.3	77.0	119
EP068: Parathion-methyl	298-00-0	2	µg/L	<2.0	5 µg/L	91.0	70.0	124
EP068: Malathion	121-75-5	0.5	µg/L	<0.5	5 µg/L	97.4	68.4	116
EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	5 µg/L	91.5	68.6	112
EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	5 µg/L	90.4	75.0	119
EP068: Parathion	56-38-2	2	µg/L	<2.0	5 µg/L	89.2	67.0	121
EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	5 µg/L	84.9	69.0	121
EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	5 µg/L	95.6	71.8	110
EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	5 µg/L	88.7	67.5	112
EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	5 µg/L	99.6	64.1	116
EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	5 µg/L	87.7	67.8	114



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EP068B: Organophosphorus Pesticides (OP) (QCLot: 3602835) - continued								
EP068: Ethion	563-12-2	0.5	µg/L	<0.5	5 µg/L	89.5	74.0	120
EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	5 µg/L	102	66.2	114
EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	5 µg/L	90.8	51.6	128
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 3602834)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	77.2	50.0	94.0
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	84.0	63.6	114
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	66.7	62.2	113
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	70.3	63.9	115
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	88.3	62.6	116
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	87.9	64.3	116
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	93.6	63.6	118
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	92.6	63.1	118
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	86.1	64.1	117
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	73.1	62.5	116
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2	1	µg/L	<1.0	5 µg/L	83.3	61.7	119
	205-82-3							
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	71.8	63.0	115
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	73.9	63.3	117
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	74.3	59.9	118
EP075(SIM): Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	76.9	61.2	117
EP075(SIM): Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	75.0	59.1	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3602661)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	91.9	75.0	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3602833)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	400 µg/L	70.7	55.8	112
EP071: C15 - C28 Fraction	----	100	µg/L	<100	600 µg/L	77.4	71.6	113
EP071: C29 - C36 Fraction	----	50	µg/L	<50	400 µg/L	102	56.0	121
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3602661)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	92.7	75.0	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3602833)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	500 µg/L	74.3	57.9	119
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	700 µg/L	83.9	62.5	110
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	300 µg/L	83.6	61.5	121
EP080: BTEXN (QCLot: 3602661)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	101	70.0	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	90.8	69.0	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	95.7	70.0	120



Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result			Low	High
EP080: BTEXN (QCLot: 3602661) - continued								
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	95.6	69.0	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	96.8	72.0	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	95.6	70.0	120
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 3604363)								
EP202-SL: 4-Chlorophenoxy acetic acid	122-88-3	10	µg/L	<10	100 µg/L	115	82.0	136
EP202-SL: 2,4-DB	94-82-6	10	µg/L	<10	100 µg/L	119	65.0	147
EP202-SL: Dicamba	1918-00-9	10	µg/L	<10	100 µg/L	120	83.0	137
EP202-SL: Mecoprop	93-65-2	10	µg/L	<10	100 µg/L	122	75.0	143
EP202-SL: MCPA	94-74-6	10	µg/L	<10	100 µg/L	114	76.0	140
EP202-SL: 2,4-DP	120-36-5	10	µg/L	<10	100 µg/L	121	76.0	144
EP202-SL: 2,4-D	94-75-7	10	µg/L	<10	100 µg/L	120	77.0	139
EP202-SL: Triclopyr	55335-06-3	10	µg/L	<10	100 µg/L	120	77.0	141
EP202-SL: Silvex (2,4,5-TP/Fenoprop)	93-72-1	10	µg/L	<10	100 µg/L	120	75.0	143
EP202-SL: 2,4,5-T	93-76-5	10	µg/L	<10	100 µg/L	118	78.0	140
EP202-SL: MCPB	94-81-5	10	µg/L	<10	100 µg/L	105	69.2	139
EP202-SL: Picloram	1918-02-1	10	µg/L	<10	100 µg/L	118	70.0	144
EP202-SL: Clopyralid	1702-17-6	10	µg/L	<10	100 µg/L	113	70.0	145
EP202-SL: Fluroxypyr	69377-81-7	10	µg/L	<10	100 µg/L	125	77.0	145

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number			Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3601448)							
ES2112083-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	118	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3601449)							
ES2112083-001	Anonymous	ED045G: Chloride	16887-00-6	50 mg/L	102	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3603986)							
ES2111789-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	99.1	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	99.4	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	99.7	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	99.1	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	105	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	98.7	70.0	130

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 Project : 12078



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020T: Total Metals by ICP-MS (QCLot: 3603986) - continued							
ES2111789-002	Anonymous	EG020A-T: Nickel	7440-02-0	1 mg/L	98.2	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	97.2	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3603987)							
EW2101411-001	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	100	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	101	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	101	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	100	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	109	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	102	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	99.1	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	99.6	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3630996)							
EM2106519-002	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	93.4	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3601450)							
ES2112083-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	108	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3607057)							
ES2111801-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	98.8	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3607054)							
ES2111752-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	50 mg/L	86.2	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3607056)							
EW2101446-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	86.8	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3607055)							
ES2111752-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	# Not Determined	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3601451)							
ES2112095-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	102	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3602661)							
ES2111823-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	112	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3602661)							
ES2111823-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	109	70.0	130
EP080: BTEXN (QCLot: 3602661)							
ES2111823-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	104	70.0	130
		EP080: Toluene	108-88-3	25 µg/L	91.8	70.0	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	98.4	70.0	130

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 Work Order : ES2112134 Amendment 1
 Client : ROBERT CARR & ASSOCIATES P/L
 Project : 12078



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080: BTEXN (QCLot: 3602661) - continued							
ES2111823-001	Anonymous	EP080: meta- & para-Xylene	108-38-3	25 µg/L	98.1	70.0	130
			106-42-3				
		EP080: ortho-Xylene	95-47-6	25 µg/L	100	70.0	130
		EP080: Naphthalene	91-20-3	25 µg/L	99.7	70.0	130
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 3604363)							
EM2105538-001	Anonymous	EP202-SL: Mecoprop	93-65-2	100 µg/L	117	75.0	143
		EP202-SL: MCPA	94-74-6	100 µg/L	122	76.0	140
		EP202-SL: 2,4-D	94-75-7	100 µg/L	112	77.0	139
		EP202-SL: Triclopyr	55335-06-3	100 µg/L	107	77.0	141
		EP202-SL: 2,4,5-T	93-76-5	100 µg/L	103	78.0	140
		EP202-SL: Picloram	1918-02-1	100 µg/L	119	70.0	144
		EP202-SL: Clopyralid	1702-17-6	100 µg/L	118	70.0	145

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES2112134	Page	: 1 of 9
Amendment	: 1		
Client	: ROBERT CARR & ASSOCIATES P/L	Laboratory	: Environmental Division Sydney
Contact	: MS LAURA SCHOFIELD	Telephone	: +61 2 8784 8555
Project	: 12078	Date Samples Received	: 01-Apr-2021
Site	: ----	Issue Date	: 22-Apr-2021
Sampler	: ----	No. of samples received	: 3
Order number	: ----	No. of samples analysed	: 3

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- **NO** Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers exist - please see following pages for full details.



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	ES2111752--001	Anonymous	Total Phosphorus as P	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	3	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	0	3	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	8	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Dissolved Metals by ICP-MS - Suite A	0	13	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	0	3	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	0	3	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	8	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
ED037P: Alkalinity by PC Titrator									
Clear Plastic Bottle - Natural (ED037-P)		MW207 - P1446,	01-Apr-2021	----	----	----	04-Apr-2021	15-Apr-2021	✔
MW205 - P1446,									
MW303 - P1446									
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Clear Plastic Bottle - Natural (ED041G)		MW207 - P1446,	01-Apr-2021	----	----	----	03-Apr-2021	29-Apr-2021	✔
MW205 - P1446,									
MW303 - P1446									



Matrix: **WATER**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	----	----	----	03-Apr-2021	29-Apr-2021	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	----	----	----	06-Apr-2021	29-Apr-2021	✓
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	----	----	----	06-Apr-2021	28-Sep-2021	✓
EG020T: Total Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG020A-T) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	06-Apr-2021	28-Sep-2021	✓	06-Apr-2021	28-Sep-2021	✓
EG035T: Total Recoverable Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG035T) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	----	----	----	21-Apr-2021	29-Apr-2021	✓
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	----	----	----	03-Apr-2021	03-Apr-2021	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	----	----	----	07-Apr-2021	29-Apr-2021	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	08-Apr-2021	29-Apr-2021	✓	08-Apr-2021	29-Apr-2021	✓
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	08-Apr-2021	29-Apr-2021	✓	08-Apr-2021	29-Apr-2021	✓
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	----	----	----	03-Apr-2021	03-Apr-2021	✓



Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP068B: Organophosphorus Pesticides (OP)								
Amber Glass Bottle - Unpreserved (EP068) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	06-Apr-2021	08-Apr-2021	✓	07-Apr-2021	16-May-2021	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM)) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	06-Apr-2021	08-Apr-2021	✓	07-Apr-2021	16-May-2021	✓
EP080/071: Total Petroleum Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP071) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	06-Apr-2021	08-Apr-2021	✓	07-Apr-2021	16-May-2021	✓
Amber VOC Vial - Sulfuric Acid (EP080) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	07-Apr-2021	15-Apr-2021	✓	07-Apr-2021	15-Apr-2021	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Amber Glass Bottle - Unpreserved (EP071) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	06-Apr-2021	08-Apr-2021	✓	07-Apr-2021	16-May-2021	✓
Amber VOC Vial - Sulfuric Acid (EP080) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	07-Apr-2021	15-Apr-2021	✓	07-Apr-2021	15-Apr-2021	✓
EP080: BTEXN								
Amber VOC Vial - Sulfuric Acid (EP080) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	07-Apr-2021	15-Apr-2021	✓	07-Apr-2021	15-Apr-2021	✓
EP202A: Phenoxyacetic Acid Herbicides by LCMS								
Amber Glass Bottle - Unpreserved (EP202-SL) MW205 - P1446, MW303 - P1446	MW207 - P1446,	01-Apr-2021	----	----	----	07-Apr-2021	08-Apr-2021	✓

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)		Evaluation	Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected		
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	3	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	3	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202-SL	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	17	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	3	22	13.64	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	4	40	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	8	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	3	33.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	3	33.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202-SL	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	6	22	27.27	15.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	3	19	15.79	15.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							



Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Method Blanks (MB) - Continued							
Chloride by Discrete Analyser	ED045G	1	11	9.09	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	13	7.69	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	5.26	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	5.26	5.00	✔	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	3	33.33	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	3	33.33	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202-SL	1	18	5.56	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	17	5.88	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	11	9.09	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	22	9.09	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	40	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	5.26	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	8	12.50	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	5.56	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	11	9.09	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	0	13	0.00	5.00	✖	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	5.26	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	5.26	5.00	✔	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	3	0.00	5.00	✖	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	3	0.00	5.00	✖	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202-SL	1	18	5.56	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	17	5.88	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	11	9.09	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	22	9.09	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	40	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	5.26	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	8	0.00	5.00	✖	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	5.56	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO ₄ 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO ₄ . Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO ₄ suspension is measured by a photometer and the SO ₄ -2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO ₂ - B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
Nitrite and Nitrate as N (NO _x) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Combined oxidised Nitrogen (NO ₂ +NO ₃) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)



Analytical Methods	Method	Matrix	Method Descriptions
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)
Pesticides by GCMS	EP068	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202-SL	WATER	In house: LCMS (Electrospray in negative mode). After adding surrogate and acetic acid, water samples are injected on a C18 column for LC/MS determination.
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.



Client Name: RCA
Client Site: Karuah East

Contact Name: Laura Schofield
Phone Number: 0403 699 112

Email Report To: lauras@rca.com.au
Project Manager:

Turnaround Required: ☐ Urgent
☒ Standard (5 Day)

Date Required:

Expected Reporting Date:

Expected Reporting Date:

(Laboratory Use Only)

RCA Job Number: 12078

ANALYSIS REQUIRED

Page of

SAMPLE INFORMATION				ANALYSIS REQUIRED															
RCA Laboratories Environmental Sample Number	Client ID / Description	Date	Matrix	Total Samples	Total Nitrogen	Total Phosphorus	BTEX	Major Ions ((calcium, magnesium, sodium, potassium, chloride, sulphate, carbonate, bicarbonate))	Total Petroleum Hydrocarbons (TPH)	Kjeldahl Nitrogen	Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Zinc, Nickel, Manganese, Mercury, Total Iron)	Filterable Iron	Nitrate	Organophosphorus pesticides (OPP)	Organophosphorus pesticides (OPP)	Phosphate	Phenoxy Acid Herbicides	Polycyclic Aromatic Hydrocarbon (PAH)	
MM205	P1446	1/04/21	W		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
MM207	P1446	1/04/21	W		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
MM208	P1446	1/04/21	W		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
MM203	P1446	1/04/21	W		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
MMV	P1446																		

Name: <u>LOOA</u>		Date: <u>11/4/21</u>		Name: <u>KS</u>		Date: <u>1.4.21</u>	
Of: <u>RCA</u>		Time: <u></u>		Of: <u>AG</u>		Time: <u>4:04pm</u>	

LAB OF ORIGIN:
NEWCASTLE

Environmental Division
Sydney
Work Order Reference
ES2112134



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				MW205 P1446	MW207 P1446	MW303 P1446	----	----
Sampling date / time				01-Apr-2021 00:00	01-Apr-2021 00:00	01-Apr-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2112134-001	ES2112134-002	ES2112134-003	-----	-----
				Result	Result	Result	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Dibenz(a,h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(g,h,i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	160	<100	200	----	----
C29 - C36 Fraction	----	50	µg/L	<50	50	<50	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	160	50	200	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	180	130	160	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	180	130	160	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				MW205 P1446	MW207 P1446	MW303 P1446	----	----
Sampling date / time				01-Apr-2021 00:00	01-Apr-2021 00:00	01-Apr-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2112134-001	ES2112134-002	ES2112134-003	-----	-----
				Result	Result	Result	----	----
EP080: BTEXN - Continued								
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ Total Xylenes	----	2	µg/L	<2	<2	<2	----	----
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS								
4-Chlorophenoxy acetic acid	122-88-3	10	µg/L	<10	<10	<10	----	----
2,4-DB	94-82-6	10	µg/L	<10	<10	<10	----	----
Dicamba	1918-00-9	10	µg/L	<10	<10	<10	----	----
Mecoprop	93-65-2	10	µg/L	<10	<10	<10	----	----
MCPA	94-74-6	10	µg/L	<10	<10	<10	----	----
2,4-DP	120-36-5	10	µg/L	<10	<10	<10	----	----
2,4-D	94-75-7	10	µg/L	<10	<10	<10	----	----
Triclopyr	55335-06-3	10	µg/L	<10	<10	<10	----	----
Silvex (2,4,5-TP/Fenoprop)	93-72-1	10	µg/L	<10	<10	<10	----	----
2,4,5-T	93-76-5	10	µg/L	<10	<10	<10	----	----
MCPB	94-81-5	10	µg/L	<10	<10	<10	----	----
Picloram	1918-02-1	10	µg/L	<10	<10	<10	----	----
Clopyralid	1702-17-6	10	µg/L	<10	<10	<10	----	----
Fluroxypyr	69377-81-7	10	µg/L	<10	<10	<10	----	----
2,6-D	575-90-6	10	µg/L	<10	<10	<10	----	----
2,4,6-T	575-89-3	10	µg/L	<10	<10	<10	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	92.7	67.2	82.2	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	110	83.0	102	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	29.0	29.3	28.3	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	59.8	52.7	52.0	----	----
2,4,6-Tribromophenol	118-79-6	1.0	%	61.6	45.1	68.8	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	74.4	62.0	64.9	----	----



Analytical Results

Sub-Matrix: **WATER**
 (Matrix: **WATER**)

Sample ID

				MW205 P1446	MW207 P1446	MW303 P1446	----	----
Sampling date / time				01-Apr-2021 00:00	01-Apr-2021 00:00	01-Apr-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2112134-001	ES2112134-002	ES2112134-003	-----	-----
				Result	Result	Result	----	----
EP075(SIM)T: PAH Surrogates - Continued								
Anthracene-d10	1719-06-8	1.0	%	96.0	89.7	80.1	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	91.8	74.8	82.2	----	----
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	2	%	127	131	131	----	----
Toluene-D8	2037-26-5	2	%	97.6	100	100	----	----
4-Bromofluorobenzene	460-00-4	2	%	90.6	90.1	92.5	----	----
EP202S: Phenoxyacetic Acid Herbicide Surrogate								
2,4-Dichlorophenyl Acetic Acid	19719-28-9	10	%	109	115	109	----	----



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	67	111
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	67	111
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2,4,6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128
EP202S: Phenoxyacetic Acid Herbicide Surrogate			
2,4-Dichlorophenyl Acetic Acid	19719-28-9	64	140



Periodic Groundwater Monitoring October 2021

Hunter Quarries – Karuah & Karuah East

Project: P1446

Written by: Jake Duck (Environmental Scientist)

Reviewed by: Malcolm Adrien (Environmental Services Manager)

Email: office@huntercivilab.com.au

Client: Hunter Quarries

2 November 2021**Prepared for:****Hunter Quarries**

1 Andersite Road

Karuah NSW 2324

Ph: 0447 044 646

Email: joel.fleming@hunterquarries.com.au**Prepared by****Hunter Civilab**

ABN 50 103 355 531

3/62 Sandringham Avenue

PO Box 3127

Thornton NSW 2322

Ph: (02) 4966 1844

Email: office@huntercivilab.com.auWeb: huntercivilab.com.au**Project Details**

Site Address:	Hunter Quarries – Karuah & Karuah East	
Project Type:	Periodic Groundwater Monitoring	
Project no	Report type	Report no
P1446	GWM	1

We confirm that the following report has been produced for Hunter Quarries – Karuah & Karuah East, based on the described methods and conditions within.

For and on behalf of **Hunter Civilab**,

**Malcolm Adrien**

Environmental Services Manager

Table of Contents

1	Introduction	3
1.1	Background	3
1.2	Objectives	4
2	Site Works	4
2.1	Quality Assurance / Quality Control	4
3	Conclusion	5

Annex List:

Annex A – Site Features Plan

Annex B – Field sheet

Annex C – Laboratory Reports

1 Introduction

1.1 Background

Hunter Civilab were engaged by Hunter Quarries Pty Ltd (Hunter Quarries) to undertake groundwater monitoring across Hunter Quarries Karuah and Karuah East operations (herein referred to as the site). It is understood groundwater monitoring is a requirement under Section 3.2 of the Statement of Commitments (NSW Government 2013) and Section 8.2 of the Water Management Plan (SLR 2015) for quarrying operations across the site. A site locality figure is presented as Figure 1, Annex A.

The Statement of Commitments identifies monitoring of groundwater will occur bi-annually. Bi-annual analyses comprise:

- pH
- Electrical Conductivity
- Total Dissolved Solids
- Alkalinity
- Total nitrogen
- Total Phosphorus
- Calcium
- Magnesium
- Sodium
- Potassium
- Chloride
- Sulphate
- Carbonate
- Bicarbonate
- Total Petroleum Hydrocarbon (TPH)
- BTEX (benzene, toluene, ethyl benzene, xylene)

Annual analyses include the bi-annual suite supplemented with:

- Nitrate
- Total Kjeldahl Nitrogen
- Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Zinc, Nickel, Manganese, Mercury)
- Total Iron
- Filterable Iron
- Total Petroleum Hydrocarbon (TPH)
- Polycyclic Aromatic Hydrocarbon (PAH)
- Organophosphorus pesticides
- Phenoxy acid herbicides

The Assessment works were undertaken in accordance with services agreement Q2018_032, dated 4th April 2018.

1.2 Objectives

The objective of this engagement was to complete groundwater monitoring in accordance with Hunter Quarries monthly monitoring requirements.

2 Site Works

A Hunter Civilab environmental scientist experienced in groundwater sampling visited the site on the 6th October 2021. Core elements of the works completed include:

- 1) Measurement of standing water level (SWL) and well depth and calculation of well volume;
- 2) Purging of groundwater using a disposable bailer and measurement of physical parameters including:
 - Temperature;
 - Dissolved oxygen (DO);
 - Electric Conductivity (EC);
 - pH; and
 - Oxido-reduction potential (ORP).
- 3) Purging generally continued until physical parameters stabilised and stabilisation was considered an indicator that purge water was representative of groundwater (i.e. the well was ready to be sampled);
- 4) Samples were collected using a disposable bailer and bottles / vials specific to requested analyses; and
- 5) Transport of samples under chain of custody and submission to the sub-contracted NATA accredited laboratory.

Field sheets recording measurement of physical parameters during purging and sampling details are presented as Annex B. Analytical results are presented within laboratory reports presented as Annex C.

2.1 Quality Assurance / Quality Control

Quality assurance measures for sampling within this assessment were adopted to provide confidence in the analytical results to support determinations on material categorization and to facilitate satisfaction of project specific objectives. Adopted measures included complimentary regimes of field and laboratory-based quality assurance techniques and quality control sampling/analyses. Quality assurance measures, results and implications for data quality associated with this assessment are broadly defined within the following categories:

- sample collection, storage transport and analysis;
- laboratory quality control procedures and results; and
- the occurrence of apparently unusual and anomalous results.

Sampling was completed by a suitably qualified scientist experienced in contaminated site assessments and in accordance with Hunter Civilab Standard Operating Procedures (SOPs). Disposable nitrile gloves were worn during sampling and changed between locations. Bailers were replaced between monitoring locations. Samples were stored in bottles and vials provided by the NATA accredited laboratory sub-contracted to complete analysis (SGS) and were specific to targeted analytes. Samples were labelled with unique identifiers referencing the monitoring well ID and date of sampling. Samples were stored on ice and transported under chain of custody to the laboratory and then analysed according to NATA accredited test methods.

Tabulated assessments of laboratory quality control samples are presented within laboratory reports presented as Annex C.

3 Conclusion

Hunter Civilab were engaged by Hunter Quarries to undertake periodic groundwater monitoring in accordance with a Statement of Commitments for operation of Karuah and Karuah East Quarries. The works described here-in are considered to address commitments to groundwater monitoring for this period.

For and on behalf of

Hunter Civilab Pty Ltd

A blue ink signature of Jake Duck.

Jake Duck
Environmental Scientist

A blue ink signature of Malcolm Adrien.

Malcolm Adrien
Environmental Services Manager

LIMITATIONS

This report has been prepared in accordance with normal industry practice and per the scope of work outlined within this report. This report is limited by time, cost and other constraints associated with the terms of Hunter Civilab's commercial engagement. Hunter Civilab does not warrant the suitability of the site for any purpose and this report is limited to assessment of specified environmental conditions associated with the subject site. Lack of identification in the report of any hazardous or toxic materials on the subject site should not be interpreted as a guarantee that such materials do not exist on the site.

Conclusions and recommendations made in this report are based on interpretation of the limited amount of information presented here-in. Hunter Civilab assumes no responsibility or liability for errors in data obtained from such sources, regulatory agencies or any other external sources, or from occurrences outside the scope of this project.

Hunter Civilab have prepared this report for the use of Hunter Quarries Pty Ltd. Unless otherwise specifically agreed reliance on this report is limited to Hunter Quarries Pty Ltd and Hunter Civilab accepts no liability for the use of this report by any other party to the extent permitted by law.

REFERENCES

NSW Government Department of Planning and Infrastructure (2013) *Appendix 6, Statement of Commitments*

SLR (2015) *Karuah East Quarry Project Water Management Plan*



Annex A



Notes:
(1) The scale bar is approximate.
(2) Base layer sourced from NearMaps (2020)

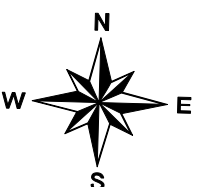
**Figure 1 - Site Locality and
Well Locations**

Legend

 Groundwater Well

Scale (m)

0 50 100





Annex B

Groundwater Sampling Sheet



Date: 6/10/2021

Client: Hunter Quarries

Site: Karuah

Project Ref: P1446

Sampler: JD

WELL ID
MW208

Equipment

 Puring equipment type / ID: ☒ Bailer ☐ Peristaltic ☐ Micropurge

Water Quality Meter ID: YSI Pro DSS 15J100066

Interface Probe ID: 3954

Well Gauging and Purge Volume Calculations (For Bailer Only)

Total well depth (m BTOC)	21.1	
Standing Water Level (m BTOC)	20.54	
Water Column (m)	0.56	
Well Volume (L)	1	Conversion factor for 50mm well (well casing only) = 1.96 Conversion factor for 100mm well (well casing only) = 7.85
Product Thickness (m)	---	
Volume removed (L)		

Water Quality Parameters

Starting Purge Time: 8:54:00 AM		Ending Purge Time:				Pump Intake (mBTOC): N/A		
Litres	Time	Drawdown <10cm	Temp (C) ± 0.5	DO (mg/L) ± 0.3 mg/L	EC (µS/cm) ± 3%	pH ± 0.1	ORP (mV) ± 10mV	Comments
-	-		-		-	-	-	Well dry, insufficient water for purging/ sampling

 Sample Time: - No. of containers used: n/a Was the well dry purged ☒ Y ☐ N

QA/QC Checklist

Did Field Parameters Stabilise? ☐ Y ☐ N ☒ N/A
 Are air bubbles present in Vials? ☐ Y ☐ N ☒ N/A
 Was Sample for metals field filtered? ☐ Y ☐ N ☒ N/A
 Duplicate Sample Collected? ☐ Y ☐ N
 Rinsate Blank Collected? ☐ Y ☐ N

Duplicate Sampe ID(s): N/A

Rinsate Blank ID: N/A

Groundwater Sampling Sheet



Date: 6/10/2021

Client: Hunter Quarries

Site: Karuah

Project Ref: P1446

Sampler: JD

WELL ID
MW303

Equipment

 Puring equipment type / ID: ☒ Bailer ☐ Peristaltic ☐ Micropurge

Water Quality Meter ID: YSI Pro DSS 15J100066

Interface Probe ID: 3954

Well Gauging and Purge Volume Calculations (For Bailer Only)

Total well depth (m BTOC)	35.54	
Standing Water Level (m BTOC)	30.72	
Water Column (m)	4.82	
Well Volume (L)	9	Conversion factor for 50mm well (well casing only) = 1.96 Conversion factor for 100mm well (well casing only) = 7.85
Product Thickness (m)	---	
Volume removed (L)		

Water Quality Parameters

Starting Purge Time: 9:15:00 AM		Ending Purge Time: 9:42:00 AM		Pump Intake (mBTOC):				
Litres	Time	Drawdown <10cm	Temp (C) ± 0.5	DO (mg/L) ± 0.3 mg/L	EC (µS/cm) ± 3%	pH ± 0.1	ORP (mV) ± 10mV	Comments
3			18.0	3.21	1992	6.21	15.3	
3			18.0	2.86	2247	5.95	10.8	
3			17.9	3.74	2675	5.90	12.5	
1			17.8	1.29	2591	5.86	5.3	
1			17.8	2.22	2533	5.85	3.1	

Sample Time: 9:43am

No. of containers used: 5

 Was the well dry purged? ☐ Y ☒ N

QA/QC Checklist

Did Field Parameters Stabilise? ☒ Y ☐ N ☐ N/A
 Are air bubbles present in Vials? ☐ Y ☒ N ☐ N/A
 Was Sample for metals field filtered? ☒ Y ☐ N ☐ N/A
 Duplicate Sample Collected? ☐ Y ☒ N
 Rinsate Blank Collected? ☐ Y ☒ N

Duplicate Sampe ID(s): N/A

Rinsate Blank ID: N/A

Groundwater Sampling Sheet



Date: 6/10/2021

Client: Hunter Quarries

Site: Karuah

Project Ref: P1446

Sampler: JD

WELL ID
MW205

Equipment

 Puring equipment type / ID: ☒ Bailer ☐ Peristaltic ☐ Micropurge

Water Quality Meter ID: YSI Pro DSS 15J100066

Interface Probe ID: 3954

Well Gauging and Purge Volume Calculations (For Bailer Only)

Total well depth (m BTOC)	33.52	
Standing Water Level (m BTOC)	16.73	
Water Column (m)	16.79	
Well Volume (L)	33	Conversion factor for 50mm well (well casing only) = 1.96 Conversion factor for 100mm well (well casing only) = 7.85
Product Thickness (m)	---	
Volume removed (L)		

Water Quality Parameters

Starting Purge Time: 10:15am		Ending Purge Time: 10.40am		Pump Intake (mBTOC): N/A				
Litres	Time	Drawdown <10cm	Temp (C) ± 0.5	DO (mg/L) ± 0.3 mg/L	EC (µS/cm) ± 3%	pH ± 0.1	ORP (mV) ± 10mV	Comments
3			17.9	8.45	734	8.34	162.1	
3			18.0	8.13	721	8.21	82.8	
3			18.0	7.84	681	7.12	31.8	
2			18.0	6.92	634	6.91	91.9	
1			18.1	7.15	561	6.80	87.3	
2			18.1	6.67	533	6.81	135.1	
1			18.1	5.31	484	6.81	112.6	

Sample Time: 10:42am

No. of containers used: 5

 Was the well dry purged? ☐ Y ☒ N

QA/QC Checklist

Did Field Parameters Stabilise?	☒ Y	☐ N	☐ N/A	
Are air bubbles present in Vials?	☐ Y	☒ N	☐ N/A	
Was Sample for metals field filtered?	☒ Y	☐ N	☐ N/A	
Duplicate Sample Collected?	☐ Y	☒ N		Duplicate Sample ID(s): N/A
Rinsate Blank Collected?	☐ Y	☒ N		Rinsate Blank ID: N/A

Groundwater Sampling Sheet



Date: 6/10/2021

Client: Hunter Quarries

Site: Karuah

Project Ref: P1446

Sampler: JD

WELL ID

MW207

Equipment

Purging equipment type / ID: ☒ Bailer ☐ Peristaltic ☐ Micropurge

Water Quality Meter ID: YSI Pro DSS 15J100066

Interface Probe ID: 3954

Well Gauging and Purge Volume Calculations (For Bailer Only)

Total well depth (m BTOC)	26.2	
Standing Water Level (m BTOC)	7.4	
Water Column (m)	18.8	
Well Volume (L)	37	Conversion factor for 50mm well (well casing only) = 1.96 Conversion factor for 100mm well (well casing only) = 7.85
Product Thickness (m)	---	
Volume removed (L)		

Water Quality Parameters

Starting Purge Time: 10.58am			Ending Purge Time: 11:25am			Pump Intake (mBTOC): N/A		
Litres	Time	Drawdown <10cm	Temp (C) ± 0.5	DO (mg/L) ± 0.3 mg/L	EC (µS/cm) ± 3%	pH ± 0.1	ORP (mV) ± 10mV	Comments
4			18.2	98.6	4084	7.80	82.7	
3			18.2	102.8	3921	7.12	78.1	
3			18.2	92.4	4213	6.97	76	
2			18.3	83.6	3589	6.61	72.1	
1			18.3	81.2	3612	6.60	66.7	
1			18.3	76.6	3486	6.58	61.4	

Sample Time: No. of containers used: 5 Was the well dry purged? ☐ Y ☒ N

QA/QC Checklist

Did Field Parameters Stabilise?	☒ Y	☐ N	☐ N/A	
Are air bubbles present in Vials?	☐ Y	☒ N	☐ N/A	
Was Sample for metals field filtered?	☒ Y	☐ N	☐ N/A	
Duplicate Sample Collected?	☐ Y	☒ N		Duplicate Sample ID(s): N/A
Rinsate Blank Collected?	☐ Y	☒ N		Rinsate Blank ID: N/A



Annex C

Karuah East Quarry Pty Ltd
PO Box 3284
THORNTON NSW 2324

Attention: Joel Flemming

Project:	RCA ref 12078-1476/WATER/0		
Date:	20/10/2021		
Client reference:	Water Sampling		
Received date:	1/10/2020	Number of samples:	3
Client order number:	N/A	Testing commenced:	1/10/2020

CERTIFICATE OF ANALYSIS

1 ANALYTICAL TEST METHODS

ANALYSIS	METHOD	UNITS	ANALYSING LABORATORY	NATA ANALYSIS/ NON NATA
pH	ENV-LAB006*	pH	RCA Laboratories - Environmental	NATA
Conductivity	ENV-LAB010	µS/cm	RCA Laboratories - Environmental	NATA
Total Alkalinity	ENV-LAB0112	mg/L	RCA Laboratories - Environmental	NATA
Total Sulphate	ED041G	mg/L	ALS Environmental	NATA
Total Nitrogen	EK062A	mg/L	ALS Environmental	NATA
Total Phosphorus	EK067A	mg/L	ALS Environmental	NATA
Metals (total)	ED093F/EA065	mg/L	ALS Environmental	NATA
Chloride Total	ED045G	mg/L	ALS Environmental	NATA
Total Petroleum Hydrocarbons	EP080/071	µg/L	ALS Environmental	NATA

* The analytical procedures used by RCA Laboratories - Environmental are based on established internationally recognised procedures such as APHA and Australian Standards.

** Indicates NATA accreditation does not cover the performance of this service.

Tests Subcontracted Lab No's ES2136047 (NATA Accreditation No.825)

2 RESULTS

ANALYSIS	UNITS	MW 205	MW207	MW303
Sample Number	-	102112078011	102112078012	102112078013
Date Sampled	-	6/10/2021	6/10/2021	6/10/2021
Sampled By	-	Client	Client	Client
pH Value	pH unit	6.76	6.46	5.82
Conductivity	µS/cm	428	3370	2710
Hydroxide Alkalinity as CaCO ₃	mg/L	<1	<1	<1
Carbonate Alkalinity as CaCO ₃	mg/L	<1	<1	<1
Bicarbonate Alkalinity as CaCO ₃	mg/L	225	188	63
Total Alkalinity as CaCO ₃	mg/L	225	188	63
Benzene	µg/L	<1	<1	<1
Toluene	µg/L	<2	<2	<2
Ethylbenzene	µg/L	<2	<2	<2
m/p-xylene	µg/L	<2	<2	<2
o-xylene	µg/L	<2	<2	<2
Total Xylenes	µg/L	<2	<2	<2
Total BTEX	µg/L	<1	<1	<1
TRH C6-C9	µg/L	<20	<20	<20
TRH C10-C14	µg/L	<50	<50	<50
TRH C15-C28	µg/L	170	160	480
TRH C29-C36	µg/L	<50	70	100
TRH C10-C36 sum	µg/L	170	230	580
Total Recoverable Hydrocarbons - NEPM 2013 Fractions				
C6 - C10 Fraction	µg/L	<20	<20	<20
C6 - C10 Fraction minus BTEX (F1)	µg/L	<20	<20	<20
>C10 - C16 Fraction	µg/L	<100	<100	110
>C16 - C34 Fraction	µg/L	230	200	480
>C34 - C40 Fraction	µg/L	<100	<100	<100
>C10 - C40 Fraction (sum)	µg/L	230	200	590

ANALYSIS	UNITS	MW 205	MW207	MW303
>C10 - C16 Fraction minus Naphthalene (F2)	-	<100	<100	110
Chloride	mg/L	1330	952	852
Sulphate, SO ₄	mg/L	172	78	44
Total Kjeldahl Nitrogen	mg/L	0.4	0.4	0.4
Total Nitrogen (calc)	mg/L	3	0.4	0.5
Total Phosphorus	mg/L	0.08	0.47	0.22
Calcium, Ca	mg/L	84	45	43
Magnesium, Mg	mg/L	78	57	46
Sodium, Na	mg/L	634	563	396
Potassium, K	mg/L	7	3	6

NATA Scope of Accreditation does not cover the sampling of surface and ground waters by the client or by RCA.

Analysis on samples is on an as received basis.

Appendix 1

Internal Laboratory Analysis Report and
Chain of Custody Documentation

CERTIFICATE OF ANALYSIS

Work Order : **ES2136047**
Client : **ROBERT CARR & ASSOCIATES P/L**
Contact : MS LAURA SCHOFIELD
Address : PO BOX 175
 CARRINGTON NSW, AUSTRALIA 2294
Telephone : +61 02 49029200
Project : 12078
Order number : ----
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : SYBQ/400/20
No. of samples received : 3
No. of samples analysed : 3

Page : 1 of 5
Laboratory : Environmental Division Sydney
Contact : Juliana Gonzalez
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 07-Oct-2021 13:50
Date Analysis Commenced : 08-Oct-2021
Issue Date : 13-Oct-2021 15:43



Accreditation No. 825
 Accredited for compliance with
 ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.



Analytical Results

Sub-Matrix: **WATER**
 (Matrix: **WATER**)

Sample ID

				102112078006 MW205	102112078007 MW207	102112078008 MW303	----	----
Sampling date / time				06-Oct-2021 00:00	06-Oct-2021 00:00	06-Oct-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2136047-001	ES2136047-002	ES2136047-003	-----	-----
				Result	Result	Result	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	531	347	297	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	172	78	44	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	1330	952	852	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	84	45	43	----	----
Magnesium	7439-95-4	1	mg/L	78	57	46	----	----
Sodium	7440-23-5	1	mg/L	634	563	396	----	----
Potassium	7440-09-7	1	mg/L	7	3	6	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	2.62	<0.01	0.13	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.4	0.4	0.4	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	3.0	0.4	0.5	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.08	0.47	0.22	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	170	160	480	----	----
C29 - C36 Fraction	----	50	µg/L	<50	70	100	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	170	230	580	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	110	----	----
>C16 - C34 Fraction	----	100	µg/L	230	200	480	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	230	200	590	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	110	----	----



Analytical Results

Sub-Matrix: **WATER**
 (Matrix: **WATER**)

Sample ID

				102112078006 MW205	102112078007 MW207	102112078008 MW303	----	----
Sampling date / time				06-Oct-2021 00:00	06-Oct-2021 00:00	06-Oct-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2136047-001	ES2136047-002	ES2136047-003	-----	-----
Result				Result	Result	Result	----	----

EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued

EP080: BTEXN

Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ Total Xylenes	----	2	µg/L	<2	<2	<2	----	----
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----

EP080S: TPH(V)/BTEX Surrogates

1,2-Dichloroethane-D4	17060-07-0	2	%	85.7	106	104	----	----
Toluene-D8	2037-26-5	2	%	80.5	101	97.0	----	----
4-Bromofluorobenzene	460-00-4	2	%	82.9	103	100	----	----

Page : 5 of 5
Work Order : ES2136047
Client : ROBERT CARR & ASSOCIATES P/L
Project : 12078



Surrogate Control Limits

Sub-Matrix: **WATER**

		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

QUALITY CONTROL REPORT

Work Order	: ES2136047	Page	: 1 of 6
Client	: ROBERT CARR & ASSOCIATES P/L	Laboratory	: Environmental Division Sydney
Contact	: MS LAURA SCHOFIELD	Contact	: Juliana Gonzalez
Address	: PO BOX 175 CARRINGTON NSW, AUSTRALIA 2294	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49029200	Telephone	: +61-2-8784 8555
Project	: 12078	Date Samples Received	: 07-Oct-2021
Order number	: ----	Date Analysis Commenced	: 08-Oct-2021
C-O-C number	: ----	Issue Date	: 13-Oct-2021
Sampler	: ----		
Site	: ----		
Quote number	: SYBQ/400/20		
No. of samples received	: 3		
No. of samples analysed	: 3		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3946130)									
ES2136047-003	102112078008 MW303	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	44	45	0.0	0% - 20%
ES2136032-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	23	23	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3946131)									
ES2136047-003	102112078008 MW303	ED045G: Chloride	16887-00-6	1	mg/L	852	852	0.0	0% - 20%
ES2136032-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	13	13	0.0	0% - 50%
ED093F: Dissolved Major Cations (QC Lot: 3946700)									
ES2135722-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	98	98	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	24	24	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	125	123	1.3	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	23	23	0.0	0% - 20%
ES2136045-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	37	36	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	8	8	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	41	40	0.0	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	1	1	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3944359)									
ES2136032-006	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	1.39	1.38	0.7	0% - 20%
ES2136045-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.71	0.71	0.0	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3944385)									
ES2135998-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	308	292	5.1	0% - 20%
ES2136032-004	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	5.6	4.8	14.9	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3944388)									
ES2136047-003	102112078008 MW303	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.4	0.4	0.0	No Limit
WN2111515-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.8	3.1	9.6	0% - 20%

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Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3944386)									
ES2135998-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	86.4	85.9	0.7	0% - 20%
ES2136032-004	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	33.7	31.7	6.1	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3944387)									
ES2136047-003	102112078008 MW303	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.22	0.21	6.5	0% - 20%
WN2111515-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	7.54	7.56	0.3	0% - 20%
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3946390)									
ES2135907-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	40	40	0.0	No Limit
ES2135907-011	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3946390)									
ES2135907-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
ES2135907-011	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080: BTEXN (QC Lot: 3946390)									
ES2135907-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
ES2135907-011	Anonymous	EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
		EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3946130)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	107	82.0	122
				<1	500 mg/L	101	82.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 3946131)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	50 mg/L	95.6	80.9	127
				<1	1000 mg/L	105	80.9	127
ED093F: Dissolved Major Cations (QCLot: 3946700)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	95.8	80.0	114
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	95.1	90.0	116
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	97.1	82.0	120
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	91.7	85.0	113
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3944359)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	98.8	91.0	113
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3944385)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	88.3	69.0	101
				<0.1	1 mg/L	91.7	70.0	118
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3944388)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	89.0	69.0	101
				<0.1	1 mg/L	96.3	70.0	118
				<0.1	5 mg/L	94.4	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3944386)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	92.4	71.0	101
				<0.01	0.442 mg/L	101	72.0	108
				<0.01	1 mg/L	114	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3944387)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	97.0	71.0	101
				<0.01	0.442 mg/L	99.5	72.0	108
				<0.01	1 mg/L	106	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3944788)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	400 µg/L	87.5	55.8	112
EP071: C15 - C28 Fraction	----	100	µg/L	<100	600 µg/L	78.5	71.6	113
EP071: C29 - C36 Fraction	----	50	µg/L	<50	400 µg/L	82.1	56.0	121
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3946390)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	92.2	75.0	127



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3944788)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	500 µg/L	65.3	57.9	119
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	700 µg/L	82.5	62.5	110
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	300 µg/L	71.1	61.5	121
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3946390)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	94.9	75.0	127
EP080: BTEXN (QCLot: 3946390)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	94.2	70.0	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	98.8	69.0	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	94.0	70.0	120
EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	10 µg/L	94.9	69.0	121
	106-42-3							
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	98.8	72.0	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	103	70.0	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3946130)							
ES2136032-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	106	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3946131)							
ES2136032-001	Anonymous	ED045G: Chloride	16887-00-6	50 mg/L	110	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3944359)							
ES2136045-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	87.3	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3944385)							
ES2135998-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	# Not Determined	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3944388)							
EW2104209-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	10 mg/L	90.4	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3944386)							
ES2135998-003	Anonymous	EK067G: Total Phosphorus as P	----	50 mg/L	100	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3944387)							
EW2104209-001	Anonymous	EK067G: Total Phosphorus as P	----	2 mg/L	107	70.0	130

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Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3946390)							
ES2135907-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	89.3	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3946390)							
ES2135907-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	91.1	70.0	130
EP080: BTEXN (QCLot: 3946390)							
ES2135907-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	83.3	70.0	130
		EP080: Toluene	108-88-3	25 µg/L	83.0	70.0	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	82.9	70.0	130
		EP080: meta- & para-Xylene	108-38-3	25 µg/L	82.2	70.0	130
			106-42-3				
		EP080: ortho-Xylene	95-47-6	25 µg/L	85.0	70.0	130
		EP080: Naphthalene	91-20-3	25 µg/L	73.1	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES2136047	Page	: 1 of 6
Client	: ROBERT CARR & ASSOCIATES P/L	Laboratory	: Environmental Division Sydney
Contact	: MS LAURA SCHOFIELD	Telephone	: +61-2-8784 8555
Project	: 12078	Date Samples Received	: 07-Oct-2021
Site	: ----	Issue Date	: 13-Oct-2021
Sampler	: ----	No. of samples received	: 3
Order number	: ----	No. of samples analysed	: 3

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- **NO** Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers exist - please see following pages for full details.

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Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	ES2135998--003	Anonymous	Total Kjeldahl Nitrogen as N	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
TRH - Semivolatile Fraction	0	20	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)					
Total Kjeldahl Nitrogen as N By Discrete Analyser	5	34	14.71	15.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
TRH - Semivolatile Fraction	0	20	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA065: Total Hardness as CaCO3								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	----	----	----	09-Oct-2021	03-Nov-2021	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	----	----	----	08-Oct-2021	03-Nov-2021	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	----	----	----	08-Oct-2021	03-Nov-2021	✓



Matrix: **WATER**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	----	----	----	09-Oct-2021	03-Nov-2021	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	----	----	----	08-Oct-2021	03-Nov-2021	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	08-Oct-2021	03-Nov-2021	✓	08-Oct-2021	03-Nov-2021	✓
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	08-Oct-2021	03-Nov-2021	✓	08-Oct-2021	03-Nov-2021	✓
EP080/071: Total Petroleum Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP071) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	08-Oct-2021	13-Oct-2021	✓	11-Oct-2021	17-Nov-2021	✓
Amber VOC Vial - Sulfuric Acid (EP080) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	12-Oct-2021	20-Oct-2021	✓	12-Oct-2021	20-Oct-2021	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Amber Glass Bottle - Unpreserved (EP071) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	08-Oct-2021	13-Oct-2021	✓	11-Oct-2021	17-Nov-2021	✓
Amber VOC Vial - Sulfuric Acid (EP080) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	12-Oct-2021	20-Oct-2021	✓	12-Oct-2021	20-Oct-2021	✓
EP080: BTEXN								
Amber VOC Vial - Sulfuric Acid (EP080) 102112078006 - MW205, 102112078008 - MW303	102112078007 - MW207,	06-Oct-2021	12-Oct-2021	20-Oct-2021	✓	12-Oct-2021	20-Oct-2021	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Chloride by Discrete Analyser	ED045G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	4	34	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	4	35	11.43	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	20	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chloride by Discrete Analyser	ED045G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	5	34	14.71	15.00	✗	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	6	35	17.14	15.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	34	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	35	5.71	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	34	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	35	5.71	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	20	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Sulfate (Turbidimetric) as SO ₄ 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO ₄ . Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO ₄ suspension is measured by a photometer and the SO ₄ -2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Nitrite and Nitrate as N (NO _x) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Combined oxidised Nitrogen (NO ₂ +NO ₃) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO ₃ -. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)

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Client : ROBERT CARR & ASSOCIATES P/L
Project : 12078



Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.

CERTIFICATE OF ANALYSIS

1 ANALYTICAL TEST METHODS

ANALYSIS	METHOD	UNITS	ANALYSING LABORATORY	NATA ANALYSIS / NON NATA
pH	ENV-LAB006*	pH	RCA Laboratories - Environmental	NATA
Conductivity	ENV-LAB010	µS/cm	RCA Laboratories - Environmental	NATA
Total Dissolved Solids	ENV-LAB020*	mg/L	RCA Laboratories - Environmental	NATA
Total Alkalinity	ENV-LAB0112	mg/L	RCA Laboratories - Environmental	NATA

* The analytical procedures used by RCA Laboratories - Environmental are based on established internationally recognised procedures such as APHA and Australian Standards.

** Indicates NATA accreditation does not cover the performance of this service.

2 RESULTS

ANALYSIS	UNITS	MW 205	MW207	MW303
Sample Number	-	102112078011	102112078012	102112078013
Date Sampled	-	6/10/2021	6/10/2021	6/10/2021
Sampled By		Client	Client	Client
pH Value	pH unit	6.76	6.46	5.82
Conductivity	µS/cm	428	3370	2710
Hydroxide Alkalinity as CaCO ₃	mg/L	<1	<1	<1
Carbonate Alkalinity as CaCO ₃	mg/L	<1	<1	<1
Bicarbonate Alkalinity as CaCO ₃	mg/L	225	188	63
Total Alkalinity as CaCO ₃	mg/L	225	188	63

NATA Scope of Accreditation does not cover the sampling of surface and ground waters by the client or by RCA.

Analysis on samples is on an as received basis.

3 QUALITY CONTROL RESULTS

Water Quality Control Sample Results

DATE	ANALYSIS	METHOD	UNITS	QUALITY CONTROL STANDARD VALUE	QUALITY CONTROL ACCEPTANCE CRITERIA	QUALITY CONTROL STANDARD RESULT
06/10/2021	pH	ENV-LAB006	pH	7.00	6.95 - 7.05	7.03
06/10/2021	Conductivity	ENV-LAB010	µS/cm	1413	1385 - 1441	1419
08/10/2021	Alkalinity	ENV-LAB112	mg/L	100	80 - 120	103

Water Duplicate Analysis Results

SAMPLE NUMBER	DATE	ANALYSIS	METHOD	UNITS	LOR	SAMPLE RESULT	SAMPLE DUPLICATE RESULT
102112078001	06/10/2021	pH	ENV-LAB006	pH	-	6.81	6.82
102112078006	06/10/2021	Conductivity	ENV-LAB010	µS/cm	1	581	581
102112078011	06/10/2021	Total Alkalinity as CaCO ₃	mg/L	mg/L	1	225	222

Please contact the undersigned if you have any queries.

Yours sincerely



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Environmental Laboratory Manager
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental



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RCA Internal Quality Review

General

1. Laboratory QC results for Method Blanks, Duplicates and Laboratory Control Samples are included in this QC report where applicable. Additional QC data maybe available on request.
2. RCA QC Acceptance / Rejection Criteria are available on request.
3. Proficiency Trial results are available on request.
4. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
5. When individual results are qualified in the body of a report, refer to the qualifier descriptions that follow.
6. Samples were analysed on an 'as received' basis.
7. Sampled dates in this report are those listed on the COC or sample jars; if no sample dates are noted, the date the samples are received at the laboratory have been used.
8. All soil results are reported on a dry basis, unless otherwise stated. (ACID SULPHATE SOILS)
9. This report replaces any interim results previously issued.

Holding Times.

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample

Receipt Acknowledgment.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

##NOTE: pH duplicates are reported as a range NOT as RPD

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR: RPD must lie between 0-30%

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Glossary

UNITS

mg/kg: milligrams per Kilogram

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100ml: Organisms per 100 millilitres

NTU: Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/L: milligrams per Litre

TERMS

Dry Where moisture has been determined on a solid sample the result is expressed on a dry basis.

LOR Limit of Reporting.

RPD Relative Percent Difference between two Duplicate pieces of analysis can be obtained upon request.

QCS Quality Control Sample - reported as value recovery

Method Blank In the case of solid samples these are performed on laboratory certified clean sands.

In the case of water samples these are performed on de-ionised water.

Duplicate A second piece of analysis from the same sample and reported in the same units as the result to show comparison.

Batch Duplicate A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.

USEPA United States Environment Protection Authority

APHA American Public Health Association

COC Chain of Custody

CP Client Parent - QC was performed on samples pertaining to this report

NCP Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

< indicates less than

> Indicates greater than

ND Not Detected

Appendix 2

External Laboratory Reports and Chain of Custody Documents

APPENDIX 7 – Audit Action Plan

Ref	Recommendation Description	KEQPL Response/Actions	KEQPL Action Timeframe	Annual Review 2021 Update
PA 09_0175 (as modified)				
Schedule 2, Condition 8	It is recommended that KEQPL confirms that construction and occupation certificates for site infrastructure are in place.	KEQPL have engaged BCA Certifiers Australia Pty Ltd to undertake an assessment of structures at Karuah East Quarry and associated design documents, with the ultimate goal to have all relevant structures certified.	31/01/2021	KEQ engaged BCA who have undertaken audit of construction and reported findings. This report is in the process of being reviewed and corrective actions undertaken.
Schedule 2, Condition 11	It is recommended that KEQPL confirms that the developer contributions to Council required during the audit period have been made.	KEQPL are investigating payments made to MidCoast Council to ensure that all required developer contribution payments have been made. If payments have not been made, KEQPL will consult with Council to establish a payment plan.	31/01/2020	No further action required.
Schedule 3, Condition 3	Pending any further directions from EPA and/or DPIE, it is recommended that noise consultant's monitoring reports are updated to include the following additional details: 1. Instrument details and a copy of current instrument calibration certificates as required by relevant Australian Standards. 2. Measurement results for a location representative of Residences A to E and calculated quarry noise levels to these residences, including calculation details and justification of the calculation method. 3. Detailed assessment and reporting of modifying factors as required by relevant policies and conditions, at least including tonal and low frequency characteristics. 4. Traffic noise measurements at the potentially most affected receptors as required by Schedule 3, Condition 4.	KEQPL have been working in consultation with the Department and EPA towards a modification of the Project Approval. Draft conditions were issued 13/10/20. Upon approval of this acoustic modification, KEQPL will seek a variation of the EPL to ensure that commitments between the two documents (Project Approval and EPL) are aligned. At this stage, KEPLQ will additionally review and where necessary revise the NMP. This will include measures for noise monitoring reports to includes details recommended by the auditor.	30/04/2021	MOD 8 approved. NMP was revised in 2021 and approved in 2022.
Schedule 3, Condition 4	It is recommended that unattended monitoring charts are included in the monthly monitoring reports as required by Section 8.4 of the NMP, or revise the NMP to not require these charts.	As discussed above, following approval of the acoustic medication, KEQPL will review the NMP and revise where necessary to reflect changes in the Consent conditions and EPL (post variation).	30/04/2021	Pending NMP revision and approval.

Ref	Recommendation Description	KEQPL Response/Actions	KEQPL Action Timeframe	Annual Review 2021 Update
Schedule 3, Condition 6	Consider carrying out a review of noise monitoring results upon receipt of each noise compliance report, to reduce response time in the event of non-compliance with criteria or other noise issues.	KEQPL are committed to operating in a compliant manner. When specialist/technical reports are prepared, they are reviewed as soon as practical then lodged with the ARA. KEQPL will take this recommendation into consideration in the process of reviewing management plans and associated procedures.	N/A	NMP approved 2022.
Schedule 3, Condition 7	It is recommended that the Noise Management Plan is revised to reflect the noise mitigation measures that were adopted by KEQ following completion of the Thearle Acoustics review that are in addition to or change the noise management commitments in the KEQ EA.	As discussed above, following approval of the acoustic medication, KEQPL will review the NMP and revise where necessary to reflect changes in the Consent conditions and EPL (post variation).	30/04/2021	NMP approved 2022.
Schedule 3, Condition 11	It is recommended that KEQ consult with relevant private landholders and seek to enter into written agreements to allow blasting within 500 m of their land.	KEQPL have operated in accordance with the approved Blast Management Plan (2015) which identifies that there are no residents/receivers within 500 metres from the potentially nearest blasting areas. Refer to <i>Section 3.4 – Sensitive Receivers of the Karuah East Quarry Blast Management Plan</i> for further details. KEQPL have never received a community complaint regarding blasting undertaken at the Quarry. KEQPL will consult with the Department to determine if any action is required.	31/01/2021	KEQ are in consultation with DPE.
Schedule 3, Condition 21	It is recommended that written confirmation of approval is sought from DPIE during the next update of the WMP.	KEQPL agree with this recommendation and will consult with the Department during the next review of the WMP.	2021 and 2022	WMP revision continued.

Ref	Recommendation Description	KEQPL Response/Actions	KEQPL Action Timeframe	Annual Review 2021 Update
	It is recommended that KEQ implement a program to monitor the health of local watercourses under the Water Management Plan.	KEQPL will consult with the Department during the next review of the WMP and BOAMP to determine whether additional monitoring is required to monitor the health of local watercourses. However, let it be noted that local watercourses are monitored and reported on in the annual Biodiversity Offset Area Monitoring Report; this is in line with the approved BOAMP.	30/04/2021	Ecologists have been consulted on this matter. Revision of BOAMP is underway. This recommendation will be further investigated during revision of the WMP.
Schedule 3, Condition 23, Schedule 5, Condition 11	It is recommended that the information required under this condition is regularly reviewed and published on the KEQ website on a quarterly basis.	KEQPL agree with this recommendation. Future environmental monitoring reports will include information on the factors identified in mentioned conditions.	31/01/2021	Adopted. Action closed out.
Schedule 3, Condition 27	Cumberland Ecology recommends that the TJTMP be updated to include performance criteria to measure the effectiveness of the program.	The TJTMP ceases after 2020. KEQPL will take this into consideration when reviewing the TJTMP.	30/04/2021	Review of this program and consultation with relevant government department to be undertaken at appropriate time.
	Cumberland Ecology recommends that 2020 monitoring include all required monitoring methods, and if undertaken outside of October 2020 an explanation of the change in survey date.	Firebird ecoSultants Pty Ltd were engaged to conduct the TJ monitoring for 2020, however; after attending site and undertaking an inspection, the monitoring was postponed due to a lack of flowering. Monitoring of the TJ has typically been done during it's flowering period, which varies dependant on climatic conditions. The auditor's recommendation will be taken into consideration when a review of the TJTMP is undertaken.	30/04/2021	Review of this program and consultation with relevant government department to be undertaken at appropriate time.

Ref	Recommendation Description	KEQPL Response/Actions	KEQPL Action Timeframe	Annual Review 2021 Update
Schedule 3, Condition 28	It is recommended that KEQ seek written confirmation from DPIE of an extension to the timeframe required to continue consultation and implement long-term security for the project Biodiversity Offset Strategy.	Officers of the Biodiversity Conservation Trust are attending site in November to assess the Biodiversity Area and consult on the progress of the Biodiversity Offset Strategy. KEQPL will consult with the Department and seek extension to the timeframe required if required.	31/01/2021	Closed out following 2020 and 2021 meetings. MOD 10 was lodged in July 2021 and is under assessment.
Schedule 3, Condition 32	Cumberland Ecology recommends that the LRMP be updated to include a three year management schedule for the period November 2018 – November 2021.	KEQPL agree with the recommendation made by the auditor and will conduct a revision of the LRMP in the near future. The revisions describe here will be made.	30/04/2021	Pending LRMP revision and approval.
	It is recommended that KEQ record and report all information required under implementation the LRMP.	During the revision of the LRMP, KEQPL will ensure all procedures to record and report are examined and responsible employees are made aware of their obligations.	30/04/2021	Pending LRMP revision and approval.
Schedule 3, Condition 33	Cumberland Ecology recommends that the BOAMP be updated to include a three year management schedule for the period November 2018 – November 2021.	KEQPL agree with this recommendation by the auditor. KEQPL have already engaged Kleinfelder to revise the BOAMP to reflect changes to the Project Approval. While this revision is taking place, KEQPL will request Kleinfelder to make these recommended changes.	30/04/2021	Pending LRMP revision and approval.
Schedule 3, Condition 35	No evidence was available at the time of audit to confirm that the Conservation and Rehabilitation Bond was reviewed within three months of the previous IEA.	This is proposed to be completed	30/06/2021	Pending completion.
Schedule 3, Condition 37	It is recommended that KEQ consult with DPIE over the progressive rehabilitation strategy for the visually prominent ridgeline identified in this condition and update the Landscape and Rehabilitation Management Plan, if required.	During the process outline above, KEQPL will consult with the Department over the progressive rehabilitation strategy of the ridgeline. This visual factor has been considered by KEQPL and it believed that as rehabilitation of the neighbouring quarry (Karuah Hard Rock Quarry) is established and finalised over the next few years, this visual impact will be mitigated.	30/04/2021	Pending LRMP revision and approval.

Ref	Recommendation Description	KEQPL Response/Actions	KEQPL Action Timeframe	Annual Review 2021 Update
Schedule 4, Condition 1	It is recommended that KEQ update their notification procedures to ensure the relevant landholders are notified as soon as possible after receipt of monitoring results confirming that an exceedance has occurred.	KEQPL are committed to operating in a compliant manner and maintaining positive relations with community. Over recent years, this positive relationship can be demonstrated by the lack of complaints received from community and positive feedback received at Community Consultation Committee meetings. KEQPL will review and where necessary revise the notification procedures followed when notifying landholders of pollution incidents.	30/04/2021	Pending PIRMP revision and approval.
Schedule 5, Condition 1	It is recommended that KEQ undertake a review of the approved EMS to ensure that the document remains consistent with environmental monitoring requirements and approved site management plans. Consultation with DPIE should be undertaken if major updates to the 2015 version of the EMS are required.	KEQPL will undertake a review of the EMS and revise if deemed necessary at the conclusion of this IEA.	31/01/2021	EMS revision continued in 2021
Schedule 5, Condition 2	It is recommended that KEQ update their communications and incident response procedures to ensure that any future exceedances of the Project Approval criteria and any implementation management controls / remediation measures are reported to DPIE at the earliest opportunity once they are identified.	KEQPL are in the process of reviewing and where necessary revising the PIRMP. During this process KEQPL will review all communication and notification procedures for reporting of pollution exceedances to ARAs.	30/04/2021	Pending PIRMP revision and approval.
Schedule 5, Condition 5	It is recommended that KEQ document any reviews undertaken as required under this condition.	KEQPL agree with this recommendation. A controlled template will be prepared for use when reviewing documents (such as procedures or management plans).	30/04/2021	Pending procedural revision.
Schedule 5 Condition 7	Evidence was not available at the time of audit to confirm that KEQ had notified DPIE and other relevant regulatory agencies of all environmental incidents.	Complete notification as per this condition.	31/01/2021	This has been completed. Closed off

Ref	Recommendation Description	KEQPL Response/Actions	KEQPL Action Timeframe	Annual Review 2021 Update
Schedule 5, Condition 10	It is recommended that the KEQ response this IEA and implementation of actions are summarised in the next KEQ Annual Review.	KEQPL agrees with this recommendation and will ensure that the KEQPL RAR and status of actions is reported in the next Annual Review.	31/03/2021	Completed
Schedule 5 Condition 11	The response to the previous IEA recommendations was not available on the KEQ website at the time of audit.	Add action plan.	31/01/2021	Completed
PA 09_0175 (as modified) SOC's				
SoC 3.1	It is recommended that topsoil stripping depths and associated stockpile locations are recorded during future clearing works to assist with site rehabilitation.	KEQPL agree with this recommendation. During revision of the LRMP, this recommendation will be taken into consideration and if necessary, a procedure will be prepared to ensure future stripping works record critical information (such as stripping depths and stockpile locations).	30/04/2021	LRMP revision continued
	It is also recommended that KEQ develop an internal topsoil stripping and stockpiling procedure to ensure that the information under this SoC is retained on site to assist in site rehabilitation.	KEQPL agree with this recommendation. During revision of the LRMP, this recommendation will be taken into consideration and if necessary, a procedure will be prepared to ensure future stripping works record critical information (such as stripping depths and stockpile locations).	30/04/2021	LRMP revision continued
SoC 4.1	Recommend that KEQ review the process for salvage of large logs during clearing and whether any further emplacement of additional material would be beneficial in Lots 12 and 13.	KEQPL currently use fallen trees to create natural wooden bunding around the boundary of the disturbance area. Additionally, KEQPL have had approximately 300 nest boxes installed through the Biodiversity Offset area. These nest boxes are monitored and maintained yearly by trained ecologists. Albeit, KEPLQ will take this recommendation into consideration when revising the LRMP.	30/04/2021	LRMP revision continued
EPL 20611				

Ref	Recommendation Description	KEQPL Response/Actions	KEQPL Action Timeframe	Annual Review 2021 Update
Condition A1.2	It is recommended that KEQPL consult with EPA over the approved use of soil and overburden material from KEQ to assist with the final rehabilitation of the adjacent Karuah Quarry site and confirm whether an associated variation to EPL 20611 is required.	KEPL agree with this recommendation and will consult with the EPA regarding this matter as soon as practical to ensure there are no compliance issues as a result of this process.	31/01/2021	KEQ consulted with the EPA and resolved this matter.
Condition L4.5	Bridges Acoustics recommendation: Require consultants to specifically report assessment methods and results for tonal and low frequency modifying factors, as required by this condition, for all attended noise compliance surveys.	KEQPL will take this recommendation into consideration when undertaking revision of the NMP.	30/04/2021	NMP revision (approved 2022)
Condition L5.7	It is recommended that future Annual Reviews provide comment regarding the management of blast fume.	KEQPL agree with this recommendation. During review of the BMP, revision will be made to blast monitoring to direct blast technicians to report on blast fumes in the Post Blast Report. This detail will also be reported on in the Annual Review.	30/04/2021	Pending BMP revision.
Condition M5.1	It is recommended that the Complaints Register available on the KEQ website is updated on a quarterly basis.	KEQPL agree with this recommendation. Fortunately, KEQPL have not received any complaints in recent times, however; understand the importance to keep the register up-to-date and published. Future environmental monitoring reports will include quarterly updates on the Complaints Register.	31/01/2021	Reporting of complaints has been added to the monthly environmental monitoring reports, which are published monthly on the <i>Hunter Quarries</i> website.