CENTENNIAL

CENTENNIAL COAL

MYUNA COLLIERY

ANNUAL REVIEW

January 2023 to December 2023

March 2024

Table 1. Annual Review Title Block

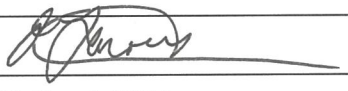
Name of Operation	Myuna Colliery
Name of Operator	Centennial Myuna Pty. Limited
Development Consent/ Project Approval #	PA10_0080 MOD3 SH110-148
Name of holder of Development Consent / Project Approval	Centennial Myuna Pty. Limited
Mining Leases **Exploration Licences**	ML1632, ML1370 and MPL344, EL4444 and EL6640, EL9625
Name of Holder of Mining Lease	Centennial Myuna Pty. Limited
Water License	WAL 41560
Name of Holder of Water License	Centennial Fassifern Pty. Limited
RMP Start Date	1st August 2022
RMP End Date	n/a
Annual Review Start Date	1st January 2023
Annual Review End Date	31st December 2023

I, Owen Farrugia, certify that this audit report is a true and accurate record of the compliance status of Myuna Colliery for the period 1st January 2023 to 31st December 2023 and that I am authorized to make this statement on behalf of Centennial Myuna Pty Limited.

Note:

a) *The Annual Review is an 'environmental audit' for the purposes of s122B(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.*

b) *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).*

Name of Authorised Reporting Officer	Owen Farrugia
Title of Authorised Reporting Officer	Mine Manager
Signature of Authorised Reporting Officer	
Date	22 March 2024

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Appendices

Appendix No	Appendix Name
1	2023 Myuna Colliery Annual Noise Monitoring Report
2	2023 Ecological Monitoring Report

1. STATEMENT OF COMPLIANCE

Table 2 provides a statement of compliance with the relevant approvals during the reporting period.

Table 2. Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
Project Approval 10_0080 (MOD3)	NO
Development consent SH110/148	YES
Mining Lease 1632	NO
Mining Lease 1370	NO
Mining Purposes Lease 334	NO
Exploration Licence 4444	YES
Exploration Licence 6640	YES
Exploration Licence 9625	YES
EPL 366	NO
WAL 41560	YES
Section 151 Point Wolstoncroft SCA	YES
Section 151 Pulbah Island SCA	YES
Section 151 Wangi Point SCA	YES

Table 3 provides a list of conditions that were not complied with during the reporting period.

Table 3. Non-Compliances

Relevant Approval/s	Condition #	Condition summary	Compliance Status	Comment	Where Addressed in Annual Review
PA10_0080	C25 Schedule 3	Water quality monitoring schedule	Non-Compliant	Missed water quality sample	Sections 7, 11.
PA10_0080 EPL366	C17 Schedule 3 M2.2	Depositional Dust Monitoring	Non-Compliant	Lost dust sample	Sections 7, 11.
EPL366	M8.1	Mass Monitoring	Non-Compliant	Failure to monitor volume of discharge at LDP 9	Sections 7, 11.
ML1632, ML1370,	Schedule 8A, Mining	Contravention of mining title.	Non-Compliant	A large mine must submit an Annual	Section 11

MPL 334	Regulation 2016	Failure to submit Rehabilitation Cost Estimate and Annual Rehabilitation Report and Forward Program by due date (31/03/2023)		Report and Forward Program, and a Rehabilitation Cost Estimate.	

Note: Compliance Status Key for Table 1-2

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
Administrative	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)

2. INTRODUCTION

Myuna Colliery is an underground coal mine owned and operated by Centennial Myuna Pty Limited. Myuna is located 25 km southwest of Newcastle NSW in the Lake Macquarie and Wyong Local Government Areas. The Colliery lease lies within the Parishes of Awaba, Coorumbung, Morisset and Wallarah in the County of Northumberland subsidence district and is located within the Shire of Lake Macquarie.

Lake Macquarie City Council (LMCC) granted Development Consent SH110_148 for the development and operation of the Myuna and Cooranbong Collieries in 1977. The Development Consent was granted pursuant to the provisions of the now repealed Local Government Act 1919. The Development Consent remains in force and authorises the extraction of coal within the Development Consent Mining Area.

The Development of Myuna Colliery began in 1979 and underground mining using bord and pillar mining methods commenced in 1982. Centennial Coal Company Limited acquired Myuna Colliery in 2002 and has operated the mine since that time. On 18 January 2012, the then Minister of Planning and Infrastructure granted Project Approval PA 10_0080 to Centennial Myuna. A modification (MOD 1) to PA10_0080 was approved 1st February 2015.

PA 10_0080 MOD 1 authorises the continued mining in areas outside the existing Development Consent SH110_148 mining area and within the boundary of existing mining leases held by Centennial Myuna. PA 10_0080 MOD 1 authorises:

- the use of bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams;
- the continued use of ancillary infrastructure until 31st December 2032;
- the extraction of not more than 3 million tonnes of ROM coal from the site in any calendar year.

A second modification (MOD 2) was related to road transport and this was later withdrawn. A third modification (MOD 3) was approved on 25th November 2022. This was an administrative change to the rehabilitation conditions to ensure consistency between the project approval and the mining leases following the rehabilitation reforms.

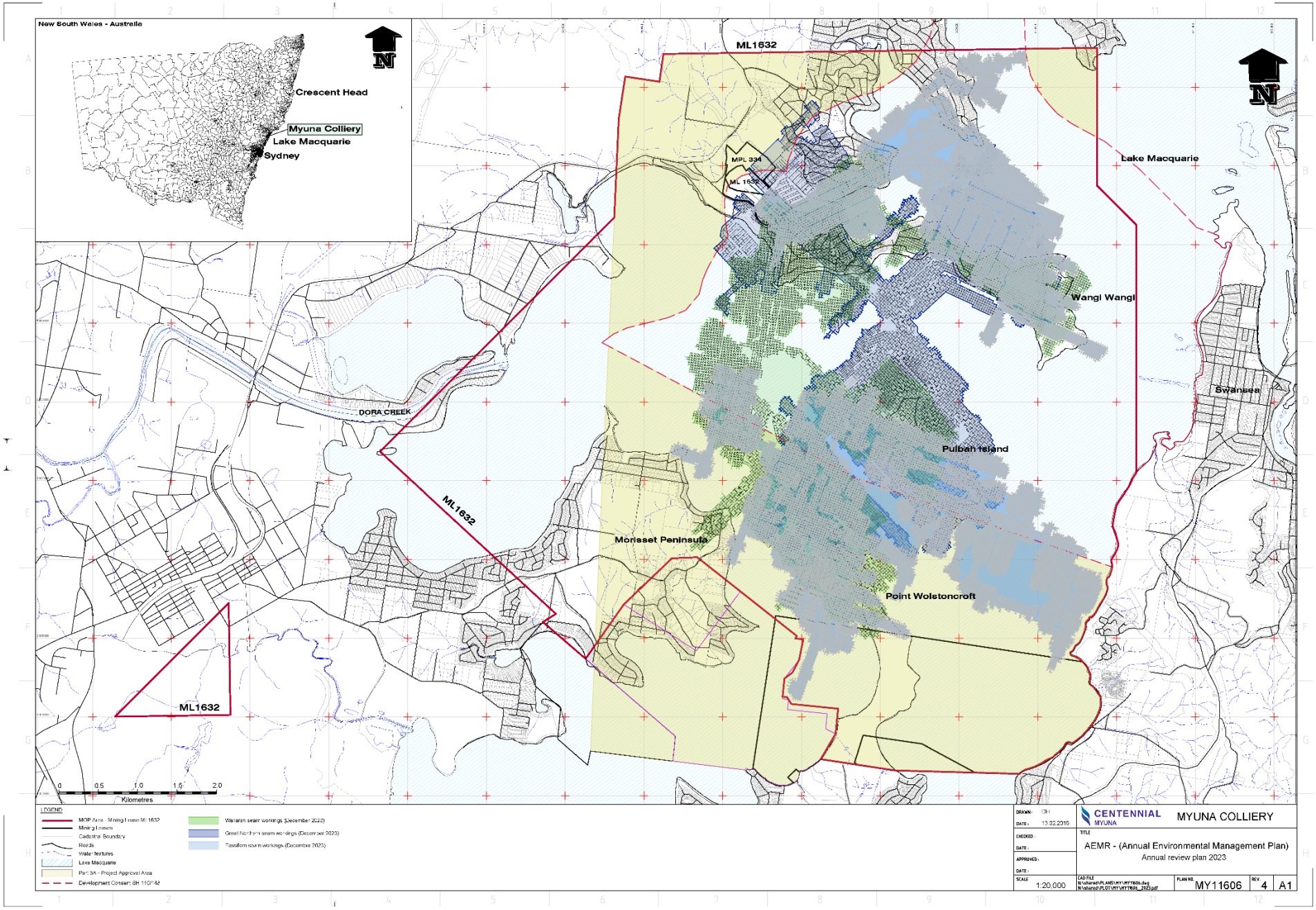
Plan MY11606, shows;

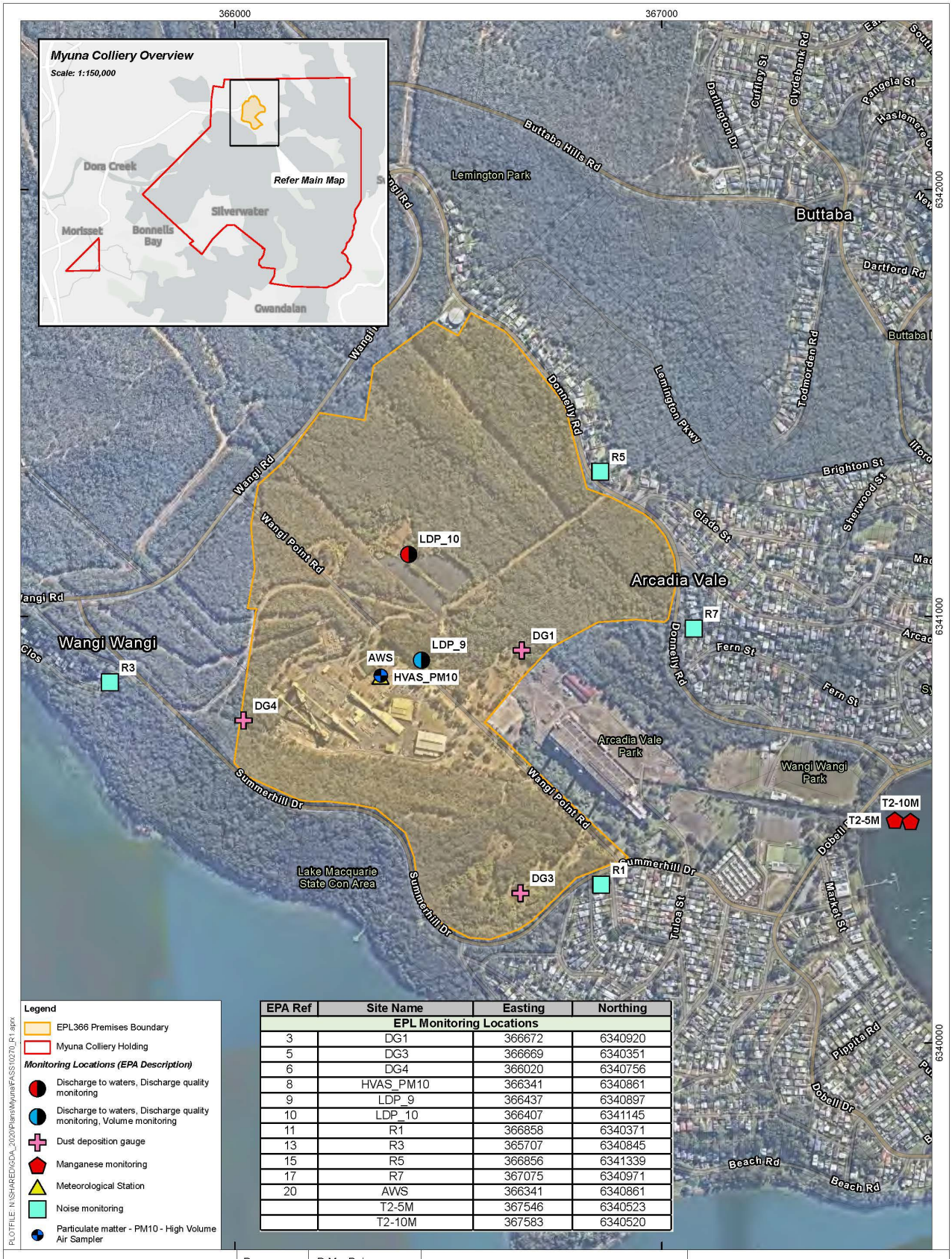
- the operation and its regional context,
- Development Consent SH110_148 and Project Approval 10_0080 boundaries,
- mining lease boundaries, and
- current operational disturbance footprint.

Table 4 provides the names and contact details of the key personnel who are responsible for the environmental management of the operation.

Table 4. Environmental Management Contact Details

Name	Position	Email	Phone
Owen Farrugia	Mine Manager	myunacolliery@centennialcoal.com.au	02 4970 0257
Kieran Fiatarone	Environment and Community Officer		02 4970 0263
Nicholas Krajewski	Technical Services Manager		02 4970 0203


New South Wales - Australia
Crescent Head
Myuna Colliery
Lake Macquarie
Sydney
ML1632
MPL 334
ML 1632
Lake Macquarie
Wangi Wangi
Swansea
DORA CREEK
Pulbah Island
ML1632
Morisset Peninsula
Point Wolstoncroft
ML1632
0 0.5 1.0 1.5 2.0
Kilometres
LEGEND
MOP Area - Mining Lease ML 1632
Mining Leases
Cadastral Boundary
Roads
Water features
Lake Macquarie
Part 3A - Project Approval Area
Development Consent: SH 110-7-92
Wallarah seam workings (December 2023)
Great Northern seam workings (December 2023)
Fassifern seam workings (December 2023)
DRAWN: DH
DATE: 13.02.2016
CHECKED:
DATE:
APPROVED:
DATE:
SCALE 1:20,000
CENTENNIAL MYUNA
MYUNA COLLIERY
TITLE
AEMR - (Annual Environmental Management Plan)
Annual review plan 2023
CAD FILE N:\shared\PLANS\MY\MY1606.dwg
N:\shared\PLOT\MY\MY1606_2023.pdf
PLAN NO. MY11606
REV. 4
A1



EPA Ref	Site Name	Easting	Northing
EPL Monitoring Locations			
3	DG1	366672	6340920
5	DG3	366669	6340351
6	DG4	366020	6340756
8	HVAS_PM10	366341	6340861
9	LDP_9	366437	6340897
10	LDP_10	366407	6341145
11	R1	366858	6340371
13	R3	365707	6340845
15	R5	366856	6341339
17	R7	367075	6340971
20	AWS	366341	6340861
	T2-5M	367546	6340523
	T2-10M	367583	6340520

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N

0 100 200 300 meters

nearmap

Coordinate System: GDA2020 MGA Zone 56

Drawn	D.MacBain
Checked	V.Howat
Approved	K.Fiatarone
Scale	1:8,000 @ A3
Revision	1

Myuna Colliery Environment Protection Licence No.366 (EPL366) Premises Boundary and Monitoring Points

CENTENNIAL MYUNA

Date: 13/09/2023 Plan No. FASS10270

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3. APPROVALS

The Myuna Colliery Holding is made up of Mining Lease No 1632 (ML1632), Mining Lease No.1370 (ML1370) and Mining Purposes Lease No.334 (MPL334). Surface land for mine infrastructure is within ML1632 (13.54 ha) and MPL334 (33.3 ha) giving a total surface mining lease area of 46.84 ha. The total area of the Myuna Colliery Holding is 7008 hectares.

MPL334 was granted the 20th October 1994 for a period of 21 years. The renewal of the Mining Purposes Lease 334 took effect 20th October 2015 for a further period of 21 years to 20th October 2036. The lease conditions were amended upon renewal.

Myuna Colliery is classed a Level 1 mine. PA 10_0080 was granted by the Minister for Planning on 18th January 2012 under Section 75J of Part 3A of the EP&A Act 1979.

Table 5 includes a list of all of the environmental approvals held by Myuna Colliery under the EP&A Act, Mining Act, POEO Act, NPWS Act, Water Act, Water Management Act, Radiation Act, and any changes made to these approvals during the reporting period.

Table 5. Approvals held by Centennial Myuna

Name	Description	Issued By	Expiry Date	Changed during reporting period?
SH. 110/148	Development Consent for Myuna Colliery	Lake Macquarie City Council	No expiration date specified in the consent. Subject to renewal of mining leases.	No
PA 10_0080	Myuna Colliery Mining Project	Department of Planning and Environment	31/12/2032	No
ML 1632	Mining Lease	Department of Planning and Environment – Division of Resources and Geosciences now managed by Department of Regional NSW	13/10/2043	No
MPL 334	Mining Purposes Lease		20/10/2036	No
ML 1370	Mining Lease		07/03/2033	No
EL 4444	Exploration Licence		23/10/2026	No
EL 6640			23/04/2026	No
EL9625		Department of Regional NSW	15/12/2029	Yes
Section 151 Licence	Mining Operations – Various Licence, Point Wolstoncroft	National Parks and Wildlife Services	10/09/2025	No
Section 151 Licence	Mining Operations –		31/10/2021	No

Name	Description	Issued By	Expiry Date	Changed during reporting period?
	Various Licence, Pulbah Island			
Section 151 Licence	Mining Operations – Various Licence, Wangi Wangi Point		15/02/2021	No
WAL 45160	Water Access Licence	Department of Primary Industries – Water	Perpetuity	No
20BL173259	Bore Licence (Monitoring Bores)		Perpetuity	No
EPL 366	Environment Protection Licence (EPL)	Environment Protection Authority	N/A	Yes
RML 5094930	Radiation Management Licence	Environment Protection Authority	1/11/2024	No

3.1. Changes made to Approvals during reporting period.

3.1.1. EPL366

January 2023 Variation

A variation to EPL366 was issued by the EPA on 20th January 2023. Changes were made to consolidate the monitoring programs for air quality and noise levels, moving from short-term to long-term monitoring programs, as prescribed in the relevant management plans. Approval was granted to remove DG2, consolidate TSP and PM10 monitoring from a single reading, reduce the number of noise monitoring points from 8 to 4, and reduce the requirement for monitoring noise levels during the 'day' and 'evening' periods.

December 2023 Revision

A variation to EPL366 was approved on 13th December 2023. The variation an update the survey plans relevant to EPL366 and general wording corrections.

3.1.2. Exploration Licences

EL9625 Issue

Exploration Licence 9625 was granted to Myuna Colliery on the 15th of December 2023 for a 6-year term for group 9 (coal) minerals. The total area is approximately 108.3 ha and is located within the most northern part of the project approval boundary.

3.2. Annual Review Requirements

The Annual Review has been developed to satisfy the reporting requirements of the approvals listed in Table 6.

Table 6. Annual Review Requirements

Approval	Condition No.	Requirement	Where addressed in Annual Review
Project Approval 10_0080 MOD3	Schedule 5 Condition 4	By the end of March 2013, and annually thereafter, the Applicant must review the environmental performance of the project to the satisfaction of the Secretary. This review must:	Noted
		(a) describe the development (including any rehabilitation) that was carried out in the past calendar year, and the development that is proposed to be carried out over the next year;	Sections 8 & 8.1
		(b) include a comprehensive review of the monitoring results and complaints records of the project over the past calendar year, which includes a comparison of these results against the: • relevant statutory requirements, limits or performance measures/criteria; • requirements of any plan or program required under this approval; • monitoring results of previous years; and • predictions in the EA;	Sections 6 & 7
		(c) identify any non-compliance over the past year, and describe what actions were (or are being) taken to ensure compliance;	Section 11
		(d) identify any trends in the monitoring data over the life of the project;	Section 6 & 7
		(e) identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and	Section 6 & 7
		(f) describe what measures will be implemented over the next year to improve the environmental performance of the project.	Section 6 & 7

4. OPERATIONS SUMMARY

Table 7. Production Summary

Material	Approved Limit (PA10_0080 MOD 3)	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
Waste Rock/ Overburden	N/A	N/A	N/A	N/A
ROM Coal (TPA)	3,000,000	1,050,621	1,097,573	1,100,423
Coarse reject	N/A	N/A	N/A	N/A
Fine reject (Tailings)	N/A	N/A	N/A	N/A
Saleable product (TPA)	3,000,000	1,050,621	1,097,573	1,100,423

4.1. Other Operations

Table 8. Operations Summary

Limits	Approved Limit (PA10_0080 MOD 3)	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Comment (if applicable)
Hours of operation	24/7	24/7	24/7	Nil
Transport (rail)	N/A	N/A	N/A	Nil
Transport (road)	N/A	N/A	N/A	Nil

*All ROM coal from Myuna Colliery is transported via a privately owned overland conveyor to the Eraring Power Station.

4.2. Mining Operations

Mining activities during the period included two super panel production units (two continuous miners per production unit) for the full year of 2023. Both units were operating in the Fassifern Seam (one in the Fassifern North region, one in the Fassifern South region). The mining method for these units is the bord and pillar Myuna Herringbone System. An additional continuous miner operated in the Fassifern North region for Q4 of 2023 as a single miner production unit operating under the Myuna Herringbone System also.

4.3. Exploration During This Reporting Period

No exploration activities were undertaken during the reporting period.

4.4. Exploration Next Reporting Period

There are no planned exploration activities for the next reporting period.

4.5. Land Disturbance

There has been no land disturbance at Myuna Colliery during the 2023 reporting period.

4.6. Construction

There has been no construction at Myuna Colliery during the 2023 reporting period.

4.7. Next Report Period

Planned production for the next reporting period is as follows:

- Two continuous miners operating in the Fassifern North region as a super panel herringbone production unit as per the 2023 reporting period.
- Two continuous miners operating in the Fassifern South region as a super panel herringbone production unit from January 2024 to mid-April 2024.
- From April 2024 onwards the two continuous miners in the Fassifern South are scheduled to mine development roadways for the partial pillar extraction mining method in the Fassifern South pending Extraction Plan approval. Secondary extraction of this panel is planned to commence in H2 of 2024.

5. ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The 2022 Annual Review was submitted to the Department of Planning, Housing and Infrastructure (DPHI), formerly the Department of Planning, Industry and Environment (DPIE), on 31st March 2022 in accordance with Schedule 5, Condition 4 of the Project Approval 10_0080.

Table 9. Actions from previous Annual Review

Action Required	Requested By	Action Taken	Where Addressed in Annual Review
Nil.	n/a	n/a	n/a

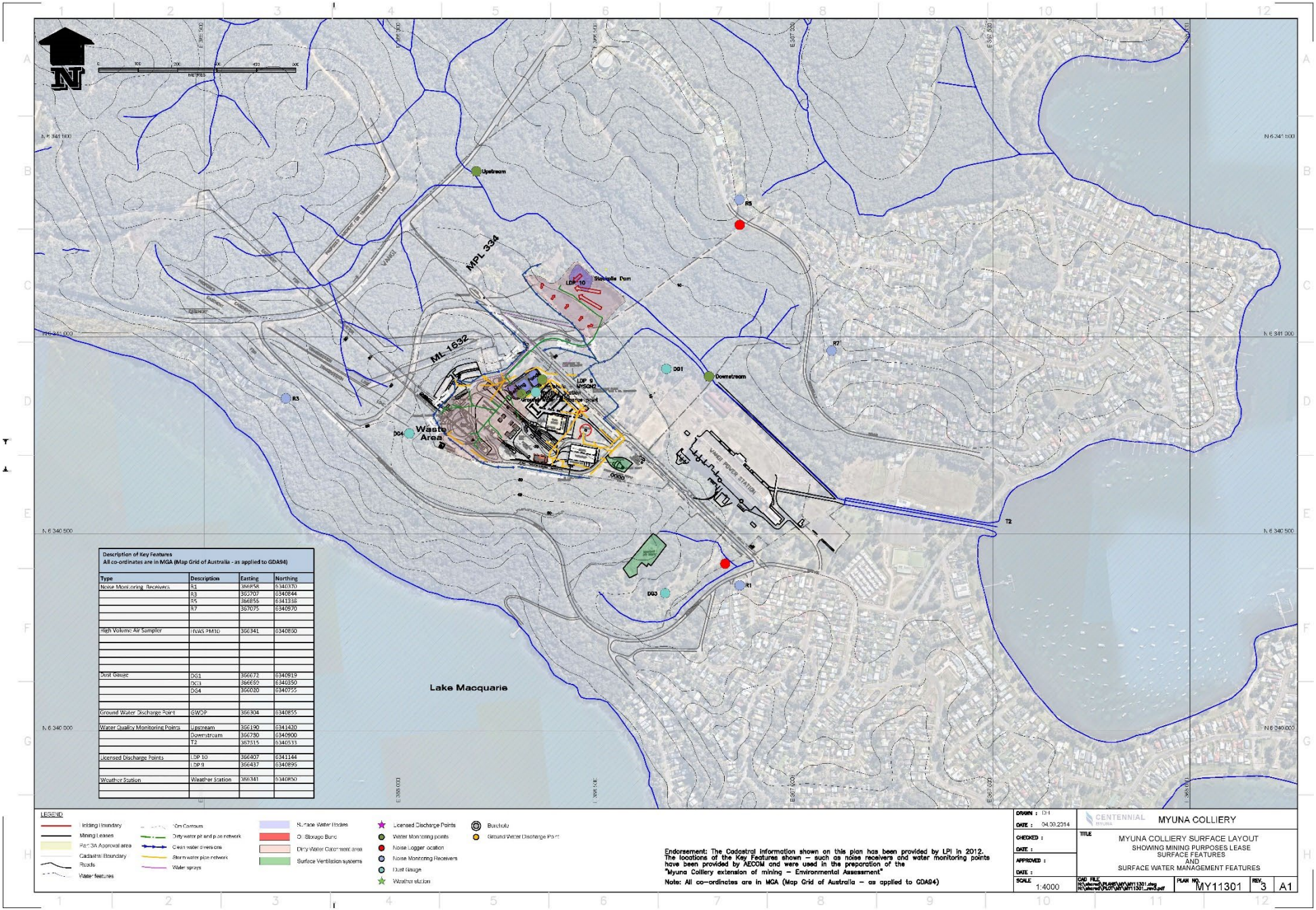
6. ENVIRONMENTAL PERFORMANCE

This section includes a summary of the environmental monitoring and management measures implemented at Myuna Colliery during the 2023 reporting period.

The monitoring locations are summarised in Table 10 below and shown on Plan MY11301 below.

Table 10. Summary of Monitoring Requirements

Monitoring Type	Overview of Monitoring Requirements	Requirement of Approval / Management Plan	Where Addressed in Annual Review
Meteorological	Temperature, wind speed, humidity, rainfall, sigma-theta	Northern Region Air Quality & Greenhouse Gas Management Plan EPL 366	Section 6.1
Noise	Quarterly at 4 locations	Northern Region Noise Management Plan EPL 366	Section 6.2
Air quality	3 x DGs - Monthly 1 x HVAS – every 6 days	Northern Region Air Quality & Greenhouse Gas Management Plan EPL 366	Section 6.3
Biodiversity	Annual surveys at 3 locations	Biodiversity Management Plan	Section 6.4
Greenhouse Gas	Monthly gas bag sample	Northern Region Air Quality & Greenhouse Gas Management Plan	Section 6.5
Heritage	As required	Northern Region Aboriginal Cultural Heritage Management Plan Northern Region Historic Heritage Management Plan	Section 6.6
Water	Surface Water Volume & Quality - Various Groundwater Depth	Water Management Plan EPL 366	Section 7
Rehabilitation	N/A	Rehabilitation Management Plan	Section 8


Upstream
R5
MPL 334
Stockpile Pam
LDP 10
ML 1532
R7
DD1
Downstream
LDP 9
R3
DG4
Waste Area
T2
R1
DG3
Lake Macquarie
Description of Key Features
All co-ordinates are in MGA (Map Grid of Australia - as applied to GDA94)
Type | Description | Easting | Northing
Noise Monitoring Receivers | R1 | 366858 | 6340370
R3 | 367207 | 6340844
R5 | 366855 | 6341338
R7 | 367075 | 6340970
High Volume Air Sampler | HVAS PM10 | 366341 | 6340860
Dust Gauge | DG1 | 366672 | 6340919
DG3 | 366660 | 6340350
DG4 | 366020 | 6340755
Ground Water Discharge Point | GWDP | 366304 | 6340855
Water Quality Monitoring Points | Upstream | 366190 | 6341420
Downstream | 366730 | 6340900
T2 | 367515 | 6340533
Licensed Discharge Points | LDP 10 | 366407 | 6341144
LDP 9 | 366437 | 6340896
Weather Station | Weather Station | 366341 | 6340850
LEGEND
Mining Leases
Part 3A Approval area
Cadastral Boundary
Roads
Water features
10m Contours
Dirty water pit and pipe network
Clean water diversions
Storm water pipe network
Water sprays
Surface Water Bodies
Oil Storage Bund
Dirty Water Catchment area
Surface Ventilation systems
Licensed Discharge Points
Water Monitoring points
Noise Logger location
Noise Monitoring Receivers
Dust Gauge
Weather station
Borehole
Ground Water Discharge Point
Endorsement: The Cadastral information shown on this plan has been provided by LPI in 2012. The locations of the Key Features shown – such as noise receivers and water monitoring points have been provided by AECOM and were used in the preparation of the "Myuna Colliery extension of mining – Environmental Assessment"
Note: All co-ordinates are in MGA (Map Grid of Australia – as applied to GDA94)
DRAWN : DH
DATE : 04.03.2014
CHECKED :
DATE :
APPROVED :
DATE :
SCALE 1:4000
CENTENNIAL MYUNA
MYUNA COLLIERY
TITLE
MYUNA COLLIERY SURFACE LAYOUT
SHOWING MINING PURPOSES LEASE
SURFACE FEATURES
AND
SURFACE WATER MANAGEMENT FEATURES
PLAN NO MY11301
REV. 3
A1

6.1. Meteorological Summary

Meteorological monitoring is completed as per conditions M5.1 and M5.2 of EPL 366 and Section 4.4.4 of the approved Northern Region Air Quality and Greenhouse Gas Management Plan. The location of the Myuna onsite weather station is shown on Plan MY11301, above. The weather station is maintained to conform to the requirements of the NSW EPA Approved Method AM-2 and NSW EPA Approved Method AM-4.

Table 11 below shows that rainfall at Myuna Colliery was average with a total of 960.2mm for 2023, in comparison to an annual average of 1128mm. The wettest months for 2023 were February, March and April each recording 135.4mm, 125.1mm and 117.1mm of rain, respectively. Note that average rainfall data presented below is from the Cooranbong (Avondale) Weather Station which has records since November 1902 and temperature data is from Newcastle Nobbys Signal Station which has records from January 1862 to date.

Table 11. Meteorological Data Summary

Month	2023 total monthly rainfall (mm)	Average total monthly rainfall (mm)	2023 monthly minimum temperature (°C)	Average monthly minimum temperature (°C)	2023 monthly maximum temperature (°C)	Average monthly maximum temperature (°C)
January	111.2	108.9	14.7	16.2	32.4	35
February	100.8	135.4	13.2	16.4	32.9	33.1
March	141.8	125.1	11.6	14.3	38.1	32.3
April	92.0	117.1	8.5	10.9	26.8	29.1
May	32.2	93.8	2.5	7.7	23.7	25.3
June	4.8	102.6	1.9	5.9	22.8	21.7
July	49.2	67.5	2.3	5.2	25.2	22
August	60.0	59.9	4.1	5.8	26.3	24.2
September	40.8	58.3	5.8	7.7	34.6	28.6
October	89.2	68.7	8	10	34.9	31.6
November	128.6	81.8	11	11.9	30.7	33.5
December	109.6	96.6	13.7	14.2	40.7	34.5
Annual Total	**960.2**					

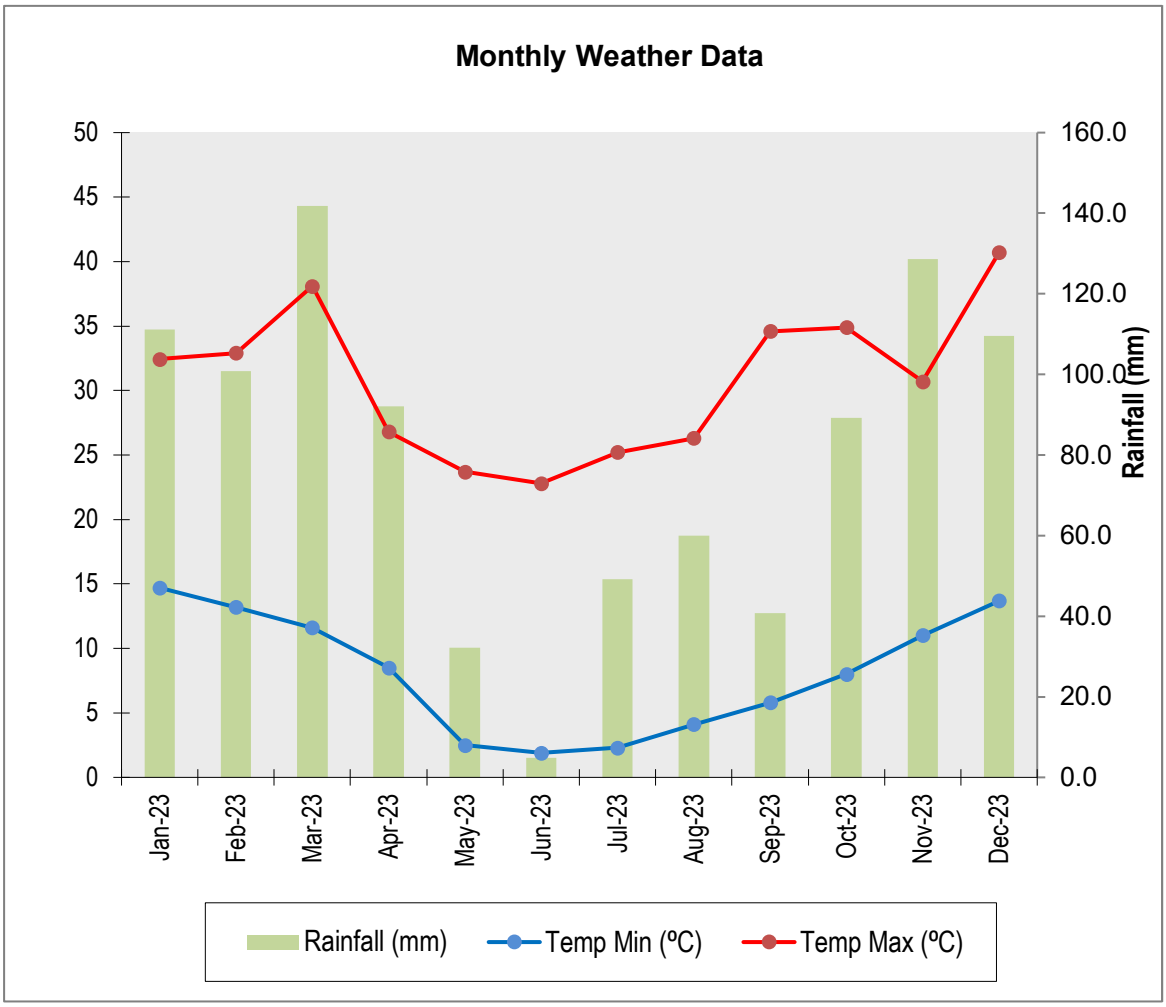


Figure 1. Meteorological Data from Myuna AWS 2023

6.2. Noise

The control strategies were implemented as per the Northern Region Noise Management Plan and were adequate to manage the risks associated with the operation during the reporting period.

The Northern Region Noise Management Plan (NRNMP) outlines potential sources and impacts of elevated noise levels. The NRNMP also identifies measures which must be in place to reduce noise levels. All contractors and employees undergo induction and regular refresher training that identifies individual responsibilities for noise management.

Quarterly noise monitoring throughout 2023 has been conducted in accordance with the requirements of Schedule 3 Condition 11, 12, 13 and 14 of the Myuna Project Approval (PA) PA10_0080, dated 25th November 2022 (PA 10_0080 MOD3) Myuna Colliery Environment Protection Licence (EPL) 366 version dated 13th December 2023 (EPL 366).

Centennial Myuna commissioned SLR Consulting Australia Pty Ltd (SLR) to produce an annual compliance noise monitoring report for Myuna Colliery.

The report provides a summary of quarterly compliance noise monitoring of Myuna operations during 2023 and is provided in full at Appendix 1.

The noise monitoring programme for 2023 was completed for the following:

- Conduct operator attended noise surveys

- Quantify all sources of noise within each of the attended noise surveys, including measured and/or estimated contribution and maximum level of individual noise sources.
- Assess the noise emissions of Myuna Colliery and determine compliance with respect to the limits contained in the PA.

EIS Predictions

Operational noise levels are predicted to continue to meet the project specific noise criteria and the PA conditions at all assessed residential receivers under calm and prevailing weather conditions.

Result Summary

Table 12 below shows a summary of the noise monitoring data for Myuna Colliery, 2023. Operator attended noise monitoring was conducted at eight (8) locations to determine the noise contributions of Myuna Colliery with the relevant criteria. There were no exceedances or non-compliances for the 2023 reporting period. As of Q2 2023, the number of noise monitoring locations has been reduced to 4 and monitoring during the day and evening periods is no longer required, in accordance with EPL366 and the approved Noise Management Plan.

Table 12. Myuna Noise Monitoring Results Summary 2023

Location	Q1	Q2	Q3	Q4	Criteria Limit
Day (LAeq (15 minute) dBA)					
R1	<30	N/A			35
R2	I/A[1]				35
R3	I/A[1]				35
R4	I/A[1]				35
R5	I/A[1]				37
R6	<25				37
R7	I/A[1]				37
R8	I/A[1]				37
Evening (LAeq (15 minute) dBA)					
R1	I/A[1]	N/A			35
R2	I/A[1]				35
R3	I/A[1]				35
R4	<25				40
R5	I/A[1]				42
R6	31				42
R7	30				42

R8	I/A[1]				42
Night (LAeq (15 minute) dBA)					
R1	34	33	35	I/A[1]	35
R2	34	N/A			35
R3	32	35	I/A[1]	30	35
R4	31	N/A			38
R5	37	30	I/A[1]	30	39
R6	37	N/A			39
R7	35	36	34	34	39
R8	34	N/A			39

1. I/A = Inaudible
2. Within 2dB tolerance as per Section 11.1.3 of the NSW Industrial Noise Policy (INP). A development will be deemed to be in non-compliance with a noise consent or licence if the monitored noise level is more than 2dB above the statutory noise limit specified in the consent or licence condition.

6.3. Air Quality

Control strategies were implemented as per the Northern Region Air Quality and Greenhouse Gas Management Plan and were adequate to manage the risks associated with the operation during the reporting period.

The Northern Region Air Quality and Greenhouse Gas Management Plan (AQGMP) outlines potential sources and impacts of elevated dust levels. The AQGMP also identifies measures which must be in place to reduce dust and environmental activities conducted to minimise elevated dust levels. All contractors and employees undergo induction and refresher training that identifies individual responsibilities for air quality management.

6.3.1. Dust Deposition

Results summary

The air quality monitoring data is assessed against the air quality criteria found in Schedule 3, Condition 17 of the Project Approval. There were no exceedances of the air quality limit criteria for the report period.

Depositional dust monitoring was performed at Myuna Colliery during 2023 on a monthly basis at four depositional dust gauges. The limit criterion for depositional dust is 4 g/m^2/month, applied as an annual average.

The current air quality controls include enclosed conveyor and coal handling plant, water sprays on the conveyor system and haul road, mobile water cannon, a road sweeper and a water cart operating on site during coal haulage activities. Controls have been implemented in the reporting period.

Figure 2 and Table 13 below show the depositional dust monitoring results of Myuna Colliery for 2023 in comparison to the long-term results and EIS predictions. At all four dust gauges the annual averages were similar to the long-term averages. The 2 g/m^2/month max annual average increase limit was not exceeded. As of October 2023, DG2 is no longer required to be monitored.

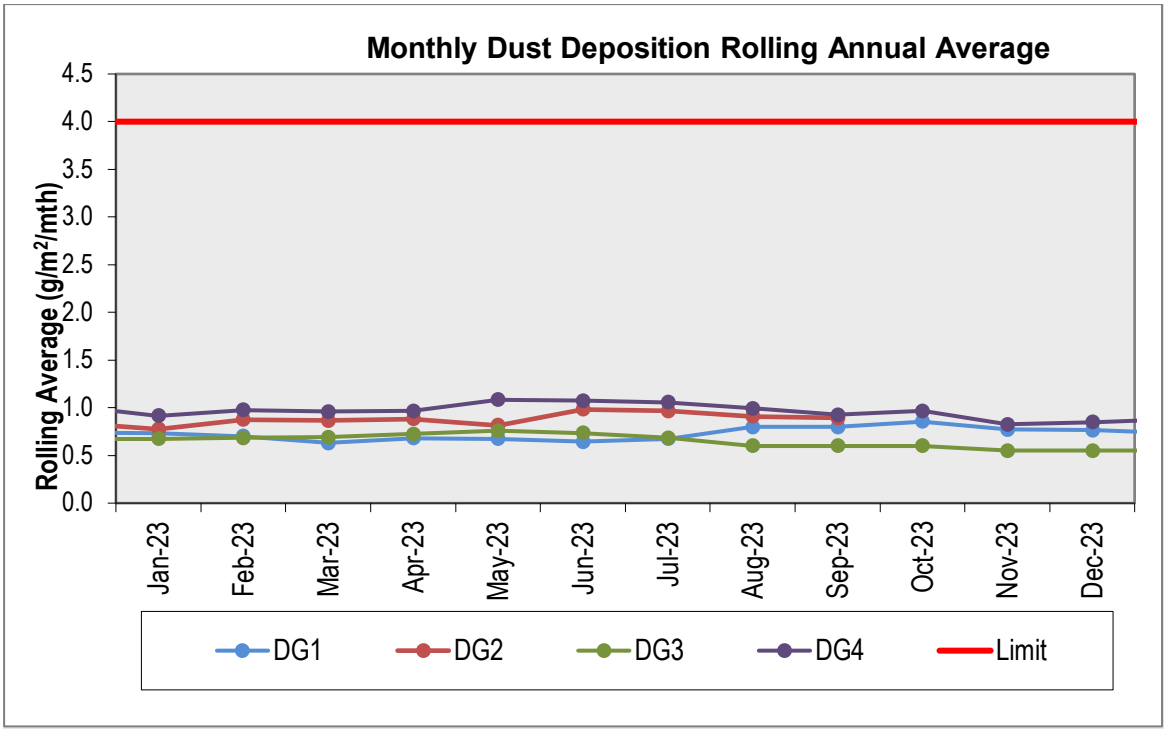


Figure 2. Dust Depositional Gauge – Rolling Annual Average

Table 13. Air Quality Environmental Performance

Dust Monitor	Approval criteria	EIS / EA Predictions	Performance during the reporting period	Long Term Average
DG1	2 g/m^2/month Max Annual Average Increase	<0.1	0.02	0.01
	4 g/m^2/month Total Annual Average	1.9	0.76	0.9
DG3	2 g/m^2/month Max Annual Average Increase	<0.1	-0.13	-0.06
	4 g/m^2/month Total Annual Average	1.9	0.55	1.4
DG4	2 g/m^2/month Max Annual Average Increase	<0.1	-0.17	0.0005
	4 g/m^2/month Total Annual Average	1.9	1.0	1.3
HVAS PM_{10}	30 µg/m^3 Annual Average	10.8	10.9	13.63

Dust Monitor	Approval criteria	EIS / EA Predictions	Performance during the reporting period	Long Term Average
	50 µg/m^3 24 hr Average	10.5 to 51.7	13.80	13.40
HVAS TSP	90 µg/m^3 Annual Average	36.1	20.33	27.73

Trend - Myuna Colliery has 20 years of dust monitoring data over the period from January 2003 to December 2023, excluding data for a 10-month period from February 2007 to November 2007 which is not available. A trend analysis was undertaken using a linear trend line for the dust deposition monitoring from January 2003 to December 2023.

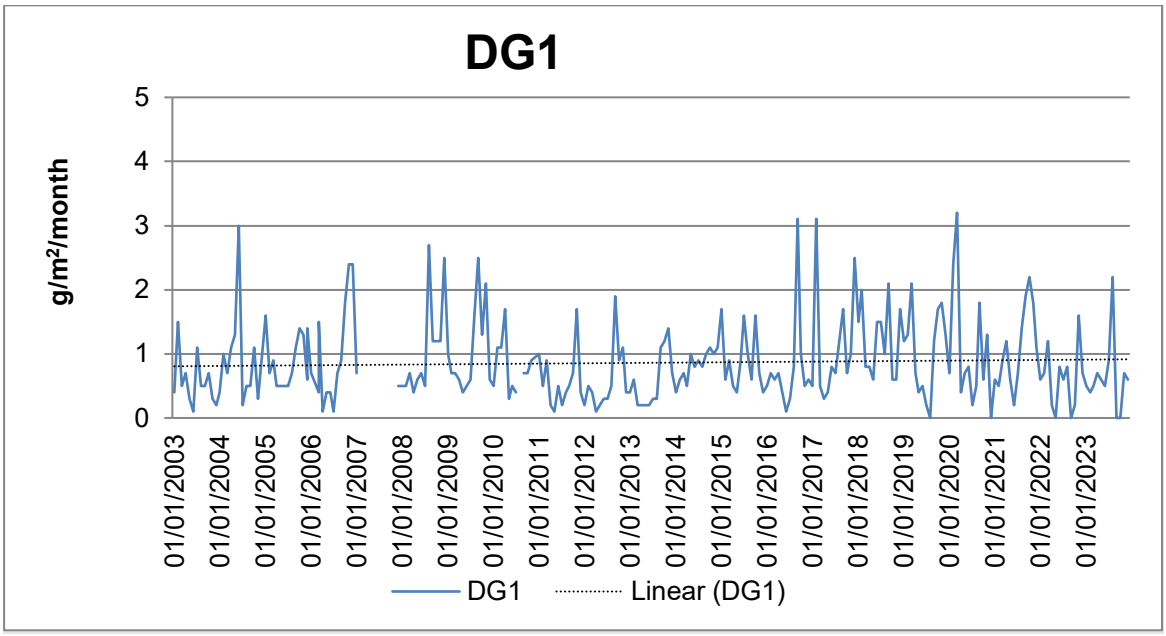


Figure 3. ***DG1 Trend Analysis Graph***

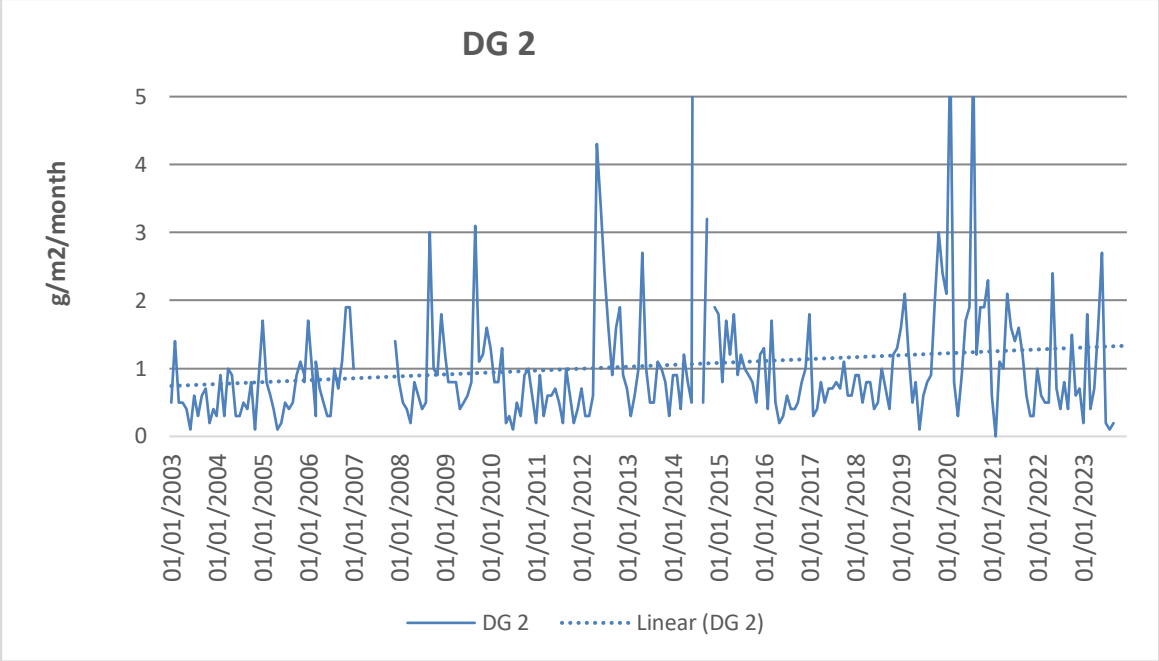


Figure 4. DG2 Trend Analysis Graph

*No data for DG2 beyond October 2023 due to the cessation of monitoring at this point following the adoption of the long-term monitoring program in accordance with the AQGGMP and corresponding EPL366 variation.

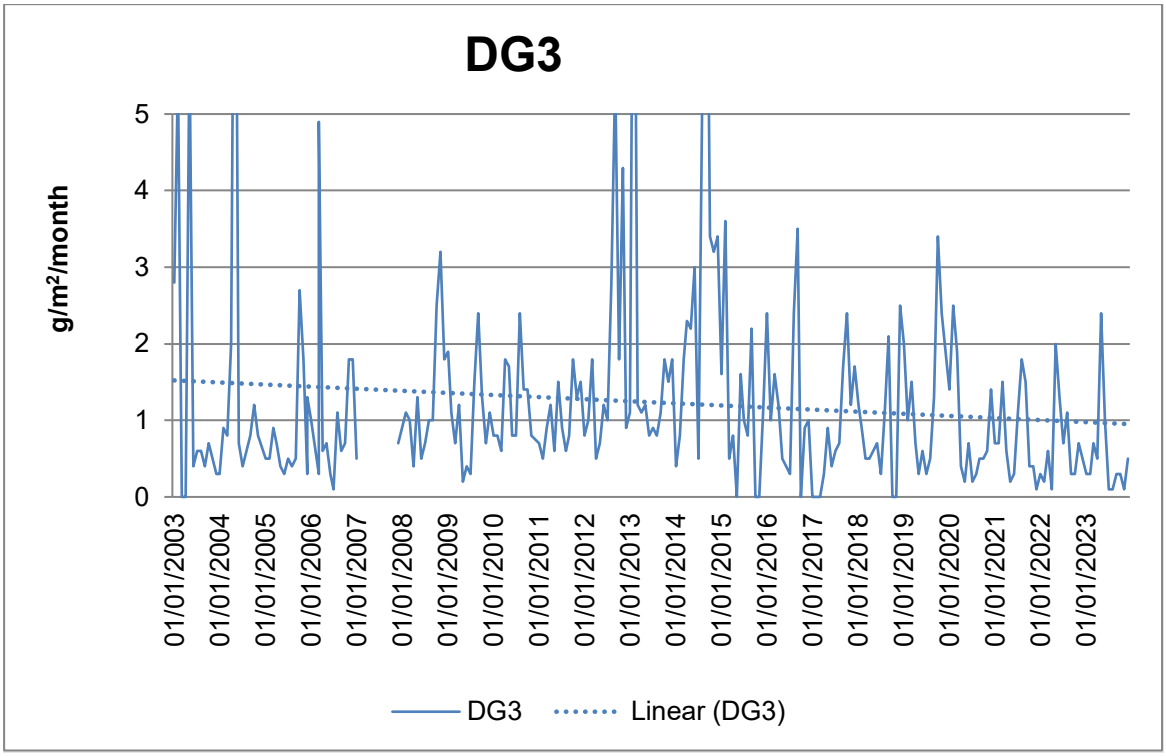


Figure 5. DG3 Trend Analysis Graph

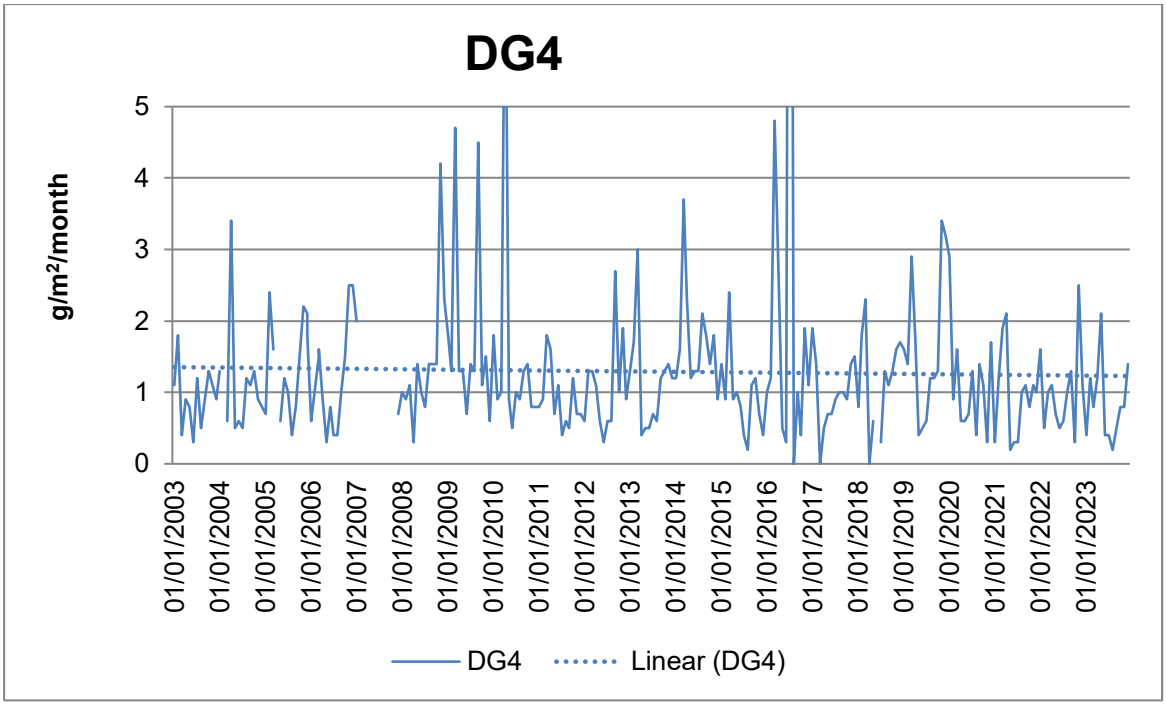


Figure 6. DG4 Trend Analysis Graph

The 2023 annual average and long-term average for each dust gauge is provided in Table 13. The 2023 annual averages for all dust gauges are less than the 19-year long term averages. The long-term trend lines of DG 3 and 4 display a slightly decreasing trend for the monthly dust deposition while DG 1 is stable and DG2 displays a slightly increasing trend.

EA Prediction

The Myuna Colliery Extension of Mining Project Air Quality Impact Assessment (Heggies 2010) predicted the dust deposition levels would be below the Project air quality criteria at all receptors for depositional dust. The dust deposition results for the report period have been consistent with the EA prediction.

6.3.2. HVAS

Result Summary

Air quality monitoring for PM10 and Total Suspended Particles (TSP) commenced in August 2013. The monitoring has been conducted in accordance with Air Quality and Greenhouse Gas Management Plan and Condition M2 of and EPL 366.

The air quality monitoring results are assessed against Schedule 3 Condition 17 of the Project Approval. The annual average limit criterion for TSP is 90 µg/m^3 and for PM10 is 30 µg/m^3. The 24-hour limit criterion for PM10 is 50 µg/m^3. There were no exceedances of the 24-hour limit criteria for PM10, or the annual average limit during the report period. As of October 2023, Myuna Colliery has adopted the long-term monitoring program as prescribed in the AQGGMP and the corresponding EPL366. This includes the consolidation of the PM10 and TSP HVAS units. From October 2023, TSP is now modelled from measurements of PM10 to determine compliance with annual averages. TSP has been removed entirely from EPL366.

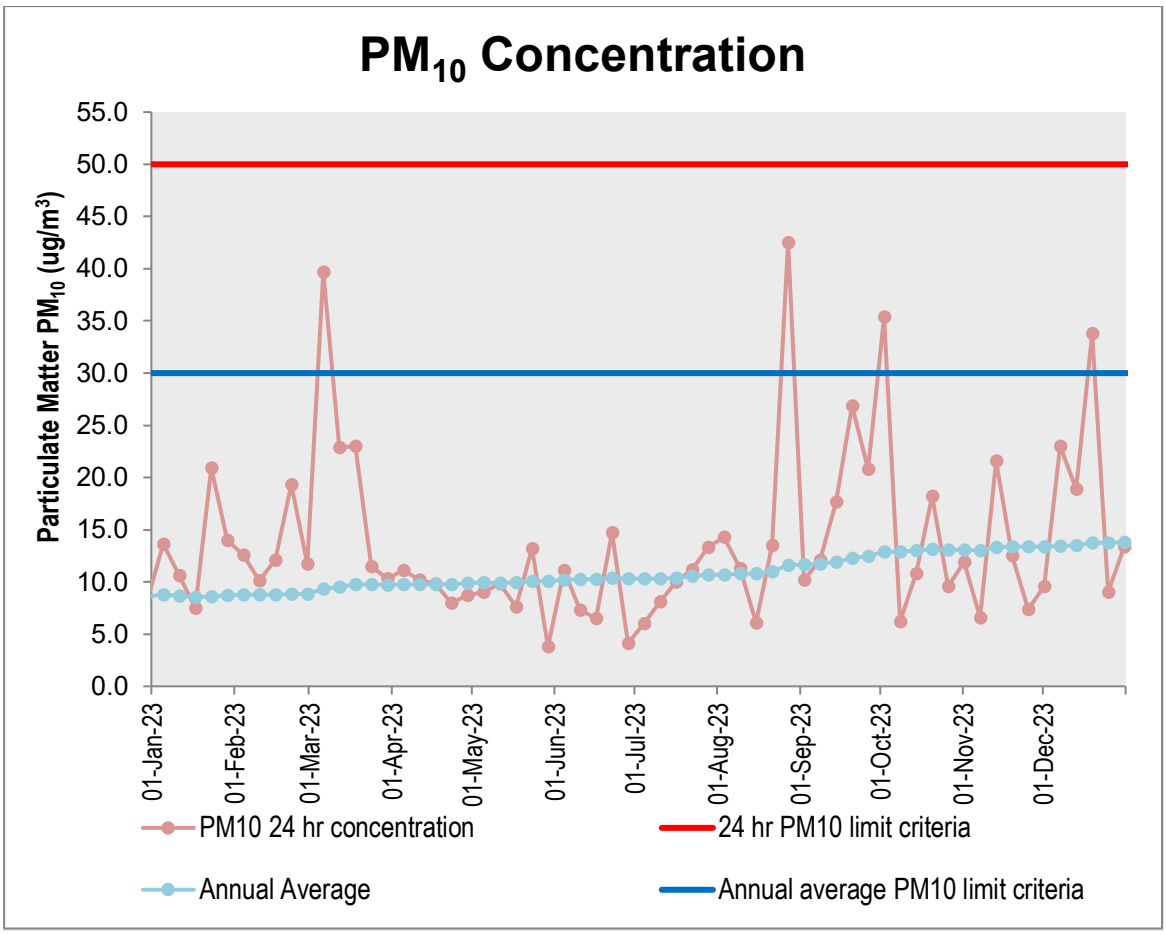


Figure 7. HVAS PM_{10} Rolling Annual Average & 24 hr Results.

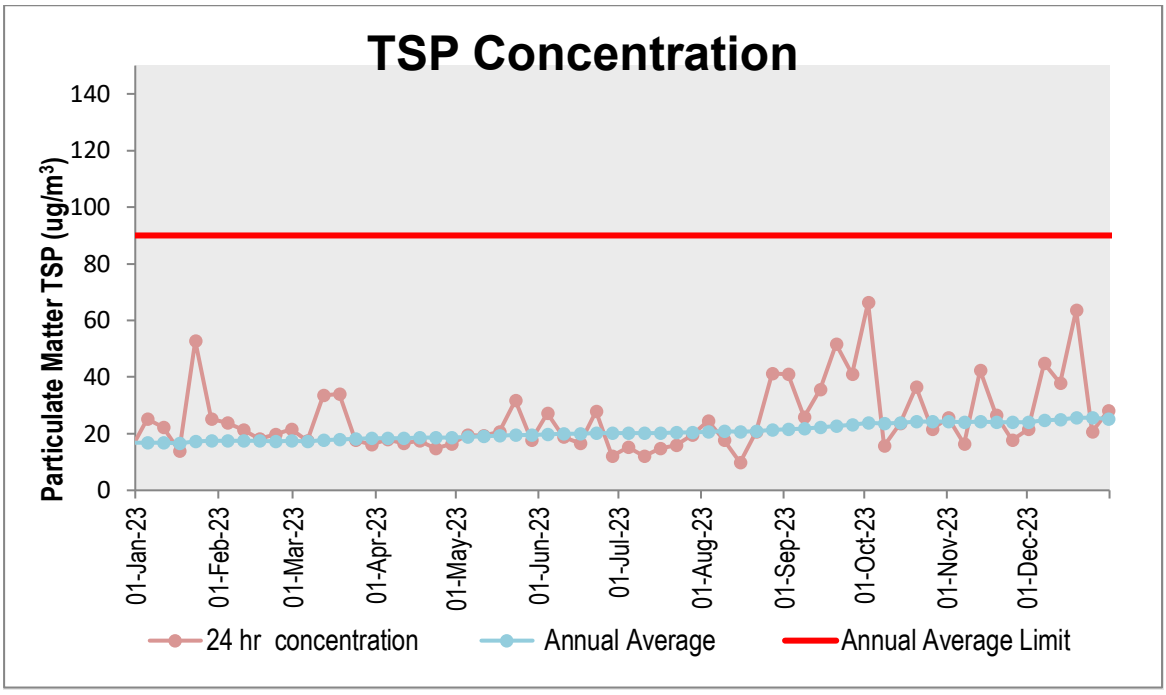


Figure 8. HVAS TSP Rolling Annual Average & 24 hr Results.

The maximum recorded 24-hour PM10 concentration for the report period was 42.5 µg/m^3 and the maximum recorded 24 hour TSP concentration for the report period was 66 µg/m^3.

Trend

The 2023 annual averages for TSP and PM10 are lower than the long-term average.

The trend analysis was undertaken using a linear trend line for the TSP and PM_{10} monitoring data from August 2013 to December 2023. The trend lines indicate slightly deceasing trends for the TSP and PM_{10} over the long-term monitoring period.

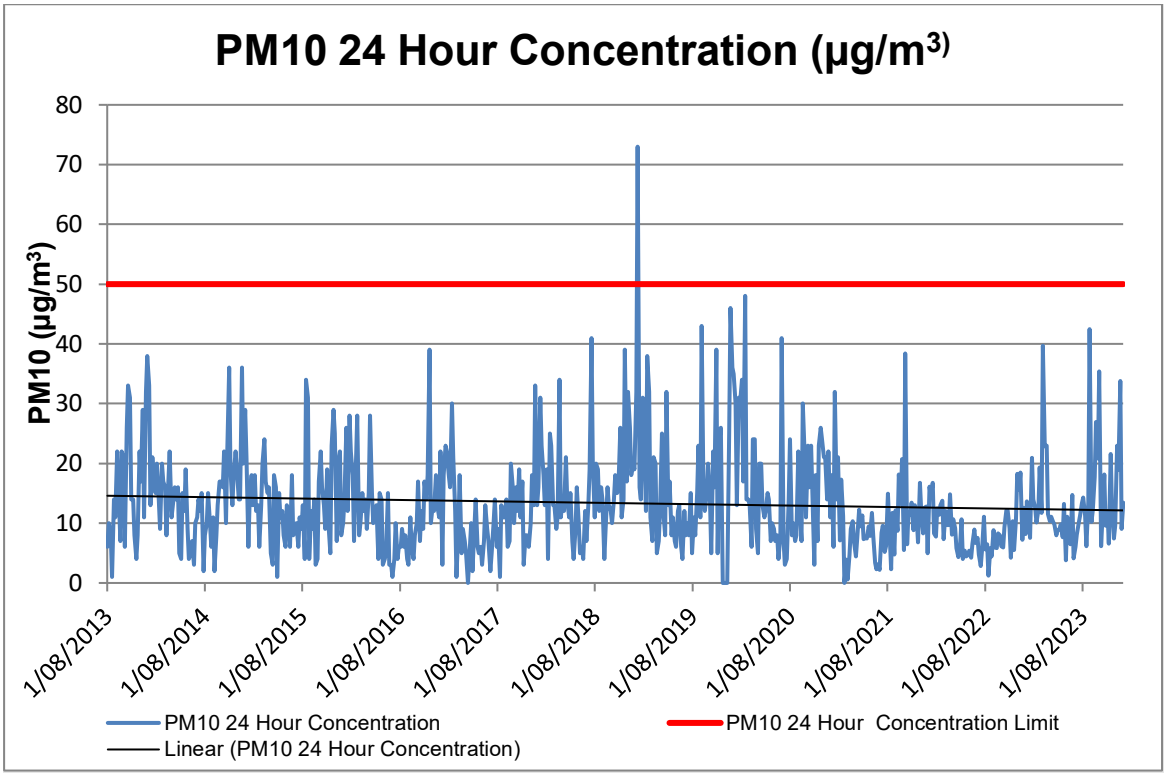


Figure 9. HVAS PM_{10} Trend Analysis Graph

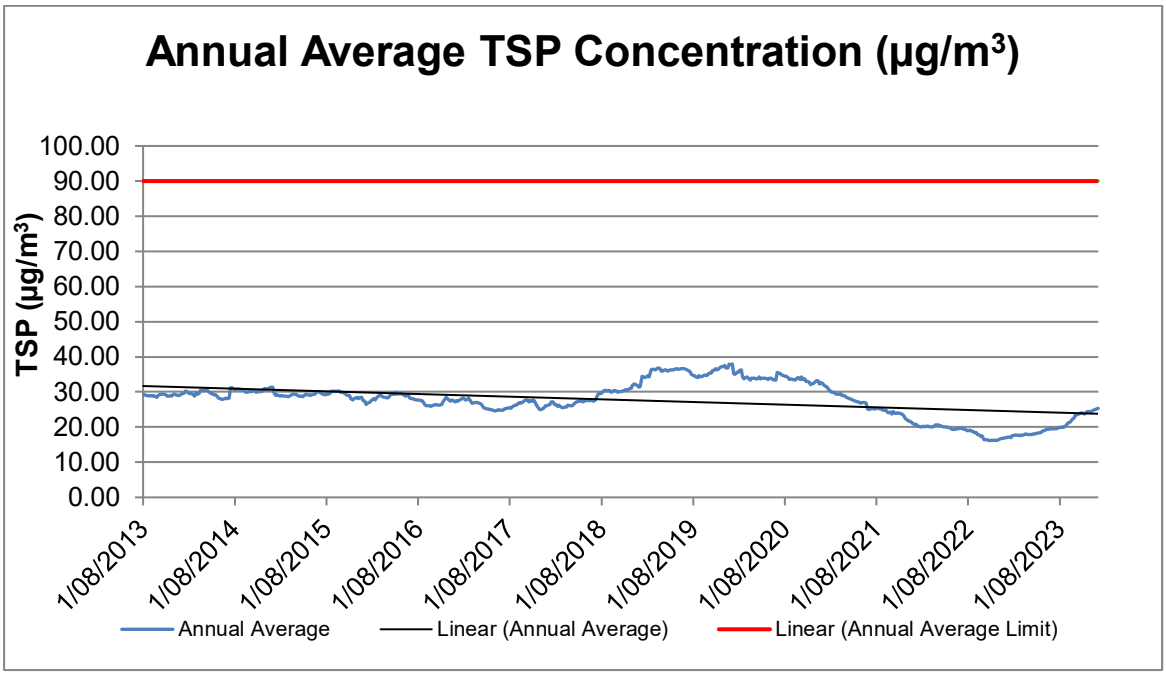


Figure 10. HVAS TSP Trend Analysis Graph

EA Prediction

The Myuna Colliery Extension of Mining Project Air Quality Impact Assessment (Heggies 2010) predicted the cumulative annual average TSP and PM_{10} concentrations would be below the project air quality goal at all private receptors. Cumulative maximum 24-hour PM_{10} concentrations attributable to the Project were predicted to be below the project air quality goals at all surrounding dwellings excluding periods of regional pollution events. The TSP and PM_{10} results for the report period have been consistent with the EA prediction.

6.4. Biodiversity

Control strategies were implemented as per the Biodiversity Management Plan and were adequate to manage the risks associated with the operation during the report period.

The Biodiversity Management Plan for the site outlines measures in place to protect and enhance the Swamp Sclerophyll Forest on Coastal Floodplains Endangered Ecological Community (EEC) on Wangi Creek.

Myuna Colliery engaged a consultant (RPS) to conduct monitoring of the EEC near Wangi Creek. The 2023 Endangered Ecological Community Monitoring: Myuna Colliery 2023 Annual Report is provided in Appendix 2.

The annual EEC monitoring program has the purposes of addressing Schedule 3, Conditions 28 (c) and (d) of the approved PA10_0080.

The purpose of the monitoring is to determine if there is any measurable change in the health/ condition of Swamp Sclerophyll Forest on Coastal Floodplains EEC and *Callistemon linearifolious*; a species listed as vulnerable under the BC Act. Where change is detected, and is deemed to be a negative change, the monitoring is to inform Myuna Colliery of the possible reasons for change and provide recommendation for the management of these changes.

Result Summary

Plots 1 and 2 of Vegetation Monitoring Area (VMA) 1 both recorded above average total counts of native species since 2015. In comparison to 2022 monitoring results there was an increase in the number and proportion of native species to total species. Exotic species richness within the plots in VMA 1 has also decreased since 2022. Averaged results from plots within VMA 1 were generally above the Plant Community Type (PCT) benchmark for species composition, but generally fell below the benchmark for habitat structure and ecosystem function. The results for 2023 were relatively consistent with previous years, with most of the values below the PCT benchmark observed as repeat triggers from 2020 to 2022. Whilst slight variation was recorded in floristic data, photo monitoring shows vegetation and habitat composition to be relatively similar to previous monitoring results.

VMA 2 (Plot 3) recorded the second highest native species count (above average) and highest proportion of native species since 2015 and an increase from monitoring activities in 2022. Count of exotic species was the same as in 2022, however there was an increase in HTW richness. Within VMA 2, species composition and habitat structure was generally below or on par with the corresponding PCT benchmark, while ecosystem function was above the PCT benchmarks except for total length of fallen logs. Previous monitoring events have also outlined elevated exotic species presence in the plot when compared to VMA 1. This is likely a consequence of initial condition of the plot and subsequent management over time.

Variations in species composition and habitat structure could be influenced by several variables including:

- High water flow moving vegetative material and sediments throughout the creek line, transporting potential weed propagative material and removing lower stratum habitat features and vegetation;
- Seasonal variation in weather patterns influencing the occurrence of some species; and
- Potential minor variations in plot location (particularly at the edges of the plots).

Presence of rubbish and other anthropogenic refuse was observed within or in close proximity to all flora monitoring plots, which may also contribute to the introduction of exotic seed product and proliferation of weed species along with disturbance of substrate within the study area.

The reduced condition of *Callistemon linearifolius* individuals can be primarily attributed to impacts related to heavy water flow experienced within the riparian zone during the 2020 monitoring event, with most of the individuals within the monitoring plots and more specifically within the wetted areas where accumulation of plant debris at their bases was observed. During the 2023 monitoring event, signs of stabilisation for individuals were variable with new leaf growth observed on most individuals, while other individuals (e.g., 152, 153 and 154) within the wetted area of the riparian zone showed signs of declining condition with browning leaves/dieback.

Results from the 2023 EEC monitoring indicate no immediate impacts of concern on PCT 1649: Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions EEC from mining related activities. Floristic data and comparisons of habitat attributes have remained relatively constant to prior monitoring events, with any slight variations likely attributed to variability in precipitation and climatic factors unrelated to mining operations.

Trend

Annual Weed Action Plans conducted at Myuna Colliery, including an annual weed survey and on ground works has resulted in the ongoing suppression and removal of high threat weed species including Lantana, Bitou Bush, Pampas Grass, Pine Trees and Castor Oil Plant among others.

EA Prediction

The Myuna Colliery Extension of Mining Project Terrestrial Flora and Fauna Assessment (RPS 2011) predicted due to negligible surface impacts that the project was unlikely to impact on any threatened species, endangered populations or threatened ecological communities.

6.5. Greenhouse Gas

The control strategies were implemented as per the Northern Region Air Quality and Greenhouse Gas Management Plan and were adequate to manage the risks associated with the operation during the reporting period.

Environmental Performance

Estimation of the GHG emissions associated with the Myuna was undertaken using the emission factors and methods outlined in the National Greenhouse and Energy Reporting (Measurement) Determination 2008.

Reasonable and feasible steps were undertaken during the reporting period to improve energy efficiency and reduce greenhouse gas emissions generated by the mine, including the following:

- Cost effective measures to improve energy efficiency;
- Regular maintenance of plant and equipment to minimise fuel consumption;
- Consideration of energy efficiency in plant and equipment selection
- Replacement of the aging ducted air conditioning unit in the administration building with individually controlled split systems in each office; and

- Replacement of fluorescent lights in the administration building with LED lights, where possible

Table 14 provides the total emissions by source in carbon dioxide equivalent tonnes for the reporting period.

Table 14. Total GHG Emissions from Site Operations

Emissions Sources July 2022-June 2023	Total (t_{CO2-e})	*EIS / EA Prediction
Scope 1 Emissions (direct emissions)		
Coal Extraction (Fugitives)	252,132	576,593
Post Mining Emissions	21,179	28,000
Diesel Fuel	1,183	1,333
Oils	142	689
Greases	0	
SF6	4	0
LPG	0	1
Scope 2 Emissions (in-direct emissions)		
Electricity	23,210	32,955
TOTAL	**297,851**	**611,571**

*EIS/ EA prediction was based on a production rate of 2MTPA

6.6. Heritage

Control strategies implemented as per the Northern Region Aboriginal Cultural Heritage Management Plan (ACHMP) and the Northern Region Historic Heritage Management Plan were adequate to manage the risks associated with the operation during the reporting period.

Result Summary

No monitoring was required under the Northern Region Historic Heritage Management Plan (HHMP) or the Northern Region Aboriginal Cultural Heritage Management Plan (ACHMP) for the 2023 reporting period.

EA Prediction

The Myuna Colliery Extension of Mining Project Cultural Heritage Assessment (RPS 2011) considered there was minimal potential for impact from the Project on sensitive Aboriginal cultural places or objects or on European cultural heritage items.

6.7. Mine Subsidence

Myuna Colliery has a requirement to limit vertical subsidence within Zone A to a maximum of 20mm for first workings as per Schedule 3 Condition 1 of PA10_0080. Myuna Colliery's mine design was assessed and approved on the basis that first workings are designed and mined according to industry standards so that workings are long term stable and non-subsiding (resulting in negligible impacts).

Myuna Colliery has not undertaken secondary extraction within the reporting period, and therefore has not triggered the requirement for an approved Extraction Plan. Subsidence monitoring within Zone A is completed as due diligence with no measured subsidence beyond the 20mm limit in Zone A.

6.7.1. Environmental Management

Myuna Colliery is currently a bord and pillar operation with no secondary workings. Therefore, the requirement for an extraction plan has not been triggered and the respective additional environmental monitoring and management, is not required.

6.7.2. Environmental Performance

Table 15 below shows the performance measures for subsidence impacts to biodiversity, built features and public safety. First workings to date at Myuna Colliery have been conducted with no measured or anticipated subsidence. Therefore, an assessment of impact with reference to predicted subsidence impacts is not applicable, as noted.

Table 15. Assessment of Subsidence Performance against Performance Measures and Predicted Impacts

Feature	Subsidence Performance Measures	[1]Predicted Subsidence Impact EIS	Assessment of Performance against Predicted Impact
Biodiversity			
Threatened species, populations, or their habitats and endangered ecological communities	Negligible impact or environmental consequences.	Negligible impacts	n/a
Seagrass beds	Negligible environmental consequences including: • negligible change in the size and distribution of seagrass beds; • negligible change in the functioning of seagrass beds; and • negligible change to the composition or distribution of seagrass species within seagrass beds.	Negligible impacts	n/a

Feature	Subsidence Performance Measures	[1]Predicted Subsidence Impact EIS	Assessment of Performance against Predicted Impact
Benthic communities	Minor environmental consequences, including minor changes to species composition and/or distribution.	Negligible impacts	n/a
Built Features			
Key public infrastructure: Eraring Power Station Ash Dam	Negligible impact or consequence.	Negligible impacts	n/a
Other public infrastructure (including sewage pipes; power and telecommunications cables). Other built features (including jetties and boat moorings)	Always safe. Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repaired, replaced or fully compensated.	Negligible impacts	n/a
Public Safety			
Public Safety	Negligible additional risk.	Negligible impacts	n/a

1. Negligible impacts, subject to further assessment in conjunction with any mine design.

7. WATER MANAGEMENT

WAL 41560 has superseded Bore Licence 20MW065029, which was granted in December 2010 for the purpose of dewatering up to 4380 ML/ year of ground water from mine workings at Myuna Colliery. Ground water extracted from the underground mine workings is currently discharged from site via LDP 9. Volumetric and water quality monitoring data at LDP 9 is therefore representative of ground water volumes and ground water quality extracted from the mine workings.

The volume of ground water extracted from the workings authorised by the licence shall not exceed 4380 ML in any twelve-month period. The total volume of water discharged through LDP 9 for 2023 is 1591.5ML. There were no exceedances of the volume limit criteria during the reporting period. There were three days where the flow monitor was offline during the reporting period at LDP 9. This downtime was due to a temporary breakdown caused by a faulty controller card.

Table 16 identifies the water take under the water licences.

Table 16. Water Take

Water Access Licence	Water Supply Works Approval	Water Sharing Plan	Entitlement	TOTAL TAKE
WAL 41560	20MW065029	North Coast Fractured and Porous Rock Ground Water Sources	4380	1831

Note: Volume is reported in megalitres per year (ML/y)

The Wallarah, Great Northern and Fassifern seams contain reservoirs which are used for the retention and settlement of mine water and surface water prior to pumping to the surface settlement ponds. The pump line and syphon line are metered for the purpose of measuring the volume pumped to the underground. The volume of surface water pumped to the underground reservoir during the 2023 reporting period was approximately 36.4 ML.

The underground water storages in the Wallarah Seam, the Great Northern Seam and the Fassifern Seam are based on an average seam height of 3 m and a recovery ratio of 0.333, Centennial Myuna has estimated the volume of water storages in each of the seams. The underground water storage volumes are shown below in the table below.

The hydrogeological model developed for Myuna Colliery assumes that the volumes of each of these storages are constant.

Table 17. Water Storage

Seam	Water Storage Volume (ML)
Wallarah	1381
Great Northern	1045
Fassifern	2041

Myuna Colliery used 107.1 ML of potable water for the 2023 reporting period.

In accordance with the requirements of the Water Management Plan, the transfer of water from the underground workings to the surface has been monitored daily.

7.1. Surface Water Monitoring

Control strategies were implemented as per the Water Management Plan and were adequate to manage the risks associated with the operation during the report period.

Myuna Colliery has a Water Management Plan which discusses responsibilities, pollution sources, hazards, risks and mitigation strategies of water management. Regular refresher training and site inductions discuss water management to make personnel aware of the site issues.

The surface water monitoring has been conducted in accordance with the conditions of EPL366 and the Water Management Plan. EPL366 specifies monitoring and reporting requirements along with concentration limits for water discharged through LDP 9 and LDP 10. Other EPL monitoring requirements included E1 Manganese monitoring in Wangi Bay.

There was no discharge of water through LDP 10 in 2023.

Table 18. Summary of Surface Water Monitoring Locations

Monitoring Point Reference	Description / Creek Catchment
LDP 9	Discharge Location 1 into Wangi Creek. EPL Monitoring Location 9, formerly referred to as LDP B.
LDP 10	Discharge Location 2 into Wangi Creek. EPL Monitoring Location 10, formerly referred to as LDP A.

7.1.1. Surface Water Monitoring Results

Mine water discharged from LDP 9 must be monitored monthly during discharge for the following parameters.

- Volume
- pH
- Total Suspended Solids (TSS)
- Oil and Grease

Discharge of mine water occurred every month in the reporting period. A sample was collected and analysed for the parameters each month of discharge. In 2023 the water monitoring program prescribed in the WMP was updated to reflect recent variations to EPL366. Daily sampling at LDP 9 has been reduced to monthly during discharge. This change was approved in the WMP in June of 2023.

The flow volumes through LDP 9 are monitored continuously in accordance with EPL366. The daily volume discharge limit for LDP 9 is 13,000 kL. The maximum daily volume discharged was 9,490 kL during the reporting period. The average daily volume discharged for 2023 was 4,396 kL. There were no exceedances of the LDP 9 volume limit criteria during the reporting period.

The pH of the mine water discharged through LDP 9 was consistent throughout 2023 with a minimum pH level of 7.5 and a maximum of 8.4. The limit criterion for pH is a range between 6.5 and 8.5. There were no exceedances of this limit during the reporting period.

The concentration of total suspended solids analysed in the mine water discharged through LDP 9 was consistently low with an average concentration of 13 mg/L and a maximum concentration of 29 mg/L during 2023. The concentration limit for TSS is 50 mg/L. There were no exceedances of this limit during the reporting period.

The concentration of oil and grease analysed in the mine water discharged through LDP 9 was consistently low with a maximum of 0 (<5) mg/L for the reporting period. The concentration limit for oil and grease is 10 mg/L. There were no exceedances of this limit during the reporting period.

Results of the main water quality analytes for LDP 9 for the reporting period are provided in table 19 and figures 11 and 12 below. There was no discharge from LDP 10 in 2023 and this is reflected in Table 20.

Table 19. LDP 9 Water Quality Results Summary

Pollutant	Unit of Measure	No. of Samples required by licence	No. of Samples collected and analysed	Lowest sample value	Mean of samples	Highest sample value	EPL Limit	Recommended Trigger Value (EA)
pH	pH	157	157	7.5	7.7	8.4	6.5 – 8.5	6.5 – 8.5
Total Suspended Solids	mg/L	157	157	0.0	13	29.0	50	<50
Oil & Grease	mg/L	157	157	0.0	0	0	10	-

Table 20. LDP 10 Water Quality Results Summary

Pollutant	Unit of Measure	No. of Samples required by licence	No. of Samples collected and analysed	Lowest sample value	Mean of samples	Highest sample value	EPL Limit	Recommended Trigger Value (EA)
pH	pH	0	0	0	0	0	6.5 – 8.5	6.5 – 8.5
Total Suspended Solids	mg/L	0	0	0	0	0	50	<50
Oil & Grease	mg/L	0	0	0	0	0	10	-

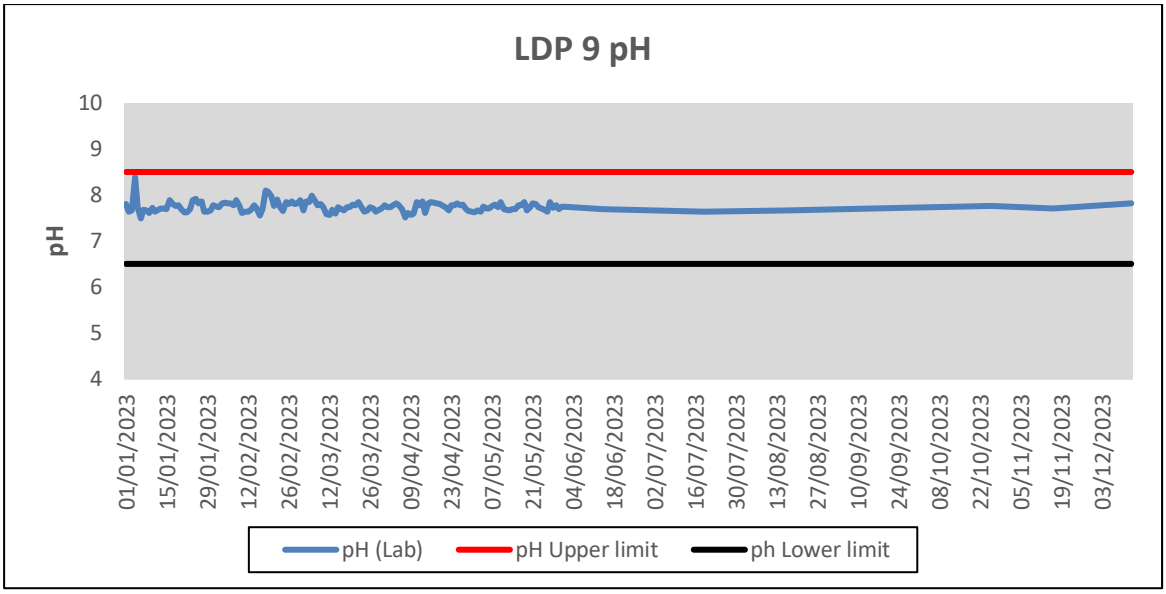


Figure 11. LDP 9 Water Quality Monitoring Results – pH

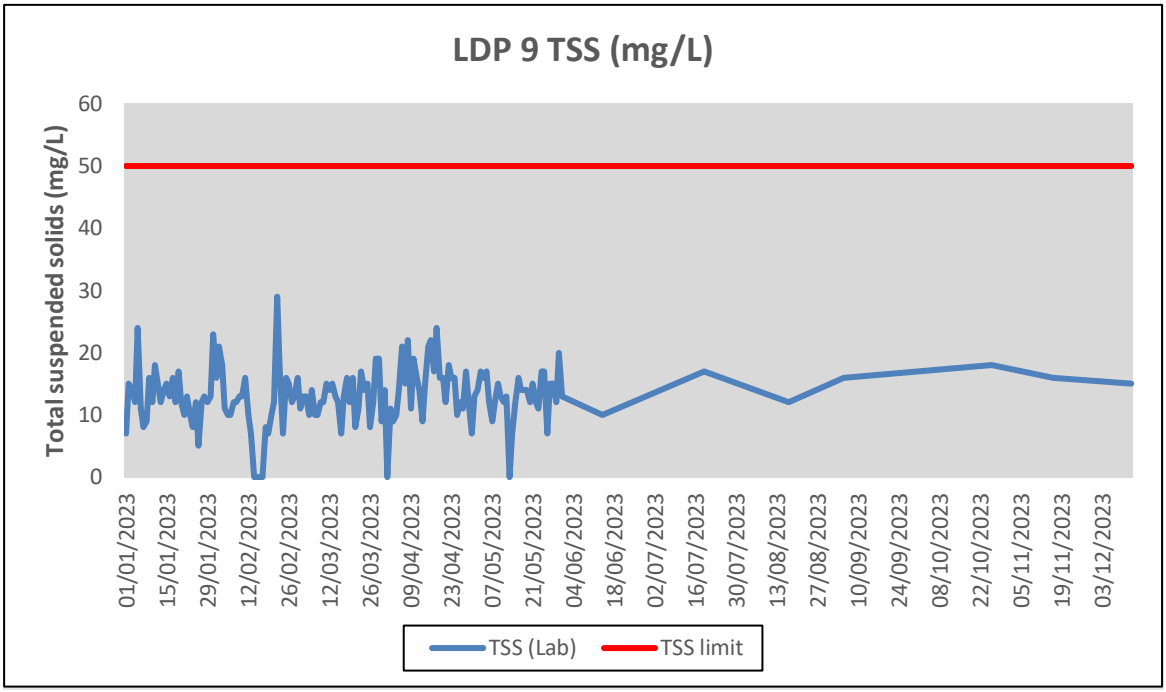


Figure 12. LDP 9 Water Quality Monitoring Results – TSS

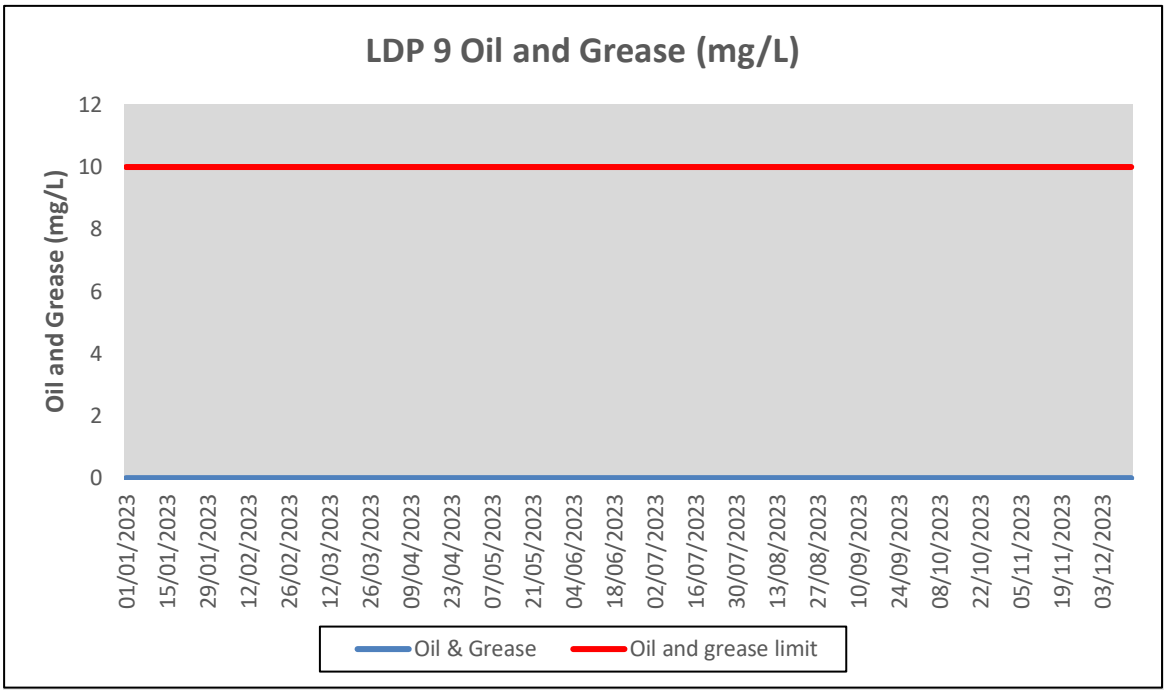


Figure 13. LDP 9 Water Quality Monitoring Results – Oil and Grease

Water Volume is required to be monitored daily during discharge at the licenced discharge points in accordance with EPL 366. Table 21 provides the discharge volume results for LDP 9 for the Annual Review period. There was no discharge from LDP 10 during the period.

Table 21. LDP 9 Discharge Volumes

Monitoring Point Reference	Frequency	No. of Measurements made	Lowest Result (kL)	Mean Result (kL)	Highest Result (kL)	EPL Limit
LDP 9 (EPL Point 9)	Daily During Discharge	362	0	4 396	9 490	13 000

7.1.2. Data interpretation

As shown in the figures below, linear trend lines were applied to the monitoring data from 2011 to December 2023 for pH, TSS and Oil & Grease. The trend lines show that results have been relatively consistent over this period.

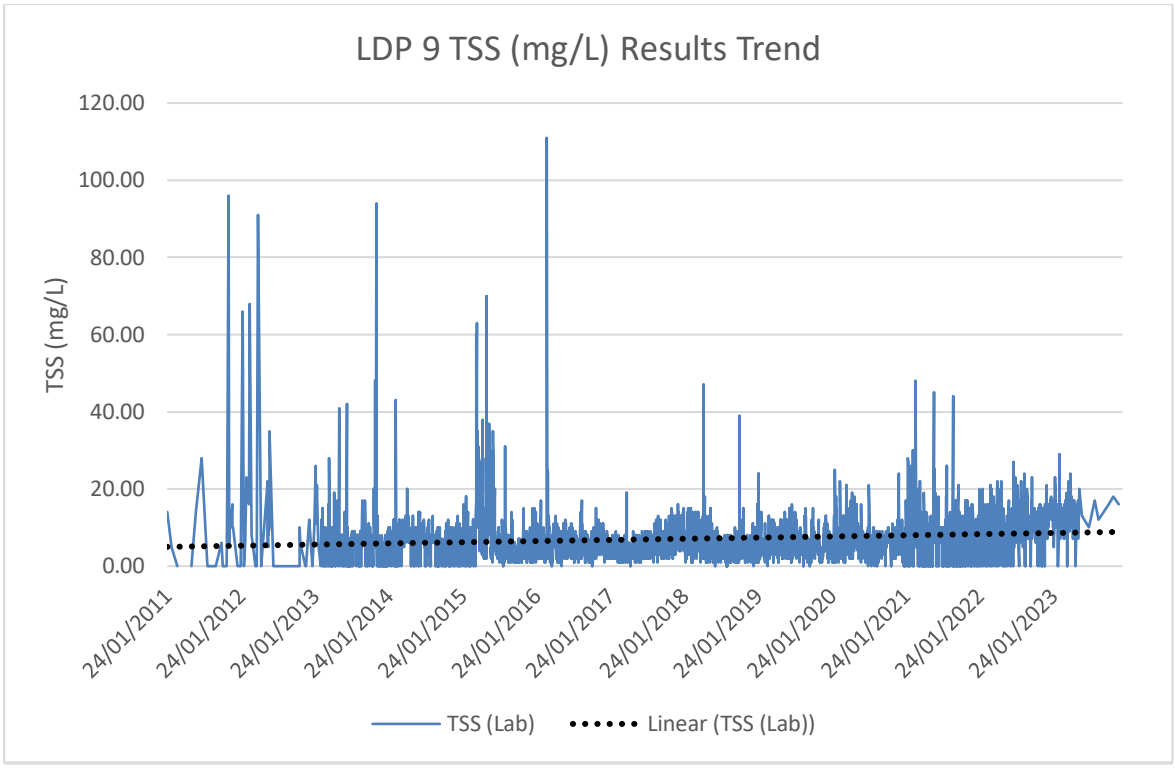


Figure 14. LDP 9 TSS Monitoring Results and Linear Trend Line

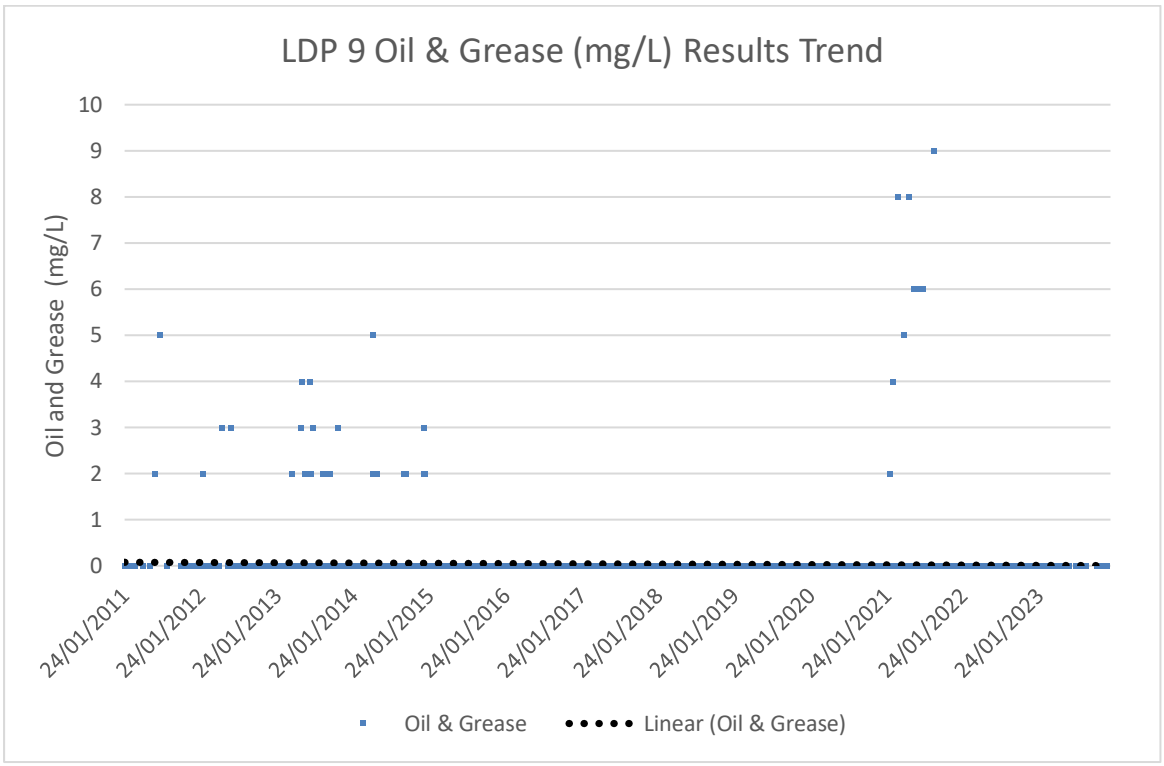


Figure 15. LDP 9 Oil and Grease Monitoring Results and Linear Trend Line

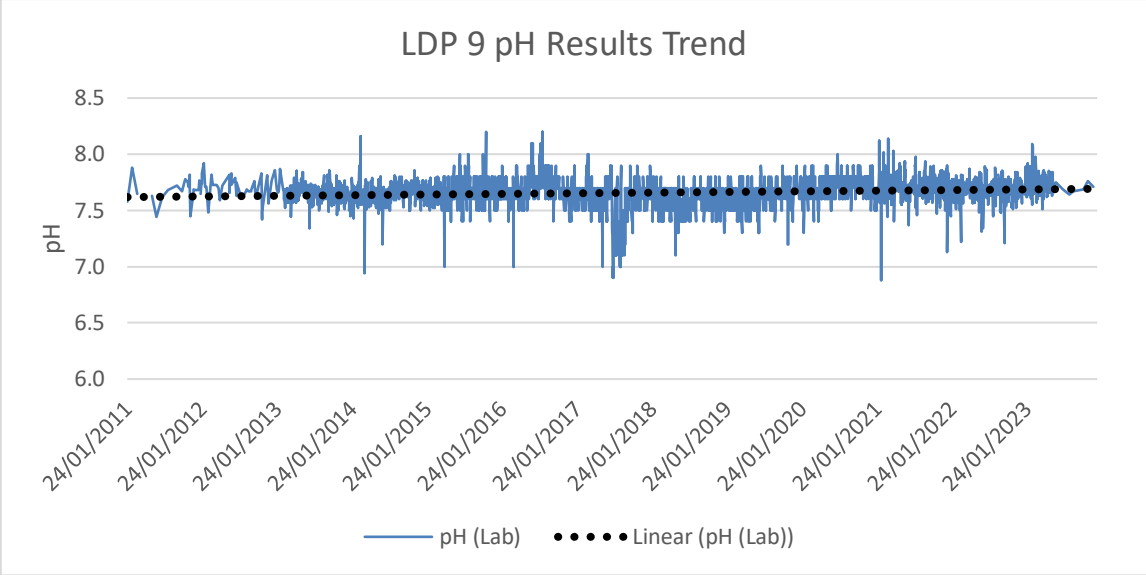


Figure 16. LDP 9 pH Monitoring Results and Linear Trend Line

7.2. Water Balance

Goldsim modelling was completed by a third-party contractor for the reporting period. A summary of the outputs of this model are shown in Table 22. below. A schematic of the water balance is on the following page. Note that results shown include inputs modelled estimates of water volumes that are not able to be directly measured.

Table 22. Goldsim Model Output (2023)

Element	2023 (simulated) (ML/year)
INPUTS	
Runoff into storages	92.82
Precipitation	3.43
Potable water supply	92.71
Groundwater inflows	2332.20
In situ moisture	120.44
TOTAL INPUTS (rounded)	**2642**
OUTPUTS	
Evaporation	5.56
Tank loss (CHP)	120.44
Tank loss (washdown)	0.39
Sewage	2.68
Discharge through LDP009	2262.90
Discharge through LDP010	0
Consumption	213.15

TOTAL OUTPUTS (rounded)	**2605**
CHANGE IN STORAGE	
Change in storage	224.1
TOTAL CHANGE IN STORAGE (rounded)	**224**
BALANCE	
Inputs – outputs – change in storage	-187

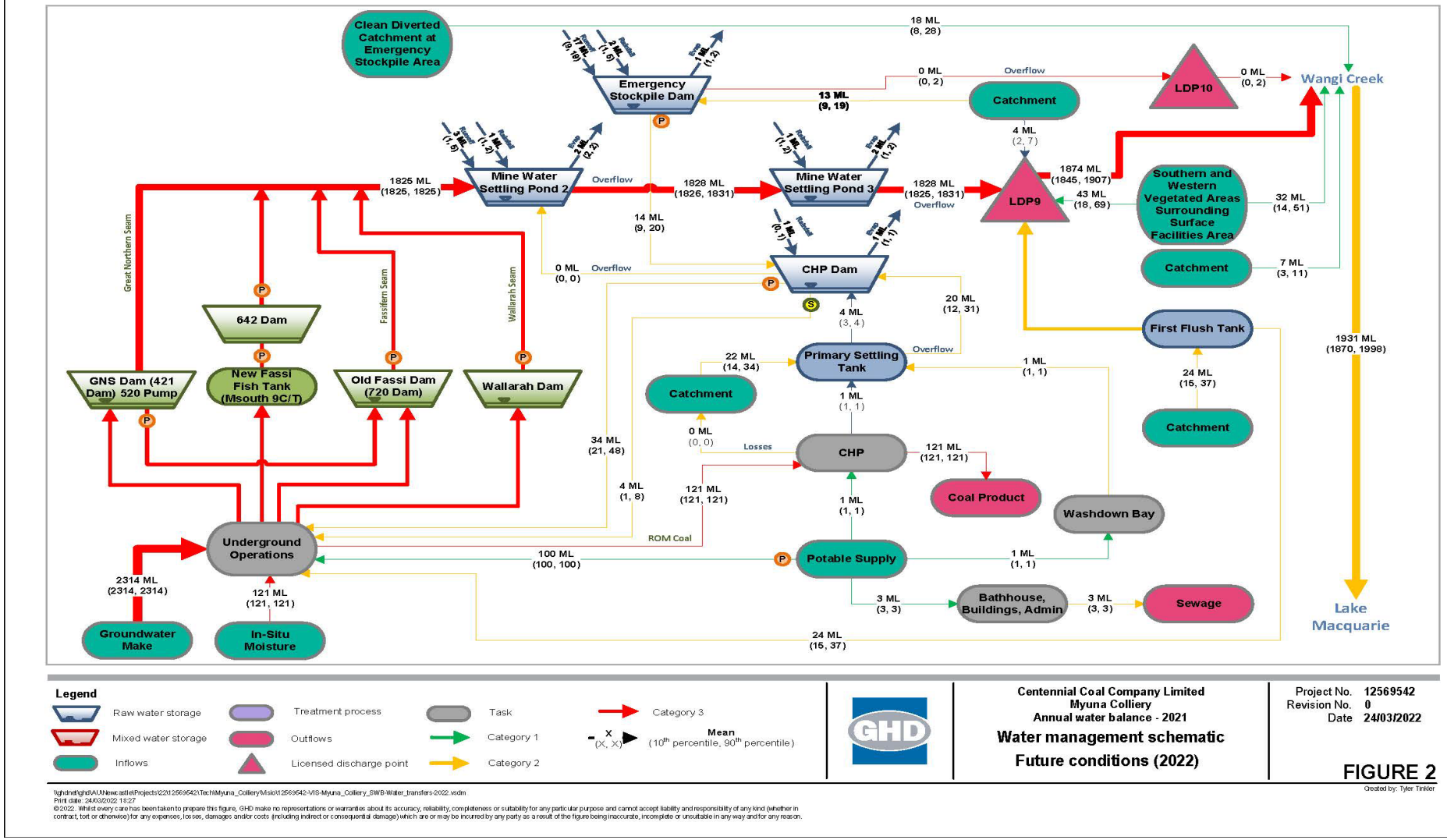


Figure 17. Water Balance Schematic

7.3. Groundwater Management

In November 2017, Myuna commenced monitoring of groundwater levels around the pit top area. The groundwater monitoring network includes ten shallow alluvial monitoring bores which were installed in August 2012. Details of the groundwater monitoring bores are provided below in Table 23. Groundwater bores have been monitored monthly until May 2023 and are now monitored quarterly in line with recent updates to the approved Myuna Water Management Plan.

Table 23. Groundwater Monitoring Bore Details

Bore	Monitoring Period	Lithology	Bore Depth (m)	Monitoring Parameters
MW01	Nov 2017 – Ongoing	Alluvium	6	Groundwater Level
MW05	Nov 2017 – Ongoing	Alluvium	18.5	Groundwater Level
MW06	Nov 2017 – Ongoing	Alluvium	13	Groundwater Level
MW07	Nov 2017 – Ongoing	Alluvium	8.5	Groundwater Level
MW08	Nov 2017 – Ongoing	Alluvium	9	Groundwater Level
MW09	Nov 2017 – Ongoing	Alluvium	7	Groundwater Level
MW10	Nov 2017 – Ongoing	Alluvium	10	Groundwater Level
MW11	Nov 2017 – Ongoing	Alluvium	7	Groundwater Level
MW12	Nov 2017 – Ongoing	Alluvium	8	Groundwater Level
MW13	Nov 2017 – Ongoing	Alluvium	11	Groundwater Level

7.3.1. Groundwater Monitoring Results

As discussed in Section 7.3, the groundwater monitoring network at Myuna Colliery includes ten alluvial monitoring bores. Observed groundwater levels at these monitoring bores for 2023 are shown below in Table 24.

Table 24. Groundwater Levels for Myuna Colliery

Bore	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Aug-23	Nov-23	EIS Prediction
MW01	19.4	19.3	19.5	19.3	19.4	18.8	19.2	Minimal Impact
MW05	15.1	15.0	14.4	13.8	N.R.	14.2	13.6	Minimal Impact
MW06	13.7	11.5	13.7	13.9	13.6	13.2	13.3	Minimal Impact
MW07	22.4	22.3	22.3	22.2	22.2	21.7	21.7	Minimal Impact
MW08	21.2	21.0	20.9	20.9	20.9	20.5	20.4	Minimal Impact
MW09	16.0	15.7	16.0	16.3	16.4	15.1	13.1	Minimal Impact
MW10	24.4	24.1	24.0	24.1	24.3	23.4	23.1	Minimal Impact
MW11	10.1	10.0	10.1	10.1	10.1	9.9	9.9	Minimal Impact
MW12	6.7	6.6	6.8	7.1	7.2	6.6	6.9	Minimal Impact
MW13	2.1	2.0	2.2	2.2	2.3	2.0	2.0	Minimal Impact

7.3.2. Data Interpretation

Groundwater levels at all monitoring locations remained relatively stable during the reporting period. Groundwater levels have been relatively stable at all other groundwater monitoring locations since November 2016.

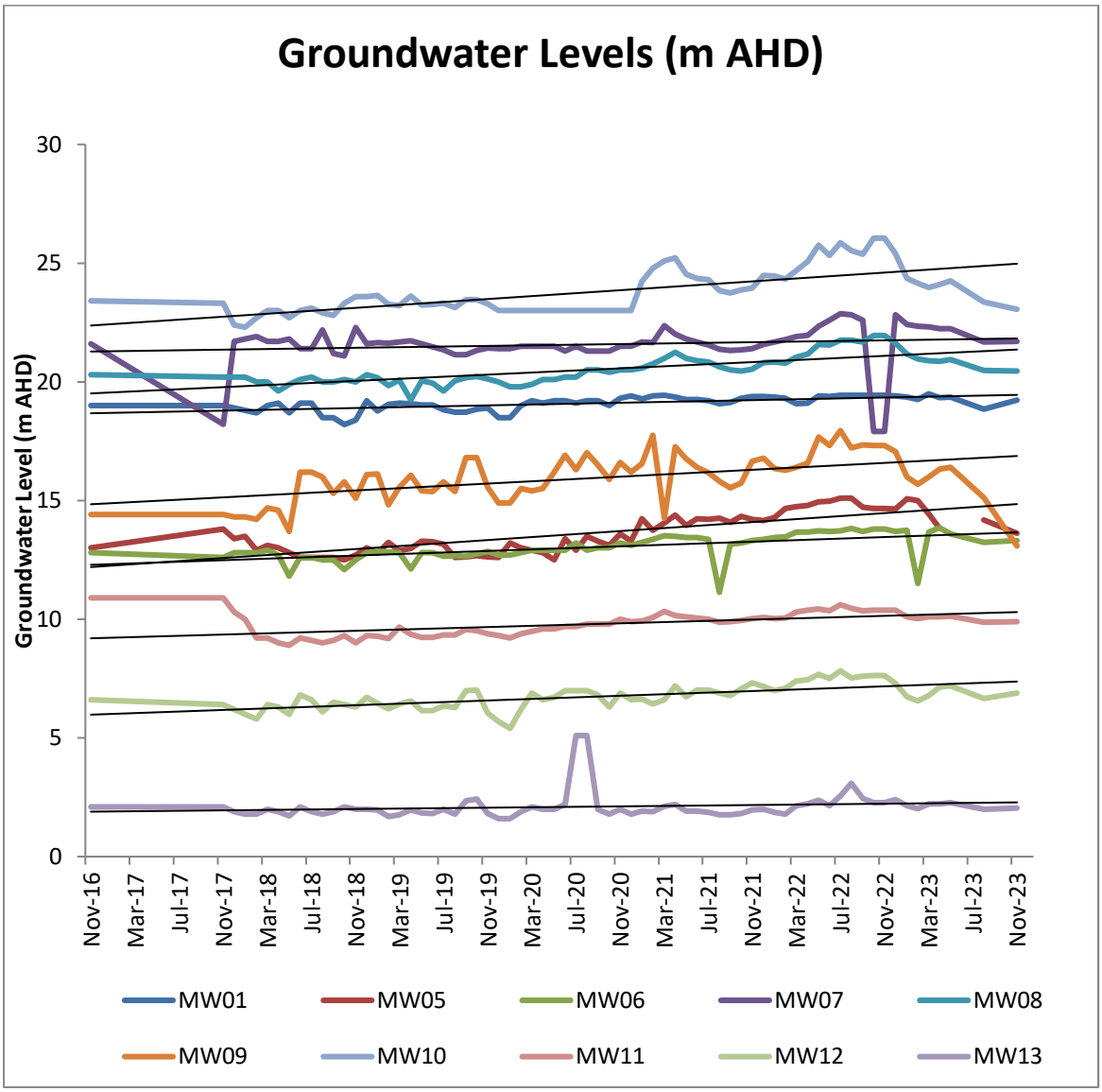


Figure 18. Groundwater Levels (m AHD) 2016 - 2023

7.4. Manganese Monitoring

The monitoring of filterable Manganese is undertaken as per special condition E1 of EPL366, in Wangi Bay on a quarterly schedule. There are no limit criteria applied to the Manganese monitoring. The monitoring results are submitted to the EPA quarterly.

Result Summary

Four samples are collected quarterly from Wangi Bay at the outlet of Wangi Creek. The average of the samples for each quarter is provided in Table 25.

Table 25. Manganese Monitoring Results

Manganese Monitoring					
Location	**Unit of Measure**	**Mar-23**	**Jun-23**	**Sep-23**	**Dec-23**
T2-5M(1)	mg/L	0.034	0.02	0.067	0
T2-5M(2)	mg/L	0.033	0.012	0.071	0
T2-10M(1)	mg/L	0.01	0	0	0
T2-10M(2)	mg/L	0	0	0	0

Trends

The Manganese monitoring has been conducted over a period of ten years from 2011. Manganese concentrations recorded in Wangi Bay over the ten-year period of monitoring display a relatively constant trend at T2 10m and a downward trend at T2 5m.

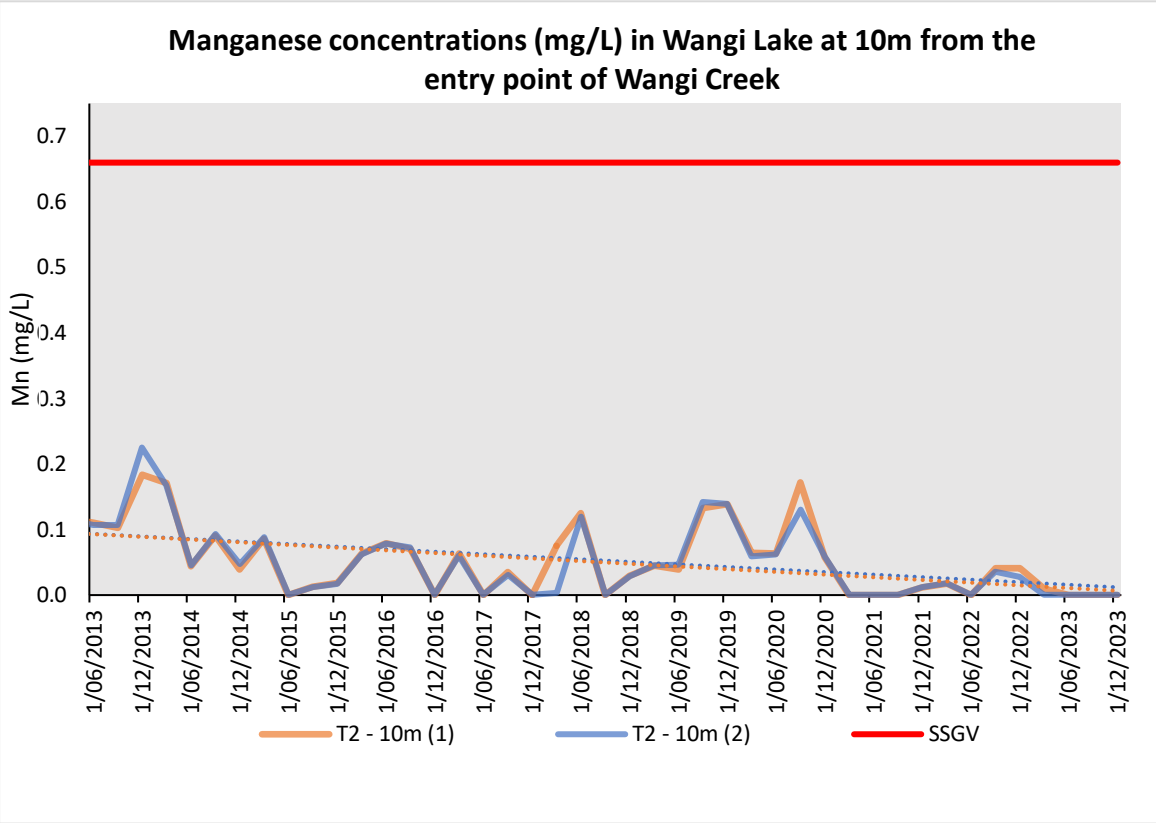


Figure 19. Manganese Monitoring Results and Linear Trend Line

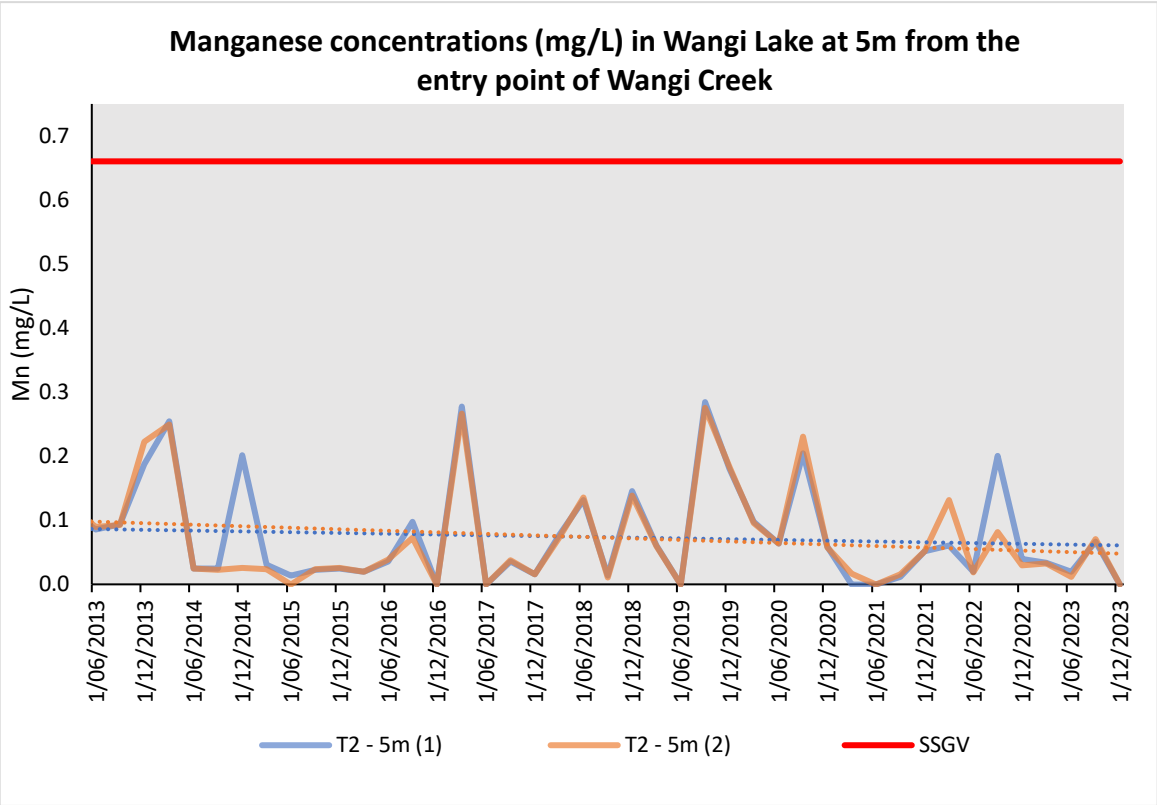


Figure 20. Manganese Monitoring Results and Linear Trend Line

8. REHABILITATION

As of the 2022 Myuna Annual Review, rehabilitation is presented in the Annual Rehabilitation Report which will be submitted to the NSW Resources Regulator (RR) and made available on the Centennial Myuna website. An overview of rehabilitation activities during the report are as below.

8.1. Rehabilitation Planning Activities

The Myuna Rehabilitation Strategy, Rehabilitation Objectives, and The Final Landform and Rehabilitation Plan were all approved in November 2023 by the Resources Regulator.

8.2. Subsidence Repair and Remediation

There were no subsidence repair and remediation activities undertaken at the site during the reporting period.

8.3. Exploration

No exploration was completed during 2023.

8.4. Rehabilitation Management and Maintenance Activities

Rehabilitation management and maintenance activities undertaken at the site during the reporting period including:

- Weed management activities were completed on site as a part of ongoing weed management, informed by EEC condition monitoring conducted on an annual basis; and
- Weekly environmental inspections.

9. COMMUNITY

9.1. Community Consultation and Engagement

The Myuna Colliery Community Consultative Committee (CCC) has been established to provide a formal conduit for exchange of information and views between the local community and Myuna's Management Team.

Regular agenda items for the meetings include:

- Progress at the Mine – Operational;
- Monitoring and Environmental Performance;
- Community Complaints and Responses;
- Update on Management Plans & External Audits; and
- Information provided to the community and any feedback.

There were two CCC meetings held in March and October, 2023. The Chairman and Committee were provided with six monthly updates the operation and performance electronically throughout the report period. Copies of the meeting minutes and presentations are available on the Centennial Myuna website.

9.2. Community Sponsorships

Centennial Myuna continues to support the local community through various sponsorship schemes. The following is the sponsorship and support carried out locally to community and sporting groups during the calendar year:

- Wangi Bowling Club
- Wangi Women's Bowling Club
- Toronto Bridge Club
- Wangi Wangi Lions Club
- Morisset Meals on Wheels
- Macquarie Scorpions
- Wangi Community Fireworks
- Rathmines Public School
- Westpac Rescue Helicopter
- Talk2MeBro

9.3. Complaints

A community complaints register is kept on site and published on the Centennial Myuna website. All community enquiries and complaints received by Myuna Colliery are recorded in accordance with the Centennial Myuna Community Complaint and Enquiries Procedure. This information is then entered into the Centennial Coal Environment and Community Database (ECD).

There were no complaints for the report period relating to Myuna general surface operations. Table 26 below shows a summary of complaints for the last 10 years.

Table 26. Complaints History

Year	Air	Water	Noise	Waste	Other	Total
2023	0	0	0	0	0	0
2022	0	0	0	0	1	1
2021	0	0	0	0	11	11
2020	0	0	0	0	193	193
2019	0	0	0	0	0	0
2018	0	0	0	0	0	0
2017	0	0	0	0	0	0
2016	0	0	0	0	0	0
2015	0	0	0	0	0	0
2014	0	0	0	0	0	0

10. AUDITING

10.1. Independent Environmental Audit

Centennial Myuna engaged IEMA Environmental Pty Ltd (IEMA) as the independent expert approved by the DPIE to carry out an Independent Environmental Audit (IEA) of Myuna Colliery in accordance with Condition 9, Schedule 5 of Project Approval 10_0080 MOD3.

The audit period was defined as from 7th May 2019 (last date of the previous IEA site inspection) to 20th June 2022 (date of site visit conducted by IEMA Environmental). The Independent Environmental Audit assessed compliance with the PA10_0080 MOD 1, EPL366, Mining Lease 1632, Mining Lease 1370 and Mining Purposes Lease 334. In addition, the audit included a review of the adequacy of the strategies, plans and programs required under the project approval. Table 26 below summarizes the results of the audit.

An Action Plan was developed and submitted to the Department of Planning, Industry and Environment which describes the corrective actions to be undertaken for each non-compliance and recommendation. The Action Plan has a scheduled completion date for each action. The Audit Report and Action Plan has been published on the Centennial Coal website.

Progress against the action plan is shown in Table 27. The next Independent Environmental Audit is scheduled for June 2025.

Table 27. Independent Environmental Audit Compliance

Compliance Status	PA 10_0080	PA 10_0080 SOC	EPL 366	ML 1632	ML 1370	MPL 334	Total
Compliant	41	8	48	6	5	3	**111**
Not triggered	13	4	12	7	6	5	**47**
Admin Non-Compliance	5	0	4	0	0	0	**9**
Low Non-Compliance	1	0	1	0	0	0	**2**
Medium Non-Compliance	0	0	0	0	0	0	**0**
High Non-Compliance	0	0	0	0	0	0	**0**
Not Verified	0	0	0	0	0	0	**0**
Observation	0	0	0	0	0	0	**0**
Note	3	0	11	1	1	3	**19**
Total	**63**	**12**	**76**	**14**	**12**	**11**	**188**

Table 28. Independent Environmental Audit Action Plan

Item No.	Title Condition No.	Aspect	Compliance/ Recommendations	Action Required	Proposed Completion	Progress
NC REC 1	PA 10_0080 S3 C13	Noise Management Plan	Update Noise Management Plan to ensure consistency with site operations/monitoring undertaken.	Myuna Colliery will revise the Northern Region Noise Management Plan– Appendix B.	31/03/2023	Complete
NC REC 2	EPL 366 M2.3	Water Monitoring	Liaise with the EPA regarding the frequency of monitoring at LDP 9. The daily discharge monitoring is overly onerous for a site that has met water quality criteria in Condition L2.4 for numerous years. These discussions may result in an EPL variation.	Myuna Colliery has submitted a licence variation with the EPA to change the frequency of monitoring at LDP 9.		Complete
NC REC 3	EPL 366 M2.4	Water Monitoring	Request condition M2.4 becomes a 'note' in the next EPL variation as relates to Condition M2.3.	See R2 MYU 2022 IEA as above.		Complete
NC REC 4	EPL 366 M5.1	Automated Weather Station	Any future data loss from the Automatic Weather Station should be reported in the Annual Review and EPL Annual Return, along with details of how the issue has been rectified.	Myuna Colliery will report future data loss from the AWS in the Annual Review and EPL Annual Return with details on how the issue has been rectified. A note will be included in the Monthly Website report concerning data continuity.		n/a
IMP Rec 1	PA 10_0080 schedule 3 condition 13	Noise	IEMA recommends that the external noise consultant undertakes real-time monitoring when doing attended monitoring rather than continuous real-time monitoring at the site	Myuna Colliery will investigate feasibility of external noise consultant undertaking real-time monitoring during attended monitoring.		Complete
IMP Rec 2	PA 10_0080 schedule 3 condition 22	Water management	Update the Water Management Plan to include the following:	Myuna Colliery will revise the Water Management plan with consideration of the changes noted in IMP REC 2.	31/03/2023	Complete

Item No.	Title Condition No.	Aspect	Compliance/ Recommendations	Action Required	Proposed Completion	Progress
			- Additional details explaining that the first flush tank can also discharge to Wangi Creek during overflow conditions. - Revised water schematic and updated figures throughout. - Additional column in Table 3-1 to list where water goes to. - Justification of why monitoring of groundwater alluvial bores is no longer required at the site. - Justification of why monitoring of coal seam aquifers not possible - Proposed monitoring changes (monthly to quarterly) based on a high level of compliance for many years. - Inclusion of groundwater trigger values based on the proposed changes to groundwater monitoring. - Review of TARPs and monitoring requirements in relation to alluvial monitoring and reflect current operations.			
IMP Rec 3	PA 10_0080 schedule 3 condition 24	Erosion and sediment control	Undertake minor repair to access tracks to clean water drain around site boundary (near conveyors) following high rainfall (note now complete).	Completed since audit.		Complete
IMP Rec 4	PA 10_0080 schedule 3 condition 24	Erosion and sediment control	Undertake minor reshaping of the waste storage area and laydown additional gravel to improve water flow in periods of heavy rainfall.	Myuna Colliery undertakes ongoing maintenance of the waste sorting area which includes the stabilization of ground with material and drainage improvement works.		Complete

Item No.	Title Condition No.	Aspect	Compliance/ Recommendations	Action Required	Proposed Completion	Progress
IMP Rec 5	PA 10_0080 schedule 3 condition 27	Water management	Inform NRAR of the breach of Wangi Creek Bed into Myuna Canal. Remediation to Wangi Creek is proposed to be undertaken in consultation with relevant departments and technical experts. Centennial Myuna should then prepare and implement a remediation plan for these works.	Myuna Colliery will prepare and implement a remediation plan for the Wangi Creek breach into the Myuna Canal. Remediation will be undertaken in consultation with relevant departments.	30/06/2023	Complete
IMP Rec 6	EPL 366 A2.1	Administrative	Update Plan in next EPL Variation to remove portion of ML 1632 transferred to Chain Valley from premises boundary.	Myuna Colliery will update Plan PC7301, 10/02/2021 to reflect recent changes to ML1632.	31/09/2023	Complete
IMP Rec 7	EPL 366 L5.6	Noise	Request removal of requirement to locate noise monitoring equipment within 1 metre of a dwelling façade when assessing LA1(1minute) noise limits as part of next EPL variation	Myuna Colliery will apply for an EPL variation as per the recommendation of IMP REC 7 and IMP REC 8.		Complete
IMP Rec 8	EPL 366 M4.1	Noise	Liaise with EPA to standardise condition M4.1 (noise monitoring frequency) with other Centennial Operations			Complete

11. INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

Table 29. Incident/Non-Compliance Summary 1

Nature of the incident/non-compliance	Failure to collect grab sample at LDP 9 during daily discharge
Date of incident/ non-compliance (if known; if not known state not known)	12 January 2023
The location of the incident/ non-compliance (include a figure if appropriate), if known	N/A
Detail the cause of the incident/non-compliance	LDP 9 was not discharging at time when sampler arrived on site. Underground transfer pump triggered on later in the afternoon
Detail action that has been, or will be, taken to mitigate any adverse effects of the incident/ non-compliance	No adverse environmental effects due to the incident.
Detail action that has been, or will be, taken to prevent recurrence of the incident/ non-compliance	The Myuna WMP has since been updated to reduce monitoring requirements to Monthly rather than daily. No further action to be taken.
Consultation with relevant agency (who, when and the response), or agencies if more than one	Notification letters sent to DPIE (January 2023)

Table 30. Incident / Non-Compliance Summary 2

Nature of the incident/non-compliance	Lost Depositional Dust Sample
Date of incident/ non-compliance (if known, if not known state not known)	27 September 2023
The location of the incident/ non-compliance (include a figure if appropriate), if known	DG1 as described in EPL366 and PA10_0080
Detail the cause of the incident/non-compliance	The glass container for the dust gauge was found broken in situ at the time of recovery. The root cause of the damage is unknown.
Detail action that has been, or will be, taken to mitigate any adverse effects of the incident/ non-compliance	The depositional dust gauge sample at DG1 for the period 5 September 2024 to 5 October 2024 was unable to be analysed as the glass container for the dust gauge was found on the ground.
Detail action that has been, or will be, taken to prevent recurrence of the incident/ non-compliance	Fence lines are routinely inspected with ongoing repairs required due to public intervention.

Consultation with relevant agency (who, when and the response), or agencies if more than one	Reported in the monthly website report (November 2023), The Annual Return (February 2024) reported to DPIE by letter (September 2023).

Table 31. Incident / Non-Compliance Summary 3

Nature of the incident/non-compliance	Failure to monitor discharge volume at LDP 9
Date of incident/ non-compliance (if known, if not known state not known)	26 – 28th January 2023
The location of the incident/ non-compliance (include a figure if appropriate), if known	LDP 9 as described in EPL366
Detail the cause of the incident/non-compliance	The flow monitoring controller card of the Mace real-time monitoring system failed.
Detail action that has been, or will be, taken to mitigate any adverse effects of the incident/ non-compliance	The flow monitoring controller card was replaced on Monday the 28th of January 2023.
Detail action that has been, or will be, taken to prevent recurrence of the incident/ non-compliance	Instrument downtime due to temporary breakdowns is expected as per the EPA Guidelines for Publishing Monitoring Data. The monitoring equipment is cleaned, maintained, and calibrated routinely.
Consultation with relevant agency (who, when and the response), or agencies if more than one	Reported in the Website Report (January 2023) and the Annual Return (February 2024).

Table 32. Incident / Non-Compliance Summary 4

Nature of the incident/non-compliance	Contravention of mining title. Failure to submit Rehabilitation Cost Estimate and Annual Rehabilitation Report and Forward Program by due date (31/03/2023)
Date of incident/ non-compliance (if known, if not known state not known)	22/12/2023
The location of the incident/ non-compliance (include a figure if appropriate), if known	n/a
Detail the cause of the incident/non-compliance	Misunderstanding of the new compliance requirements of the Mining Amendment (Standard Conditions of Mining Leases—Rehabilitation) Regulation 2021
Detail action that has been, or will be, taken to mitigate any adverse effects of the incident/ non-compliance	Administrative non-compliance only. Official Caution Letter sent. All required

	documentation has been submitted as per compliance requirements.
Detail action that has been, or will be, taken to prevent recurrence of the incident/ non-compliance	N/A
Consultation with relevant agency (who, when and the response), or agencies if more than one	Yes, ongoing consultation between Centennial and the RR occurred between 24/03/23 and 22/12/2023.

Table 33. Summary of Reportable Incidents and Regulatory Actions

Compliance Type	Agency	Number	Response
Incidents	EPA, DPIE	3	To be reported in the annual review, no further action required.
	EPA, DPIE		To be reported in the annual review, no further action required.
	EPA, DPIE		n/a
Warning Letters		0	
Caution	RR	1	No further actions required.
Penalty Notices		0	
Prosecutions		0	

Note: This table includes actions taken by DPE/DPIE, DRG, Resources Regulator and the EPA during the reporting period.

12. ACTIVITES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Planned activities for the next reporting year:

- Ongoing implementation of strategies contained in Myuna's approved Management Plans to manage the risks associated with the operation.
- Review and revision of Management Plans as per approval (PA 10_0080) conditions.
- Independent Environmental Audit Action Plan

APPENDIX 1 - Myuna Colliery Annual Noise Monitoring Report

Annual Noise Compliance Report 2023 Noise Monitoring

Myuna Colliery

Centennial Myuna Pty Ltd

PO Box 1000
Toronto NSW 2283

Prepared by:

SLR Consulting Australia

10 Kings Road, New Lambton NSW 2305, Australia

SLR Project No.: 630.11620.00000

Client Reference No.: R33

16 February 2024

Revision: v1.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
v1.0	16 February 2024	Patrick Marshall	Martin Davenport	Martin Davenport

Basis of Report

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

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

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

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Appendix A Acoustic Terminology

1.0 Introduction

1.1 Background

Centennial Myuna Pty Limited (Myuna) has commissioned SLR Consulting Australia Pty Ltd (SLR) to produce an annual compliance noise monitoring report for the Myuna Colliery located in Wangi Wangi, New South Wales (NSW).

1.2 Objectives of this Report

The purpose of this report is to provide a summary of Quarterly compliance noise monitoring of Myuna operations during 2023.

Quarterly noise monitoring throughout 2023 has been conducted in accordance with the requirements of Schedule 3 Conditions 11, 12, 13 and 14 of the Myuna Project Approval (PA) PA10_0080, dated 25 November 2022 (PA 10_0080 MOD3) and Section 3 of the Statement of Conditions contained within the Myuna Colliery Environment Protection Licence (EPL) 366 version dated 13 December 2023 (EPL 366) and the Northern Region – Noise Management Plan dated July 2021 (NRNMP). It is noted that on 20 January 2023 the NSW EPA approved an update to EPL 366 to adopt the long-term monitoring program for Myuna Colliery. Noise monitoring for Quarter 1 was performed using the short-term monitoring program as detailed in the NMP.

The objectives of the noise monitoring programme for 2023 were as follows:

- During Quarter 1 conduct operator attended noise surveys at eight locations (R1, R2, R3, R4, R5, R6, R7 and R8) surrounding the colliery during day, evening and night-time periods.
- During Quarter 2, Quarter 3 and Quarter 4Conduct operator attended noise surveys at four locations (R1, R3, R5 and R7) surrounding the colliery during the night-time period.
- Quantify all discernible sources of noise within each of the attended noise surveys, including measured and/or estimated contribution and maximum level of individual noise sources.
- Assess the noise emissions of Myuna Colliery and determine compliance with respect to the limits contained in the NMP, PA and EPL366.

1.3 Acoustic Terminology

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2.0 Noise Criteria

2.1 Project Approval, EPL and NRNMP

Noise monitoring at Myuna Colliery was conducted in accordance with EPL 366, PA10_0080 MOD1 requirements and the NRNMP.

The site specific EPL and PA noise limits are summarised in Appendix B of the NRNMP and are reproduced in **Table 1**.

Table 1 Project Approval and EPL Noise Criteria (Quarter 1)

Location	Day	Emergency Day	Evening	Night	
	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{A1(15min)}$
R1, R2 and R3 Summerhill Drive and Wangi Close, Wangi Wangi	35	40	35	35	45
R4, Donelly road, Arcadia Vale	35	44	40	38	49
R5, R6, R7 and R8 Donelly road, Arcadia Vale	37	44	42	39	49
All other privately-owned land	35	40	35	35	45

Notes:

- *To identify locations see **Figure 1**.*
- *Emergency Day noise limits only apply during the Day period when the Eraring Power Station overland conveyor is not in operation and Myuna's Emergency Coal Stockpile must be used.*
- *Noise generated by the project is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the INP.*

In addition, Quaterly monitoring was conducted in accordance with the following requirements which are set out in condition M4.1 in the previous version of EPL 366:

> *In order to determine compliance with condition L5.1, attended noise monitoring must be undertaken in accordance with conditions L5.5 and L5.6, and*
>
> - *At least two (2) months between monitoring periods.*
> - *Undertaken during each day, evening and night period for a mimimum of 15 minutes at each monitoring location (for three of the Quaters).*
> - *Night-time noise monitoring is conducted between the hours of 1:00 am and 4:00 am (for three of the Quaters).*
> - *One Quaterly monitoring must occur during each day, evening and night period for a minimum of 1.5 hours during the day; 30 minutes during the evening and 1 hour during the night at each monitoring location.*
> - *Each Quaterly monitoring must be undertaken on a different day of the week not including Saturdays, Sundays and Public Holidays.*

In the second quarter of 2023, the long-term noise monitoring program from the NRNMP was adopted. The criteria at the relevant receiver locations are reproduced in **Table 2**.

Table 2 Project Approval and EPL Noise Criteria

Location	Night	
	$L_{Aeq(15min)}$	$L_{A1(1min)}$
R1	35	45
R3	35	45
R5	39	45

Location	Night	
	LAeq(15min)	LA1(1min)
R7	39	45

In addition, quarterly monitoring is conducted as per the following requirements set out in condition M4.1 of EPL 366:

- *Occur at each of the 4 monitoring locations listed in condition L5.1.*
- *Occur Quaterly within the reporting period of the Environment Protection Licence.*
- *Occur during each night period as defined in the NSW Industrial Noise Policy (EPA2000) for a minimum of 15 minutes.*

3.0 Operational Noise Monitoring Methodology

3.1 General Requirements

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672.1 – 2019 Electroacoustics—Sound level meters, AS IEC 60942 2017 Electroacoustics – Sound calibrators and carried current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA.

3.2 Methodology – Operator Attended Noise Measurements

Noise monitoring was conducted in accordance with the NRNMP.

Operator attended noise measurements were conducted for a minimum of 15 minutes per period at each of the nominated noise monitoring locations representing the most affected receiver locations, listed in **Table 3** and shown in **Figure 1**.

Table 3 Noise Monitoring Locations

Monitoring Location	Receiver Type	Address	Monitoring Location - MGA Zone 56	
			Easting (m)	Northing (m)
R1	Residence	2 Turrama Street, Wangi Wangi	366858	6340370
R2 [1]	Residence	2 Moani Street, Wangi Wangi	366652	6340175
R3	Residence	3 Sunset Close, Wangi Wangi	365707	6340844
R4 [1]	Residence	119 Donnelly Road, Arcadia Vale	366662	6341662
R5	Residence	93 Donnelly Road, Arcadia Vale	366856	6341338
R6 [1]	Residence	83 Donnelly Road, Arcadia Vale	367049	6341185
R7	Residence	63 Donnelly Road, Arcadia Vale	367075	6340970
R8 [1]	Residence	53 Donnelly Road, Arcadia Vale	367100	6340807

Note 1: Only monitored during Quater 1 of 2023

The objective of the operator attended noise monitoring was to measure the maximum (L_{Amax}) and the $L_{Aeq(15minute)}$ noise level contribution from the Myuna Colliery at the nearest potentially affected receptors to determine the noise contribution of operational activities associated with

Myuna Colliery over a 15 minute measurement period. In addition, the operator quantifies and characterises the overall levels of ambient noise in the area (i.e. L_{Amax}, L_{A1}, L_{A10}, L_{A90}, and L_{Aeq}) over the 15 minute measurement interval.

Operator attended noise measurements were conducted using a one-third octave integrating Brüel & Kjær Type 2250L sound level meter (serial number 3003389).

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Myuna Colliery
Attended Noise Monitoring Locations

FIGURE 1

Table 4 presents a summary of which days of the week the Quaterly monitoring was conducted in accordance with the NRNMP.

Table 4 Days of the Week Quarterly Monitoring was Conducted, Year 2023

Period	Days of the Week (Excluding Weekends and Public Holidays)				
	Monday	Tuesday	Wednesday	Thursday	Friday
Day	Q2		Q1, Q4	Q3	
Evening	Q2		Q1, Q4	Q3	
Night	Q2		Q1, Q4	Q3	

Notes: Taken to mean the night time period from 10:00 pm on the stated day to 7:00 am of the following day.

3.3 Myuna Colliery Operations

Measurements for the night-time period were conducted during typical operational conditions for the Myuna Colliery. Operational activities on site included the following:

- Coal preparation plant.
- General surface operations i.e. deliveries, vehicle movements etc.
- Ventilation fan, compressors and staff and materials drift haulage

4.0 Operator-Attended Noise Monitoring Results

Results of the SLR operator attended noise surveys conducted at all locations throughout 2023 are provided in **Table 5** to **Table 12**.

Ambient noise levels presented include all noise sources such as transport (roads, boats, and aircraft), fauna (insects, frogs, birds, and bats), the natural environment (wind in trees), domestic noises, other industrial operations as well as Myuna Colliery noise emissions.

Meteorological data during the monitoring period was obtained from the onsite Myuna Colliery weather station.

The tables also provide the following information:

- Date and start time.
- Monitoring location.
- Wind velocity (m/s) and temperature (°C) at the measurement location.
- Typical maximum (L_{Amax}) and contributed $L_{Aeq(15minute)}$ noise levels.

Monitoring Location R1 - 2 Turrama Street, Wangi Wangi

The operator attended noise survey results at R3 are provided in **Table 5**. The day and evening periods were only monitored during quarter 1 of 2023 at this location.

Table 5 Operator Attended Noise Survey Results – R1

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Day	15/03/2023 11:48 26°C 1.3 m/s E	69	62	55	36	51
Evening	15/03/2023 18:46 23°C 1.1 m/s NNW	81	74	56	35	59
Night	16/03/2023 03:28 19°C 0.6 m/s N	44	37	37	35	36
	22/05/2023 22:24 9°C 0.3 m/s NNE	62	51	41	36	40
	07/09/2023 22:57 21°C 1.2 m/s NW	60	52	44	38	42
	06/12/2023 22:25 21°C 1.7 m/s ESE	65	55	44	41	44

Noise from Myuna Colliery was inaudible at this location in quarters 2, 3, and 4. Myuna Colliery was audible during the day and night-time period in quarter 1 during lulls in road traffic and other extraneous noise.

Ambient noise levels at this location are typically dominated by road traffic, general urban hum, and bird noise.

Monitoring Location R2 - 2 Moani Street, Wangi Wangi

The operator attended noise survey results at R2 are provided in **Table 6**. R2 was only monitored in quarter 1 of 2023.

Table 6 Operator Attended Noise Survey Results – R2

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Day	15/03/2023 13:53 26°C 2.6 m/s ENE	73	63	59	40	55
Evening	15/03/2023 18:27 24°C 0.5 m/s ENE	77	67	61	40	57
Night	16/03/2023 03:49 19°C 0.6 m/s NNW	74	66	52	39	52

Myuna Colliery surface operations were inaudible during the day and evening. Myuna Colliery surface operations were audible during the night-time operator attended noise survey at this location.

The ambient noise environment at the monitoring location during the daytime and evening was dominated by road traffic noise, birdsong, and dog barking. During the night-time period, the ambient noise environment was dominated by road traffic noise, insect and animal noise as well as noise from Myuna Colliery operations.

Monitoring Location R3 - 3 Sunset Close, Wangi Wangi

The operator attended noise survey results at R3 are provided in **Table 7**. The day and evening periods were only monitored during quarter 1 of 2023 at this location.

Table 7 Operator Attended Noise Survey Results – R3

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Day	15/03/2023 14:14 27°C 2.1 m/s E	79	74	68	46	63
Evening	15/03/2023 18:06 25°C 1 m/s NNE	67	62	57	40	53
Night	16/03/2023 04:09 18°C 0.5 m/s WNW	67	60	45	39	48
	23/05/2023 22:01 9°C 0.3 m/s NNW	67	64	47	40	50
	07/09/2023 11:28 23°C 0.6 m/s WNW	53	45	43	39	41
	03/12/2023 22:03 21°C 0.7 m/s ESE	63	57	49	34	45

Myuna Colliery surface operations were audible during the night-time operator attended noise surveys for quarters 1, 2, and 4 at this location.

The ambient noise environment was typically dominated by road traffic, insects, urban hum, and noise from Myuna Colliery operations.

Monitoring Location R4 - 119 Donnelly Road, Acadia Vale

The operator attended noise survey results at R4 are provided in **Table 8**. R4 was only monitored in quarter 1 of 2023.

Table 8 Operator Attended Noise Survey Results – R4

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Day	15/03/2023 12:51 26°C 1.1 m/s ENE	87	75	69	35	64
Evening	15/03/2023 19:46 22°C 0.4 m/s E	81	75	67	52	63
Night	16/03/2023 01:15 19°C 0.6 m/s NW	81	70	47	34	58

Myuna Colliery surface operations were inaudible during the day, briefly audible during the evening and audible during night-time operator attended noise surveys at this location.

The ambient noise environment at the monitoring location during the day and evening was dominated by road traffic noise, Insect noise and birdsong. During the night-time period, ambient noise levels were dominated by road traffic, insect noise and noise from Myuna Colliery surface operations.

Monitoring Location R5 - 93 Donnelly Road, Arcadia Vale

The operator attended noise survey results at R5 are provided in **Table 9**. The day and evening periods were only monitored during quarter 1 of 2023 at this location.

Table 9 Operator Attended Noise Survey Results – R5

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Day	15/03/2023 12:32 25°C 2.4 m/s ESE	82	77	68	38	65
Evening	15/03/2023 19:26 22°C 0.6 m/s NNE	78	73	68	48	64
Night	16/03/2023 01:36 19°C 1.1 m/s N	75	55	36	33	47
	07/09/2023 22:14 21°C 1.3 m/s NE	78	72	49	33	57
	22/05/2023 23:04 PM 8 °C 0.3 m/s NNW	74	64	47	30	51

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
	06/12/2023 23:08 21 C 1 m/s SSE	70	64	53	32	51

Myuna Colliery surface operations were inaudible during the day and evening periods monitored throughout quarter 1. Myuna Colliery surface operations were audible during the night-time operator attended noise surveys for quarters 1, 2, and 4 at this location.

The ambient noise environment at the monitoring location during the day and evening was dominated by road traffic noise, insect noise and birdsong. During the night-time period, the ambient noise level was dominated by road traffic noise, residential noise, animal noise, urban hum, and noise from Myuna Colliery surface operations.

Monitoring Location R6 - 83 Donnelly Road, Arcadia Vale

The operator attended noise survey results at R6 are provided in **Table 10**. R6 was only monitored during quarter 1 of 2023.

Table 10 Operator Attended Noise Survey Results – R6

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Day	15/03/2023 13:10 26°C 2.6 m/s SE	76	66	60	35	56
Evening	15/03/2023 20:05 22 °C 0.3 m/s N	77	70	60	38	56
Night	16/03/2023 01:55 19 °C 0.5 m/s N	75	54	43	39	48

Myuna Colliery surface operations were barely audible during the day and audible during the evening and night-time periods of the operator attended noise surveys at this location.

The ambient noise environment at the monitoring location during the daytime and evening periods were dominated by road traffic noise, insect noise, residential noise and birdsong. The ambient noise environment during the night-time period was dominated by road traffic noise, dogs barking, insect and residential noise and Myuna Colliery surface operations.

Monitoring Location R7 - 63 Donnelly Road, Arcadia Vale

The operator attended noise survey results at R7 are provided in **Table 11**. The day and evening periods were only monitored during quarter 1 of 2023 at this location.

Table 11 Operator Attended Noise Survey Results – R7

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Day	15/03/2023 13:30 26°C 1.7 m/s NNE	74	67	62	36	57
Evening	15/03/2023 20:24 21°C 0.3 m/s NNE	66	63	52	40	50
Night	16/03/2023 02:14 18°C 1 m/s WNW	57	48	38	36	39
	22/05/2023 22:44 9 °C 0.4 m/s NNW	69	58	41	37	46
	07/09/2023 22:34 21°C 0.4 m/s ENE	82	71	51	35	57
	06/12/2023 22:47 21°C 0.8 m/s SSE	67	60	45	38	47

Myuna Colliery surface operations were inaudible during the day and audible in the evening during quarter 1.

During the night-time period Myuna Colliery surface operations were audible in all quarters at this location.

The ambient noise environment at the monitoring location during the day was dominated by road traffic noise, insect noise and residential noise. The evening and night-time periods were dominated by road traffic noise, insects and noise from Myuna Colliery surface operations.

Monitoring Location R8 - 53 Donnelly Road, Arcadia Vale

The operator attended noise survey results at R8 are provided in **Table 12**. R8 was only monitored during quarter 1 of 2023.

Table 12 Operator Attended Noise Survey Results – R8

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Day	15/03/2023 12:11 26°C 2.2 m/s ESE	84	74	68	37	63
Evening	15/03/2023 19:07 23°C 0.9 m/s SE	84	74	61	37	62

Period	Date / Start Time / Weather	Primary Noise Descriptor (dBA re 20 μPa)				
		LAmax	LA1	LA10	LA90	LAeq
Night	16/03/2023 02:36 19°C 0.7 m/s WNW	78	53	46	36	52

Myuna Colliery surface operations were inaudible during the day and evening and audible during the night-time operator attended noise surveys at this location.

The ambient noise environment at the monitoring location during the day and evening was dominated by road traffic noise, animal noise and residential noise. During the night-time period, the ambient noise level was dominated by road traffic noise, animal noise and noise from Myuna Colliery surface operations.

5.0 Performance Assessment

In accordance with the NRNMP and PA, the Myuna Colliery contribution can be estimated or calculated by the operator by noting measurable noise events and their source throughout each 15-minute noise monitoring period.

5.1 Quarter 1 2023

Results of the operator attended noise measurements compared with the relevant noise criteria contained in the NRNMP for quarter 1 are given in **Table 13** and **Table 14**.

Table 13 Q1 – Operations Performance Assessment – $L_{Aeq(15minute)}$

Location	Estimated Myuna Contribution dBA $L_{Aeq(15minute)}$			Noise Criteria dBA $L_{Aeq(15minute)}$			Compliance		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
R1	<30	I/A [1]	34	35	35	35	Yes	Yes	Yes
R2	I/A1	I/A [1]	34	35	35	35	Yes	Yes	Yes
R3	I/A1	I/A [1]	32	35	35	35	Yes	Yes	Yes
R4	I/A1	<25	31	35	40	38	Yes	Yes	Yes
R5	I/A1	I/A [1]	37	37	42	39	Yes	Yes	Yes
R6	<25	31	37	37	42	39	Yes	Yes	Yes
R7	I/A1	30	35	37	42	39	Yes	Yes	Yes
R8	I/A1	I/A [1]	34	37	42	39	Yes	Yes	Yes

Notes: I/A = Inaudible

Table 14 Q1 – Sleep Disturbance Performance Assessment – $L_{A1(1minute)}$

Location	Myuna Colliery dBA $L_{A1(1minute)}$	Noise Criteria dBA $L_{A1(1minute)}$	Compliance
R1	35	45	Yes
R2	I/A [1]	45	Yes

Location	Myuna Colliery dBA $L_{A1(1minute)}$	Noise Criteria dBA $L_{A1(1minute)}$	Compliance
R3	I/A [1]	45	Yes
R4	39	49	Yes
R5	36	49	Yes
R6	39	49	Yes
R7	40	49	Yes
R8	38	49	Yes

Notes: I/A = Inaudible

Results of the quarter 1 assessment show that no non-compliances were recorded throughout the noise monitoring period.

5.2 Quarter 2 2023

The results of the operational noise measurements compared with the relevant noise criteria contained in the PA and EPL for quarter 2 are given in **Table 15** and **Table 16**.

Table 15 Q2 – Operations Performance Assessment – $L_{Aeq(15minute)}$

Location	Estimated Myuna Contribution dBA $L_{Aeq(15minute)}$	Noise Criteria dBA $L_{Aeq(15minute)}$	Compliance
	Night	Night	Night
R1	33	35	Yes
R3	35	35	Yes
R5	30	39	Yes
R7	36	39	Yes

Table 16 Q2 – Sleep Disturbance Performance Assessment – $L_{A1(1minute)}$

Location	Estimated Myuna Contribution dBA $L_{Aeq(1minute)}$	Noise Criteria dBA $L_{Aeq(1minute)}$	Compliance
R1	35	45	Yes
R3	39	45	Yes
R5	31	45	Yes
R7	39	45	Yes

Results of the quarter 2 assessment show that no non-compliances were recorded throughout the noise monitoring period.

5.3 Quarter 3 2023

The results of the operational noise measurements compared with the relevant noise criteria contained in the PA and EPL for quarter 3 are given in **Table 17** and **Table 18**.

Table 17 Q3 – Operations Performance Assessment – $L_{Aeq(15minute)}$

Location	Estimated Myuna Contribution dBA $L_{Aeq(15minute)}$	Noise Criteria dBA $L_{Aeq(15minute)}$	Compliance
	Night	Night	Night
R1	35	35	Yes
R3	I/A [1]	35	Yes
R5	I/A [1]	39	Yes
R7	34	39	Yes

Notes: I/A = Inaudible

Table 18 Q3 – Sleep Disturbance Performance Assessment – $L_{A1(1minute)}$

Location	Estimated Myuna Contribution dBA $L_{Aeq(1minute)}$	Noise Criteria dBA $L_{Aeq(1minute)}$	Compliance
R1	38	45	Y
R3	I/A [1]	45	Y
R5	I/A [1]	45	Y
R7	35	45	Y

Notes: I/A = Inaudible

Results of the quarter 3 assessment show that no non-compliances were recorded throughout the noise monitoring period.

5.4 Quarter 4 2023

The results of the operational noise measurements compared with the relevant noise criteria contained in the PA and EPL for quarter 4 are given in **Table 19** and **Table 20**.

Table 19 Q4 – Operations Performance Assessment – $L_{Aeq(15minute)}$

Location	Estimated Myuna Contribution dBA $L_{Aeq(15minute)}$	Noise Criteria dBA $L_{Aeq(15minute)}$	Compliance
	Night	Night	Night
R1	I/A [1]	35	Yes
R3	30	35	Yes
R5	30	39	Yes
R7	34	39	Yes

Notes: I/A = Inaudible

Table 20 Q4 – Sleep Disturbance Performance Assessment – $L_{A1(1minute)}$

Location	Estimated Myuna Contribution dBA $L_{Aeq(1minute)}$	Noise Criteria dBA $L_{Aeq(1minute)}$	Compliance
R1	I/A [1]	45	Yes
R3	31	45	Yes
R5	31	45	Yes
R7	37	45	Yes

Notes: I/A = Inaudible

Results of the quarter 4 assessment show that no non-compliances were recorded throughout the noise monitoring period.

6.0 Conclusion

Quarterly noise monitoring for the Myuna Colliery has been completed throughout 2023 in accordance with the NRNMP short-term and long-term noise monitoring programs.

Operator attended noise monitoring was conducted quarterly in order to determine the noise contributions of Myuna Colliery with the relevant criteria. No non-compliances were recorded throughout any of the noise monitoring periods. Myuna Colliery was therefore found to have achieved compliance with the relevant noise criteria during all monitoring periods throughout 2023.

Sincerely,

SLR Consulting Australia

Patrick Marshall
Project Consultant – Noise and Vibration

Martin Davenport
Principal Consultant – Noise and Vibration

Appendix A Acoustic Terminology

Annual Noise Compliance Report 2023 Noise Monitoring

Myuna Colliery

Centennial Myuna Pty Ltd

SLR Project No.: 630.11620.00000

16 February 2024

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

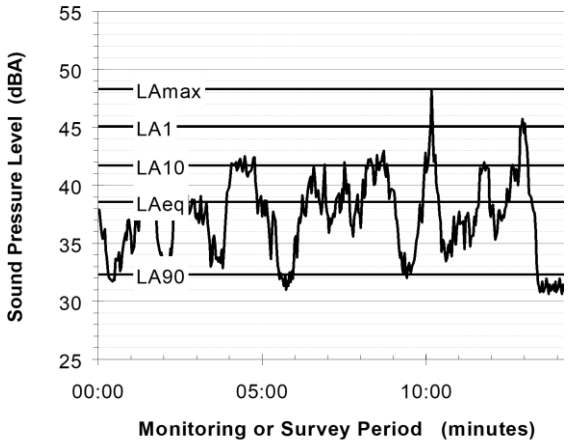
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

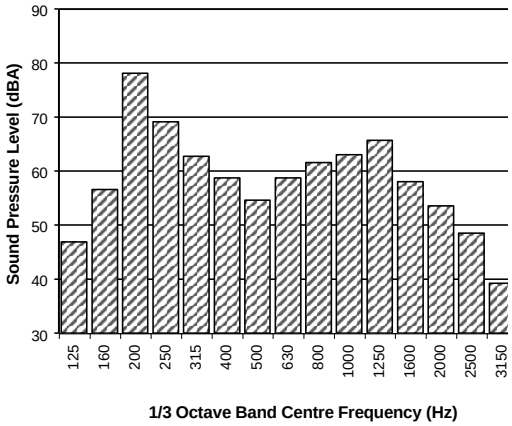
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to

measurements (ie vertical, longitudinal and transverse).

- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

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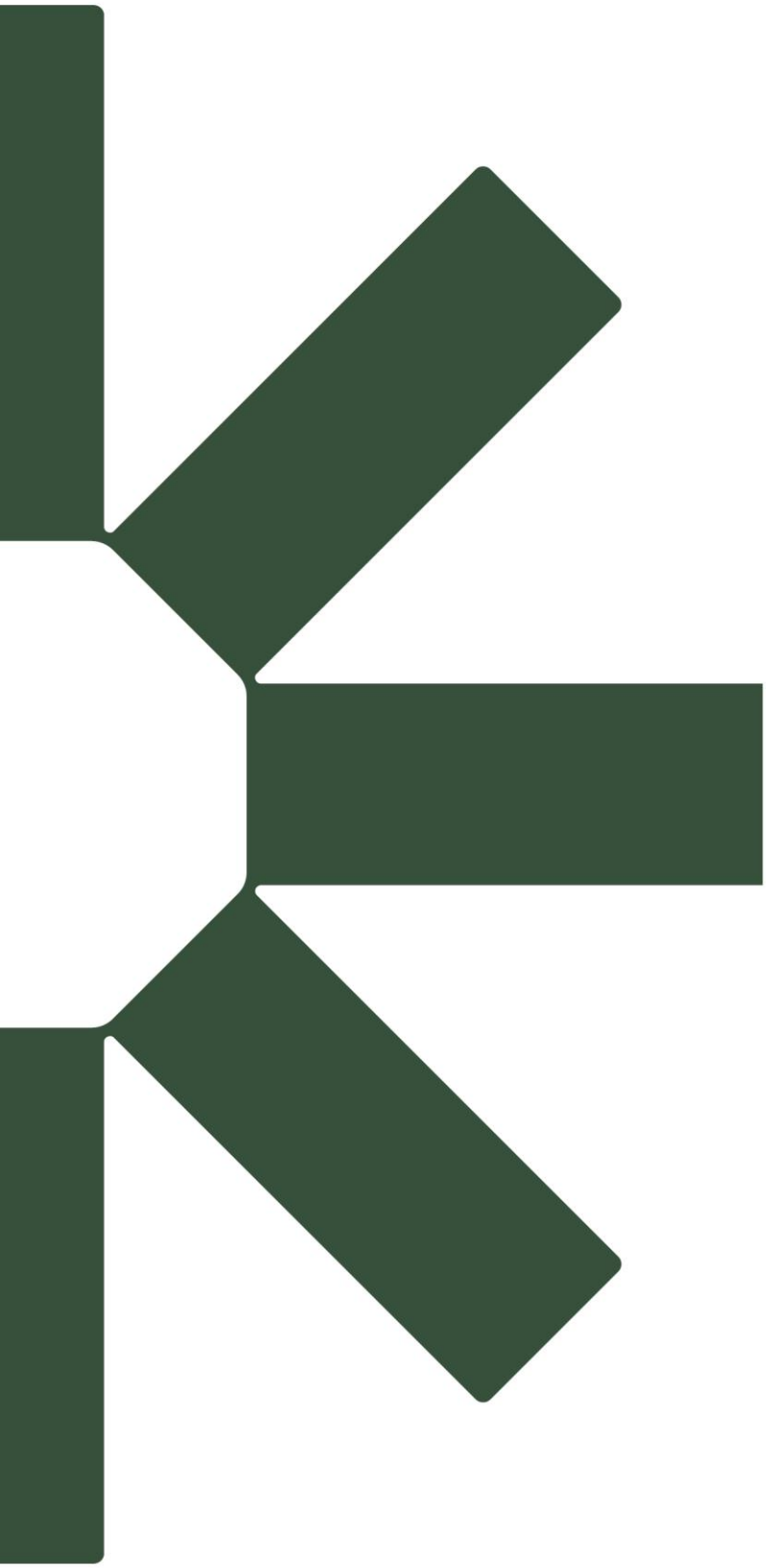

Making Sustainability Happen

APPENDIX 2 - 2022 Ecological Monitoring Report – Swamp Sclerophyll Forest on Coastal Floodplains EEC

ENDANGERED ECOLOGICAL COMMUNITY MONITORING: MYUNA COLLIERY

2023 Annual Monitoring

9338
1
23 January 2024

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
0	Internal Review	Alex McNamara	Jess Graham	Chris Wellington	22/01/2023
1	Client Review	Alex McNamara			
2	Client Review	Jess Graham			

Approval for issue

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Prepared by:

RPS

Alex McNamara
Graduate Ecologist

Unit 2A, 45 Fitzroy Street
Carrington NSW 2294

T +61 2 4940 4200
E alex.mcnamara@rpsgroup.com.au

Prepared for:

Centennial Coal Company Limited

Kieran Fiatarone
Environment and Community Officer

100 Miller Road,
Fassifern NSW 2283

T +61 (0) 2 9266 2783
E Kieran.J.Fiatarone@centennialcoal.com.au

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Appendices

Appendix A Species List

1 INTRODUCTION

Centennial Coal Myuna (Centennial) engaged RPS Australia East Pty Ltd (RPS) to undertake the annual monitoring of an Endangered Ecological Community (EEC) at Myuna Colliery as per the requirements specified in the Northern Operations Regional Biodiversity Management Plan (BMP; Centennial Coal 2022) and Myuna Colliery site specific BMP. The monitoring area is shown in **Figure 1**.

1.1 Background

The consent conditions issued for the approved Myuna Coal – Modification 1 (MP_10-0080 MOD3) requires the annual monitoring of Riparian Melaleuca Swamp Woodland (MU 42); vegetation forming part of the *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin* and *South East Corner Bioregions* EEC listed under the *Biodiversity Conservation Act* 2016 (BC Act). Monitoring specifications are described in the Northern Operations Regional and Myuna Colliery BMPs.

Baseline monitoring was undertaken by Hunter Land Management in 2015. Since then, ongoing monitoring has been carried out by RPS (2016, 2017, 2020, 2021 and 2022) and Umwelt (2018 and 2019). Initial monitoring methodology was carried out under the BioBanking Assessment Methodology (BBAM), which was made redundant in 2018 and replaced by the Biodiversity Assessment Methodology (BAM). All monitoring data collected after 2018 has occurred in accordance with plot methods specified in the BAM.

1.2 Objective

The annual EEC monitoring program has the purposes of addressing Conditions 28 (c) and (d) of the approved MP_10-0080 MOD3, which are reproduced below for convenience:

28(c) have a particular focus on measures that would be implemented over the life of the mine to protect and enhance the Swamp Sclerophyll Forest on Coastal Floodplains endangered ecological community near Wangi Creek; and

28(d) include a detailed description of the measures that would be implemented over the life of the mine to ensure that native vegetation and habitat within the surface facilities sites (particularly the Swamp Sclerophyll Forest on Coastal Floodplains endangered ecological community near Wangi Creek) are properly managed, including procedures for:

- *weed management (both control and suppression);*
- *protection and enhancement of native vegetation and habitat;*
- *feral animal control;*
- *fire management (including asset protection zones); and*
- *management of public access.*

The purpose of the monitoring is to determine if there is any measurable change in the health or condition of *Swamp Sclerophyll Forest on Coast Floodplains* EEC and *Callistemon linearifolious (*Netted bottlebrush), a species listed as vulnerable under the BC Act. Where change is detected, and is deemed to be a negative change, this monitoring report will inform Centennial of the possible reasons for change and provide recommendation for the management of these changes.

Figure 1 Location map

2 METHODOLOGY

2.1 Overview

Monitoring works performed for the 2023 reporting period were undertaken on 23 November 2023 by Miss Jess Graham (Ecologist) and Mr Alex McNamara (Graduate Ecologist). Monitoring was performed in two vegetation management areas (VMAs) reflective of observed health classes (RPS 2016), which are listed below:

- VMA 1: MU42 in moderate/good-high condition; and
- VMA 2: MU42 in moderate/good-medium condition.

Details of these monitoring sites along with description of methodology are outlined in the following section.

2.2 Monitoring sites

Sites have been monitored annually since 2015. In 2019, monitoring sites were permanently marked with a star picket at the start and end point of each transect as a recommendation of Umwelt (2018). As mentioned in the 2019 Ecological Monitoring Report (EMP), some alterations were made to ensure all transects were kept within the Vegetation Management Area (VMA). Alterations included slightly adjusting the bearing of the plots in a way that allows transects to remain within the VMA. However, start points of each transect remain in the same location as original placement in 2015.

Umwelt (2018) also recommended increasing the number of photo monitoring points at each monitoring site. Prior to 2018, only three photos were taken, from the north-east corner of the plot, and the start and end of each transect. The new method requires photos to be taken at each corner of the plot, facing inwards, and at the start and end of the transect. For consistency, RPS has conducted the 2023 monitoring in accordance with methods and recommendations provided by Umwelt in previous monitoring efforts.

2.3 Biodiversity Assessment Methodology (BAM)

At each of the three permanent monitoring locations, the BAM was utilised to estimate ecosystem composition, structure, and function to determine the vegetation integrity. The method used to measure these attributes is detailed in (OEH, 2017) and summarised in **Table 1**.

Table 1 BAM growth form groups and attributes

Growth form groups used to assess composition and structure (20 x 20 m plot)	Attributes used to assess function (20 x 50 m plot)
a) Tree	a) Number of large trees
b) Shrub	b) Tree regeneration
c) Grass and grass like	c) Tree stem size class
d) Forb	d) Total length of fallen logs
e) Fern	e) Litter cover (Five 1 m^2 sub-plots)
f) Other	f) High threat exotic vegetation cover
	g) Hollow bearing trees

Biometric plots (20 x 50 m) were established, marking the start and end points of the transect using GPS and permanent pegs. The dimensions of the standard biometric plot are shown in **Figure 2**.

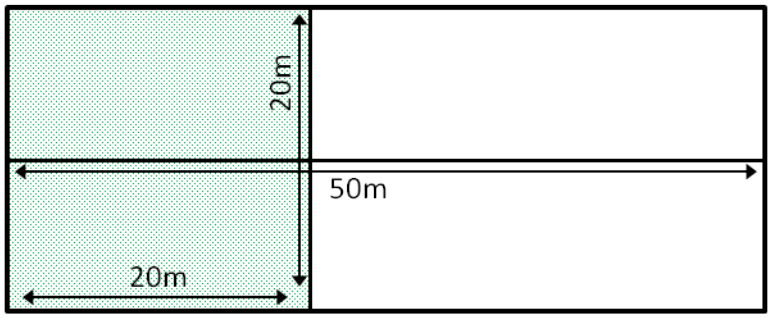


Figure 2 Biometric plot dimensions

2.4 Photo monitoring

Photo monitoring was carried out at each of the monitoring sites. Photos were used to identify any observable changes in vegetation condition over time.

Six photos were taken at each monitoring site. One photo at each corner of the 20m x 20m floristic plot, and one photo at the start and end of the transect. All photos are compared to images from 2018 onwards (due to change in methodology) to identify any changes in vegetation condition or landscape variations.

Permanent photo monitoring locations were installed using wooden stakes. During the 2020 monitoring event, photo monitoring locations were re-labelled to reflect their position in relation to the plot. These changes are outlined in **Table 2**. Confirmation of these orientation amendments can be found in **Table 2.** The updated orientations of the photo monitoring corners were utilised during the 2023 monitoring event.

Table 2 Photo monitoring location orientation amendments

2018	2019	2020
Plot 1		
North-East Corner	No matching photograph taken	North-east Corner, Matching 2018 photograph location
	Labelled as north-east	South-east Corner
	South-east Corner	South-west Corner
	South-west Corner	North-west Corner
Plot 2		
	North-east Corner	South-east Corner
	North-west Corner	North-east Corner
	South-east Corner	South-west Corner
	South-west Corner	North-west Corner
Plot 3		
	North-east Corner	South-east Corner
	North-west Corner	North-east Corner
	South-east Corner	South-west Corner
	South-west Corner	North-west Corner

2.5 Endangered Ecological Community monitoring

Data collected for composition, structure and function parameters outlined in **Section 2.3** will be compared against benchmark data for the corresponding Plant Community Type (PCT; OEH, 2020). This will be used to assess the condition of the EEC.

2.6 Groundwater Dependant Ecosystem monitoring

The *Swamp Sclerophyll Forest on Coastal Floodplains* EEC occurring within the site is representative of a ground water dependant ecosystem (GDE; RPS, 2017) and was quantitatively monitored using methods outlined in **Section 2.3.** Data collected for floristic composition, structure and function parameters will be compared against benchmark data for the corresponding PCT**.** The PCT found throughout this site is 1649 Smooth-barked Apple - Red Mahogany - Swamp Mahogany - *Melaleuca sieberi* heathy swamp woodland of coastal lowlands.

2.7 *Callistemon linearifolious* (Netted Bottlebrush) monitoring

As a continuation of the threatened species monitoring carried out by Umwelt in 2019, nine *C. linearifolius* were attempted to be relocated and a condition score assigned. Condition scores were allocated via a visual assessment of the individual and height of the individuals was also recorded. Health categories utilised to assign condition scores to individuals are outlined in **Table 3.**

Table 3 Visual health assessment categories

Category of Shrub Health	
Healthy	No signs of dieback or leaf loss
Slightly stressed	Minimal dieback through the presence of few small dead branches on otherwise healthy shrubs
Stressed	Reductions in leaf size or leaf loss, discolouration, canopy thinning, or dead branches with some level of die back
Near Dead	Brown leaves, fine branches, and thin canopy
Dead	Absence of leaves, fine branches, or bark

Umwelt, 2019

3 RESULTS

3.1 Weather

A summary of the weather data for the 12-month period preceding the 2023 monitoring event (i.e., November 2022 to October 2023), along with historical monthly data (1862 to 2023; BoM, 2023), is outlined in **Table 4**. Long term weather patterns (November 2019 to October 2023) are outlined in **Figure 3.** The data was obtained from Newcastle Nobbys Signal Station AWS (61055), located approximately 28km north of the monitoring sites.

Mean maximum monthly temperatures were generally higher than historical data for the preceding 12-month period. The same trend was observed in mean minimum monthly temperatures. Eleven months of the preceding 12-month period recorded mean monthly rainfall below the historical mean.

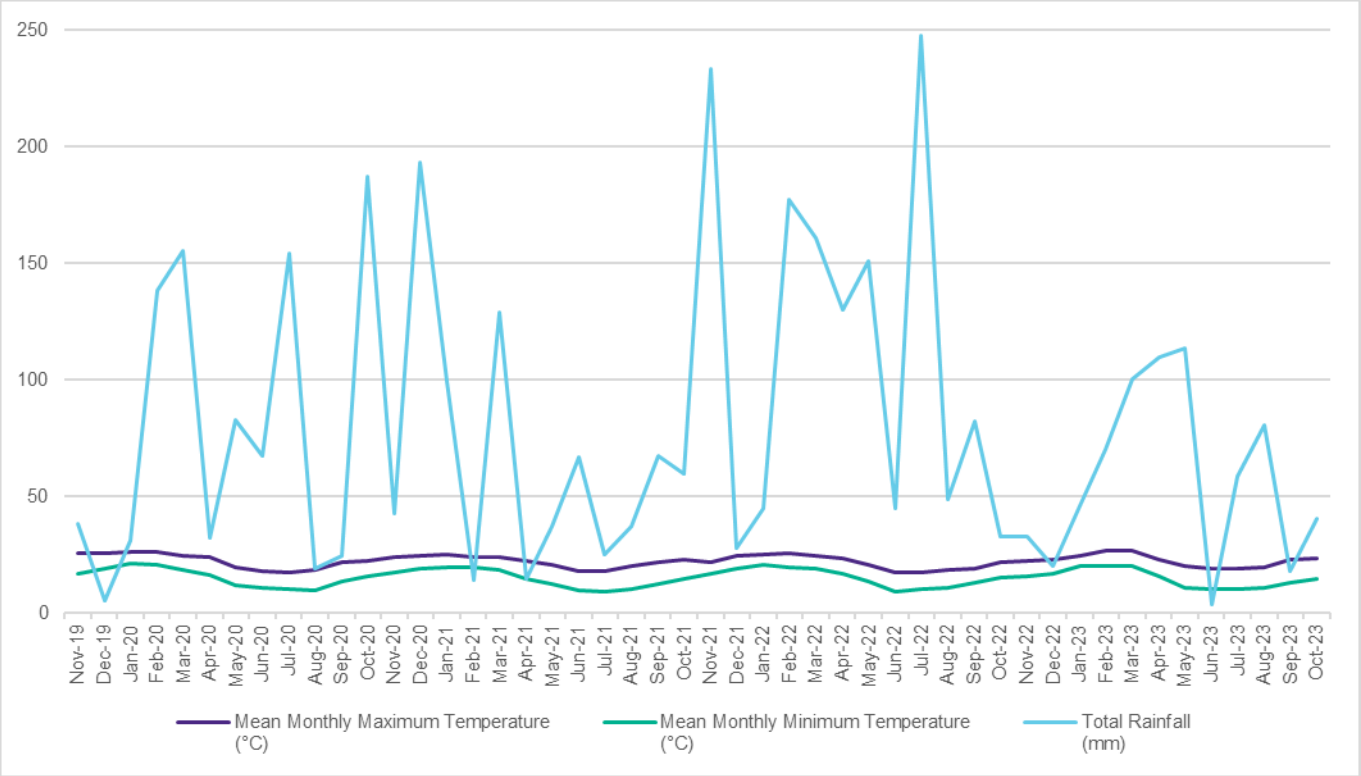
Table 4 Summary of weather data

Month	Mean maximum monthly temperature (°C)	Mean minimum monthly temperature (°C)	Total monthly rainfall (mm)	Historical mean maximum monthly temperature (°C)	Historical minimum mean monthly temperature (°C)	Historical mean monthly rainfall (mm)
Nov-22	22.5	15.8	32.8	23.5	16.2	71.3
Dec-22	23	17	20.2	24.9	18.1	79.1
Jan-23	24.8	20	45.8	25.6	19.3	88.1
Feb-23	26.5	20.4	70	25.4	19.4	106.7
Mar-23	26.9	20.3	100.4	24.8	18.3	119.6
Apr-23	23	15.9	109.8	22.8	15.4	115.6
May-23	20.3	10.7	113.6	20.1	12	114.5
Jun-23	18.9	10.1	3.6	17.6	9.8	117.1
Jul-23	19.2	10.2	58.8	16.8	8.5	92.6
Aug-23	19.8	10.8	80.4	18.1	9.3	72
Sep-23	22.7	12.9	18.2	20.3	11.5	71.3
Oct-23	23.2	14.9	40.6	22.2	14.1	73
Total	**-**	**-**	**694.2**	**-**	**-**	**1120.9**

Historical weather data 1862 – 2023

Green = above average statistics

Red = below average statistics



Graph 1 Long term weather patterns (November 2019 to October 2023) preceding the 2023 monitoring event

3.2 Floristic monitoring

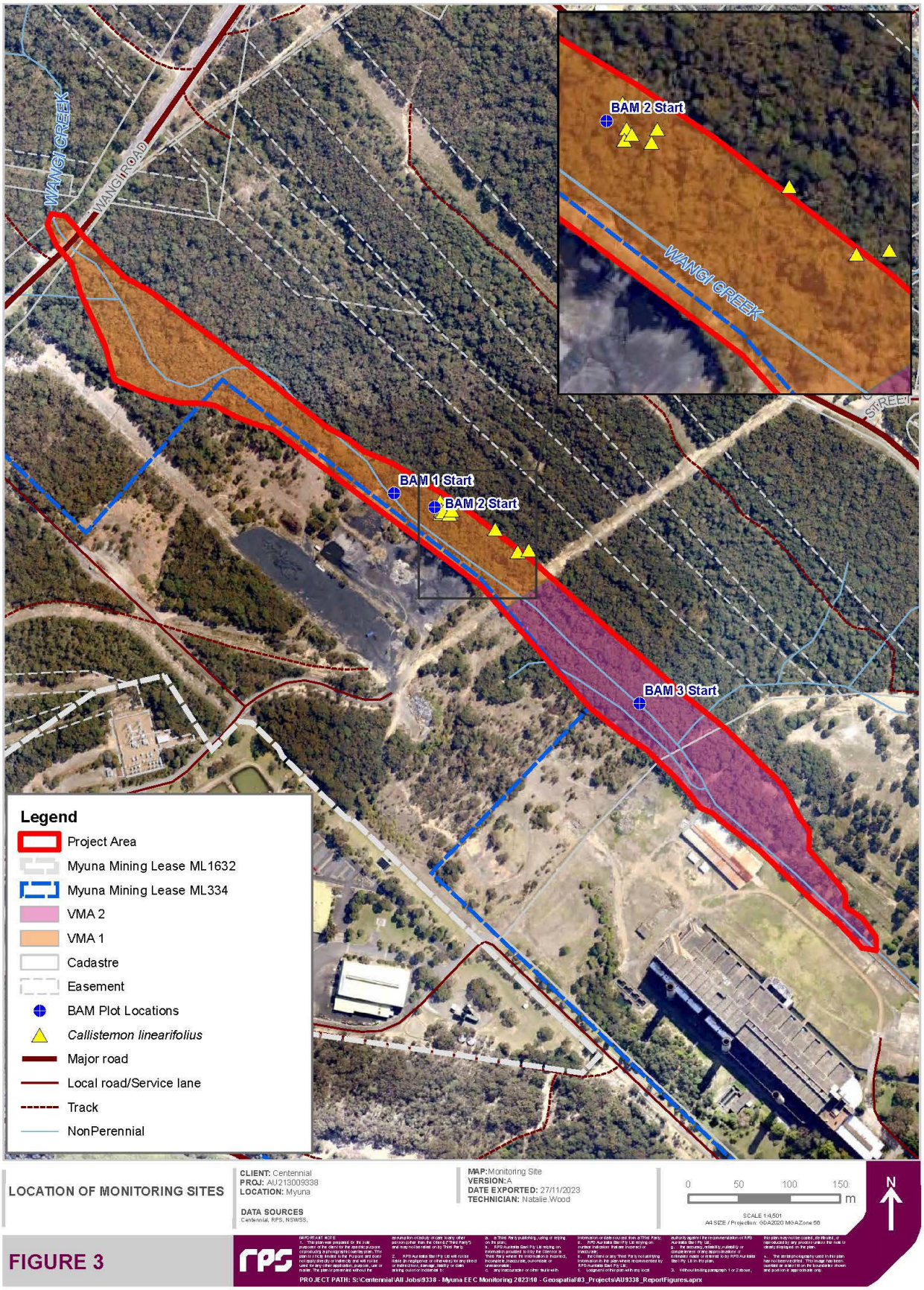
Data collected during the 2023 monitoring effort was compared to Umwelt's 2019 and RPS 2020, 2021 and 2022 data.

To fulfil EEC and GDE monitoring, a comparison of attributes found throughout all plots were to be compared to BAM benchmark conditions. This requires a PCT to be assigned to the vegetation community throughout the site. Umwelt had previously assigned PCT 1649: Smooth-barked Apple - Red Mahogany - Swamp Mahogany - *Melaleuca sieberi* heathy swamp woodland of coastal lowlands to the vegetation community found at both VMA sites. PCT 1649 is present in two IBRA Bioregions, NSW North Coast and Sydney Basin. Benchmarks from the Sydney Basin bioregion were employed. To allow for consistent comparison across years, these PCT benchmarks have been used for the 2023 EEC and GDE data analysis.

3.2.1 VMA 1

VMA 1 consists of two plots of high condition native vegetation (**Figure 3**). These plots are in locations which have historically experienced relatively high levels of water inundation due to rainfall events. This inundation appeared to be a low energy influx, with minimal deposition of vegetative debris and unconsolidated material. The following section reports on data collected from the 2023 monitoring event. There were no visual indicators of mining related activities or impacts (i.e., subsidence or ponding). Evidence of rubbish were present within both monitoring plots.

Figure 3 Location of monitoring sites



3.2.1.1 Plot 1

A total of 41 species were recorded, with 35 of these being native (**Table 5**).

Tree canopy comprises *Angophora costata* (Sydney Red Gum), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum) and *Glochidion ferdinandi* (Cheese Tree), with *E. robusta* being the most dominant canopy species. The shrub layer was dominated by *Melaleuca linariifolia* (Flax-leaved Paperbark) and *Pittosporum undulatum* (Sweet Pittosporum). Less dominant mid stratum species include *Banksia spinulosa* (Hairpin Banksia), *Breynia oblongifolia* (Coffee Bush) and *Callistemon linearifolius* (Netted Bottle Brush) which is listed as vulnerable under the BC Act. Dominant species recorded within the understory include *Gahnia clarkei* (Tall Saw-sedge), *Lomanda longifolia* (Spiny-headed Mat-rush) and *Oplismenus imbecillis*. Species observed in Plot 1 are provided in **Appendix A.**

Table 5 Plot 1 summary statistics – year on year native and introduced flora species richness

Year	Number of native flora species (per cent of total)	Number of introduced flora species (per cent total)	Total number of flora species
2023	**35 (85.4)**	**6 (14.6)**	**41**
2022	33 (82.5)	7 (17.5)	40
2021	37 (82.2)	8 (17.6)	45
2020	29 (76)	9 (24)	38
2019	32 (78)	9 (22)	41
2018	45 (83)	9 (17)	54
2017**	35 (97)	1 (3)	36
2016**	30 (97)	1 (3)	31
2015*	-	-	-
Mean native species richness (ex 2023)			34.4±5.4 SE
Range in native species richness (ex 2023)			29 - 45
Mean introduced species richness (ex 2023)			6.3±3.7 SE
Mean species richness (ex 2023)			40.7±7.3 SE

* No floristic data collected in 2015 (HLM)

** Floristic data collected according to BBAM (RPS)

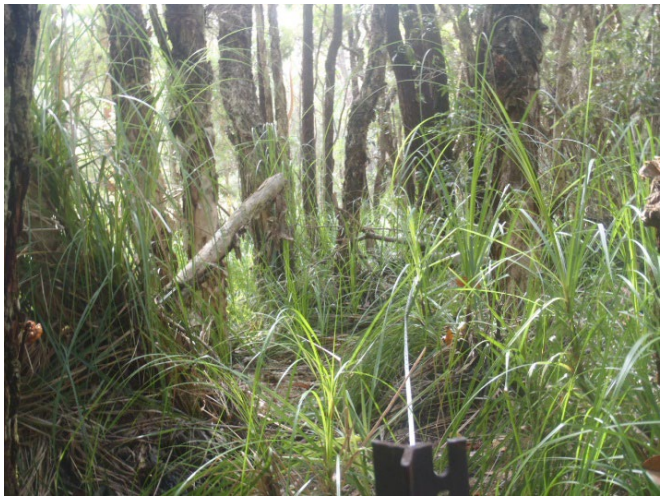
A total of six exotic species were recorded within Plot 1. Three of these exotic species were recorded as High Threat Weeds (HTW) under BAM (OEH, 2017) and two species are listed as a Weed of National Significance (WoNS; Commonwealth of Australia, 2017). **Table 6** lists exotics species and associated listings.

Table 6 Exotic species and associated listing

Scientific name	Common name	WoNS	HTW
Conyza bonariensis	Flaxleaf Fleabane		
Hypochoeris radicata	Catsear		
Lantana camara	Lantana	YES	YES
Rubus fruticosus	Blackberry complex	YES	
Senecio madagascariensis	Fireweed	YES	YES
Tradescantia fluminensis	Wandering Trad		YES

Photographs at specified monitoring points over the last 4 years are shown in **Table 7.**

Table 7 Plot 1 – photo monitoring points



2020 – Transect Start

2021 – Transect Start

2022 – Transect Start

2023 – Transect Start

2020 – Transect End

2021 – Transect End

2022 – Transect End

2023 – Transect End

2020 – North-east Corner

2021 - North-east Corner

2022 – North-east Corner

2023 - North-east Corner

2020 – South-west Corner

2021 - South-west Corner

2022 – South-west Corner

2023 - South-west Corner

2020 – South-east Corner

2021 – South-east Corner

2022 – South-east Corner

2023 – South-east Corner

2020 – North-west Corner

2021 – North-west Corner

2022 – North-west Corner

2023 – North-west Corner

A comparison of images captured at the photo monitoring locations displays minimal variation in vegetation composition and structure, with any changes likely to be attributed to seasonal variations, or a change in camera positioning. Care will be taken in 2024 to ensure photos are lined up correctly.

3.2.1.2 Plot 2

A total of 46 species were recorded, with 43 of these being native (**Table 8**).

Tree canopy comprises *Allocasuarina spp.* (She-Oak), *Angophora costata* (Sydney Red Gum), *Eucalyptus acmenioides* (White Mahogany), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum) and *Glochidion ferdinandi* (Cheese Tree), with *A. costata* and *E. robusta* being the most dominant canopy species. The shrub layer was dominated by *Melaleuca linariifolia* (Flax-leaved Paperbark), *Leptospermum polygalifolium* (Tantoon) and *Pittosporum undulatum* (Sweet Pittosporum). Less dominant mid stratum species include *Banksia spinulosa* (Hairpin Banksia) *Kunzea spp.* and *Callistemon linearifolius* (Netted Bottle Brush) which is listed as vulnerable under the BC Act. Dominant species recorded within the understory include *Gahnia clarkei* (Tall Saw-sedge), *Lomandra longifolia* (Spiny-headed Mat-rush), *Cymbopogon refractus* (Barbed Wire Grass), *Dianella caerulea* (Blue Flax-lily) and *Goodenia hederacea* (Ivy Goodenia). Species observed in Plot 2 are provided in **Appendix A.**

Table 8 Plot 2 summary statistics – year on year native and introduced flora species richness

Year	Number of native flora species (per cent of total)	Number of introduced flora species (per cent total)	Total number of flora species
2023	**43 (93.5)**	**3 (6.5)**	**46**
2022	39 (89.7)	4 (10.3)	39
2021	46 (93.9)	3 (6.1)	49
2020	45 (96)	2 (4.3)	47
2019	32 (82)	7 (18)	39
2018	39 (93)	3 (7)	42
2017**	36 (90)	4 (10)	40
2016**	30 (81)	1 (3)	37
2015*	-	-	-
Mean species richness (ex 2023)			41.9±4.5 SE
Mean introduced species richness (ex 2023)			3.4±1.9 SE
Mean native species richness (ex 2023)			37.6±6.1 SE
Range in native species richness (ex 2023)			30 – 46

* No floristic data collected in 2015 (HLM)

** Floristic data collected according to BBAM (RPS)

A total of three exotic species were recorded within Plot 2. **Table 9** lists exotics species and associated listings. *Lantana camara* is listed as a WoNS (Commonwealth of Australia, 2017) and is also listed as a priority weed in the Hunter Local Land Services Region (New South Wales Government, 2022) under the *Biosecurity Act* 2017.

Table 9 Exotic species and associated listing

Scientific Name	Common Name	WoNS	HTW
Lantana camara	Lantana	YES	YES
Poaceae indeterminate	Exotic Grasses		
Senna pendula var. glabrata			

Photographs at specified monitoring points over the last 3 years are shown in **Table 10**.

Table 10 Plot 2 – photo monitoring points

2020 – Transect Start	2021 – Transect Start
2022 – Transect Start	2023 – Transect Start
2020 – Transect End	2021 – Transect End

2022 – Transect End

2023 – Transect End

2020 – North-east Corner

2021 - North-east Corner

2022 – North-east Corner

2023 - North-east Corner

2020 – South-west Corner

2021 - South-west Corner

2022 – South-west Corner

2023 - South-west Corner

2020 – South-east Corner

2021 – South-east Corner

2022 – South-east Corner

2023 – South-east Corner

2020 – North-west Corner

2021 – North-west Corner

2022 – North-west Corner

2023 – North-west Corner

A comparison of images captured at the photo monitoring locations displays minimal variation in vegetation composition and structure, with any changes likely to be attributed to seasonal variations, or a change in camera positioning. Care will be taken in 2024 to ensure photos are lined up correctly.

3.2.2 VMA 2

VMA 2 consisted of one plot (Plot 3) of medium condition vegetation (**Figure 4**). Plot 3 exhibited increased number of exotic species within and surrounding the plot. The were no visual indicators of mining related activities or impacts (i.e., subsidence or ponding). Evidence of rubbish was present within the monitoring plot.

3.2.2.1 Plot 3

A total of 37 species were recorded, with 29 of these being native. This is the second highest native species count recorded in six years of monitoring (**Table 11**).

Tree canopy comprises *Eucalyptus robusta* (Swamp Mahogany) and *Glochidion ferdinandi* (Cheese Tree). The shrub layer was dominated by *Pittosporum undulatum* (Sweet Pittosporum), *Melaleuca linariifolia* (Flax-leaved Paperbark), and *Hymenosporum flavum* (Native Frangipani). Dominant species recorded within the understory include *Calochlaena dubia* (Rainbow Fern), *Gahnia clarkei* (Tall Saw-sedge), *Dichondra repens* (Kidney Weed), *Oplismenus imbecillis*, and *Lastreopsis decomposita* (Trim Shield Fern). Species observed in Plot 3 are provided in **Appendix A.**

Table 11 Plot 3 summary statistics – year on year native and introduced flora species richness

Year	Number of native flora species (per cent of total)	Number of introduced flora species (per cent total)	Total number of flora species
2023	**29 (78.4)**	**8 (21.6)**	**37**
2022	27 (77.1)	8 (22.9)	35
2021	30 (71.4)	12 (28.6)	42
2020	26 (68)	12 (31.6)	38
2019	25 (78)	7 (22)	32
2018	22 (65)	11 (32)	34
2017**	22 (73)	8 (27)	30
2016**	23 (72)	9 (28)	32
2015*	-	-	-
Mean species richness (ex 2023)			34.7±4.1 SE
Mean introduced species richness (ex 2023)			9.6±2.1 SE
Mean native species richness (ex 2023)			25±2.9 SE
Range in native species richness (ex 2023)			22 – 30

* No floristic data collected in 2015 (HLM)

** Floristic data collected according to BBAM (RPS)

A total of eight exotic species were recorded within Plot 3. Four of these exotic species are HTW under BAM (OEH, 2017). **Table 12** lists exotics species and associated listings. *Lantana camara* (Lantana) and *Rubus fruticosis* (Blackberry Complex) are listed as a WoNS (Commonwealth of Australia, 2017) and are also listed as a priority weed in the Hunter Local Land Services Region (New South Wales Government, 2022) under the *Biosecurity Act* 2017.

Table 12 Exotic species and associated listing

Species name	Common name	WoNS	HTW
Ageratina adenophora	Crofton Weed		YES
Cirsium vulgare	Spear Thistle		
Ehrharta erecta	Panic Veldtgrass		YES
Lantana camara	Lantana	YES	YES
Rubus fruticosus	Blackberry complex	YES	

Species name	Common name	WoNS	HTW
Senna pendula var. glabrata			
Solanum mauritianum	Wild Tobacco Bush		
Tradescantia fluminensis	Wandering Trad		YES

3.2.2.1.1 Photo Monitoring

Photographs at specified monitoring points over the last 3 years are shown in **Table 13**.

Table 13 Plot 3 – photo monitoring points

2020 – Transect Start	2021 – Transect Start
2022 – Transect Start	2023 – Transect Start

2020 – Transect End	2021 – Transect End
2022 – Transect End	2023 – Transect End
2020 – North-east Corner	2021 - North-east Corner
2022 – North-east Corner	2023 - North-east Corner

2020 – South-west Corner

2021 - South-west Corner

2022 – South-west Corner

2023 - South-west Corner

2020 – South-east Corner

2021 – South-east Corner

2022 – South-east Corner

2023 – South-east Corner

2020 – North-west Corner

2021 – North-west Corner

2022 – North-west Corner

2023 – North-west Corner

A comparison of images captured at the photo monitoring locations displays minimal variation in vegetation composition and structure, with any changes likely to be attributed to seasonal variations.

3.3 Endangered ecological community and groundwater dependant ecosystem

A comparison of data collected since 2018 against PCT 1649 benchmarks are outlined in **Table 14.** Green indicates above the benchmark, red is below the benchmark and orange is equal to the benchmark.

Table 14 Comparison of habitat attributes against PCT benchmark

Attribute	Benchmark	2018	2019	2020	2021	2022	2023
VMA 1							
Composition							
Tree richness	4	5	5	5	4	5	5
Shrub richness	9	13	14	11	12	9	10
Grass & grass-like richness	7	8	11	7	9	8	8
Forb richness	6	8	7	8	5	5	8
Fern richness	2	3	3	2	4	3	3
Other richness	5	6	8	6	9	6	6
Exotic Richness	NA	6	10	6	6	6	5
High Threat Weed Richness	NA	3	8	4	1	2	2
Structure							
Tree cover	27	75	33	35	30	39	30
Shrub cover	19	63	74	39	37	35	31
Grass & grass-like cover	51	91	57	36	35	51	42
Forb cover	3	9	1	1	1	4	1
Fern cover	2	16	0	0	1	1	0
Other cover	3	8	1	1	2	2	1
Function							
Total length of fallen logs	44	9	27	18	26	1	15
Litter cover	44	81	84	67	60	69	71
No. of large trees (per 0.1ha)	5	0	0	1	0	1	1
VMA 2							
Composition							
Tree richness	4	2	2	2	2	2	2
Shrub richness	9	7	6	5	6	5	5
Grass & grass-like richness	7	4	4	7	4	6	3
Forb richness	6	7	6	7	9	8	6
Fern richness	2	1	2	1	4	1	4
Other richness	5	1	5	4	5	5	9
Exotic Richness	NA	11	7	12	12	8	8
High Threat Weed Richness	NA	4	4	4	3	2	4

Attribute	Benchmark	2018	2019	2020	2021	2022	2023
Structure							
Tree cover	27	65	40.3	51	41	32	32
Shrub cover	19	37.6	30.7	32.3	17	24	23
Grass & grass-like cover	51	71	40.3	10.5	6	34	5.8
Forb cover	3	3.3	0.7	1.7	4	9	1.7
Fern cover	2	1	0.2	0.1	1	4	0.9
Other cover	3	0.5	0.6	0.6	1	6	7.1
Function							
Total length of fallen logs	44	27	41	51	35	8	38
Litter cover	44	84	43	97.6	72	71	71
No. of large trees (per 0.1ha)	5	0	5	3	1	8	7

Green = above benchmark, Red = below benchmark, Orange = equal to benchmark

Results from Plots 1 and 2 in VMA 1 were averaged to compare with Plot 3 found in VMA 2. Results for VMA 1 were largely above the PCT benchmark, except the attributes grass and grass like cover, forb cover, fern cover, other cover, total length of fallen logs and number of large trees. All of these except forb cover were repeated triggers from 2022. An increase above benchmark in 2023, in comparison to values equal to or below the benchmark in 2022 were observed in shrub and forb richness in VMA 1.

Results from VMA 2 were varied, with seven out of 15 of the indicators below the PCT benchmark (red). The indicators which fell below benchmark were tree, shrub, and grass & grass-like richness, grass & grass-like cover, other cover, and total length of fallen logs. Since 2022 ubstantial reductions were observedin grass and grass-like cover, forb cover and fern cover from 34%, 9% and 4% to 5.8%, 1.7% and 0.9% respectively. Below-PCT benchmark observations for tree richness, shrub richness, grass & grass-like richness and grass & grass-like cover were repeated triggers from 2022, while forb and fern cover reductions are new triggers in 2023. Alternatively, fern richness and other species richness have both increased from equal to or below the benchmark in 2022 to above the benchmark in 2023.

3.4 *Callistemon linearifolius* (Netted Bottlebrush) Monitoring

A comparison of the health of *C. linearifolius* is outlined in **Table 15**. A total of eight *C. linearifolius* were relocated during the 2021 monitoring event. Umwelt had initially marked and tagged nine individuals. One individual (150) was unable to be relocated. Individuals appeared to have been impacted by heavy water flow during the 2020 monitoring event, with some individuals having broken branches resulting from the accumulation of debris around their stems. Seven out of ten individuals surveyed recorded signs of no change in condition from the previous year. The other three individuals showed a decline in condition from the previous year. As per the recommendations from 2021, two additional *C. linearifolius* individuals (individuals 159 and 160) were surveyed to allow for more rigorous analysis of condition of the population within the EEC.

Table 15 *C. linearifolius* height and condition

	2019		2020		2021		2022		2023	
Plant I.D.	Height (m)	Condition	Height (m)	Condition	Height (m)	Condition	Height (m)	Condition	Height (m)	Condition
150	2.3	Healthy	-	-	-	-	-	-	-	-
151	2.15	Healthy	2.3	Slightly stressed*	2.3	Slightly Stressed*	2.2	Slightly stressed**	2.1	Slightly stressed*
152	1.7	Healthy	1.7	Slightly stressed*	1.7	Slightly Stressed*	1.6	Stressed**	1.6	Stressed**

	2019		2020		2021		2022		2023	
153	1.03	Healthy	1.0	Slightly stressed*	1.0	Healthy	1.1	Healthy	1.1	Stressed**
154	0.45	Healthy	0.9	Slightly stressed**	0.9	Healthy	1.2	Healthy	1.0	Slightly Stressed**
155	1.9	Healthy	2.3	Healthy	2.3	Healthy	2.2	Healthy	2.4	Healthy
156	1.12	Slightly stressed	2.0	Slightly stressed	2.0	Slightly Stressed	1.8	Slightly stressed**	2.0	Slightly stressed**
157	2.0	Healthy	2.0	Slightly stressed**	2.0	Healthy	-	Unable to be located	2.1	Healthy
158	1.72	Healthy	1.6	Healthy	1.6	Healthy	1.85	Slightly stressed**	1.8	Healthy
159	-	-	-	-	-	-	1.6	Healthy	1.8	Healthy
160	-	-	-	-	-	-	2.0	Healthy	2.0	Healthy

*Broken stem, **Browning leaves/dieback. Red indicates decline in condition, Green indicates no change, or increased condition.

Additional morphological and reproductive attributes (i.e., leaf growth, presence of flowers or fruit) were recorded to assess the condition of *C. linearifolius.* These attributes are outlined in **Table 16**.

Table 16 Additional condition assessment attributes

Plant I.D.	New leaf growth (Y/N)	Flowers (Y/N)	Fruit (Y/N)
151	Y	N	Y
152	N	N	Y
153	N	N	N
154	N	N	Y
155	N	N	Y
156	Y	N	Y
157	Y	N	Y
158	Y	N	Y
159	Y	Y	Y
160	Y	Y	Y

Fruit – refers to the presence of fruit from the previous year

4 DISCUSSION

Section 3 presents the results from the 2023 EEC monitoring event for comparison with data collected by Umwelt in 2018 and 2019 and RPS from 2020 onwards. Data collected prior to the Umwelt 2018 and 2019 monitoring events was collected under BBAM and was therefore not directly comparable.

Plots 1 and 2 of VMA1 both recorded above average total counts of native species since 2015. In comparison to 2022 monitoring results there was an increase in the number and proportion of native species to total species. Exotic species richness within the plots in VMA 1 has also decreased since 2022. Averaged results from plots within VMA 1 were generally above the PCT benchmark for species composition, but generally fell below the benchmark for habitat structure and ecosystem function. The results for 2023 were relatively consistent with previous years, with most of the values below the PCT benchmark observed as repeat triggers from 2020 to 2022. Whilst slight variation was recorded in floristic data, photo monitoring shows vegetation and habitat composition to be relatively similar to previous monitoring results.

VMA 2 (Plot 3) recorded the second highest native species count (above average) and highest proportion of native species since 2015 and an increase from monitoring activities in 2022. Count of exotic species was the same as in 2022, however there was an increase in HTW richness. Within VMA 2, species composition and habitat structure was generally below or on par with the corresponding PCT benchmark, while ecosystem function was above the PCT benchmarks except for total length of fallen logs. Previous monitoring events have also outlined elevated exotic species presence in the plot when compared to VMA 1. This is likely a consequence of initial condition of the plot and subsequent management over time.

Variations in species composition and habitat structure could be influenced by several variables including:

- High water flow moving vegetative material and sediments throughout the creek line, transporting potential weed propagative material and removing lower stratum habitat features and vegetation;
- Seasonal variation in weather patterns influencing the occurrence of some species; and
- Potential minor variations in plot location (particularly at the edges of the plots).

Presence of rubbish and other anthropogenic refuse was observed within or in close proximity to all flora monitoring plots, which may also contribute to the introduction of exotic seed product and proliferation of weed species along with disturbance of substrate within the study area.

The reduced condition of *C. linearifolius* individuals can be primarily attributed to impacts related to heavy water flow experienced within the riparian zone during the 2020 monitoring event, with most of the individuals within the monitoring plots and more specifically within the wetted areas where accumulation of plant debris at their bases was observed. During the 2023monitoring event, signs of stabilisation for individuals were variable with new leaf growth observed on most individuals, while other individuals (e.g., 152, 153 and 154) within the wetted area of the riparian zone showed signs of declining condition with browning leaves/dieback.

Results from the 2023 EEC monitoring indicate no immediate impacts of concern on PCT 1649: *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions EEC* from mining related activities. Floristic data and comparisons of habitat attributes have remained relatively constant to prior monitoring events, with any slight variations likely attributed to variability in precipitation and climatic factors unrelated to mining operations.

4.1 Recommendations

The incursion of exotic species is evident in both VMAs and has the potential to negatively impact the overall condition of the EEC. Of most concern is VMA 1, which currently is regarded to be in ‘high’ condition. VMA 2 has constantly fallen below PCT benchmark and recorded higher levels of exotic species. As this VMA is only regarded as ‘moderate’ condition, resilience to weed incursion and associated impacts is not as high. Although it has been observed that exotic species richness has reduced or stabilised over time, ongoing monitoring and appropriate management must continue to be implemented to ensure weed species recruitment in these VMAs does not persist in the future.

The following recommendations aim to maintain the integrity of the EEC and improve study design and repeatability:

- It is recommended that ongoing weed management plan occur, with primary focus on those species that have the highest percent cover of the plot and are listed as high threat weeds. Species lists outlining target species can be found in **Table 6**, **Table 9** and **Appendix A**; and
- Two C. linearifolious individuals need to be re-tagged to assist in locating them in future monitoring activities. These include Plant IDs 157 and 158.

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Appendix A
Species List

Scientific name	Exotic	Common name	HTW	Plot 1 cover	Plot 1 Abundance	Plot 2 cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance
Acacia longifolia						0.2	1		
Acacia spp.		Wattle		0.1	1				
Acacia ulicifolia		Prickly Moses				0.1	1		
Adiantum aethiopicum		Common Maidenhair						0.1	5
Adiantum hispidulum		Rough Maidenhair						0.1	3
Ageratina adenophora	*	Crofton Weed	Yes					0.3	5
Allocasuarina spp.						0.6	3		
Angophora costata		Sydney Red Gum		5	5	20	15		
Banksia spinulosa		Hairpin Banksia		0.3	4	1	7		
Billardiera scandens		Hairy Apple Berry				0.1	1		
Blechnum nudum		Fishbone Water Fern		0.2	5			0.2	10
Breynia oblongifolia		Coffee Bush		0.2	2				
Callistemon linearifolius		Netted Bottle Brush		0.3	2	0.5	8		
Calochlaena dubia		Rainbow Fern		0.1	5	1	20	5	50
Carex spp.				0.1	5				
Cayratia clematidea		Native Grape						0.2	5
Centella asiatica		Indian Pennywort		0.1	20	0.2	40	0.2	100
Cirsium vulgare	*	Spear Thistle						0.2	3
Cissus hypoglauca		Giant Water Vine						1	10
Clematis aristata		Old Man's Beard		0.1	2			0.1	5
Conyza bonariensis	*	Flaxleaf Fleabane		0.1	3				
Cymbopogon refractus		Barbed Wire Grass		0.2	20	0.5	60		
Dampiera spp.						0.3	10		

Scientific name	Exotic	Common name	HTW	Plot 1 cover	Plot 1 Abundance	Plot 2 cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance
Desmodium varians		Slender Tick-trefoil		0.1	10			0.1	20
Dianella caerulea		Blue Flax-lily		0.2	10	0.5	20	0.2	10
Dichondra repens		Kidney Weed						1	100
Dioscorea transversa		Native Yam						0.1	3
Ehrharta erecta	*	Panic Veldtgrass	Yes					5	300
Embelia australiana								0.1	3
Empodisma minus				0.1	20				
Entolasia marginata		Bordered Panic						0.3	40
Entolasia stricta		Wiry Panic		0.1	5	0.2	10		
Eucalyptus acmenioides		White Mahogany				1	1		
Eucalyptus robusta		Swamp Mahogany		15	12	15	12	30	15
Eucalyptus sclerophylla		Hard-leaved Scribbly Gum		1	1	1	1		
Euchiton spp.				0.1	5				
Exocarpos cupressiformis		Cherry Ballart				0.1	1		
Ficus coronata		Creek Sandpaper Fig						3	20
Gahnia clarkei		Tall Saw-sedge		50	120	30	100	5	30
Geitonoplesium cymosum		Scrambling Lily		0.1	15	0.1	10	0.2	30
Glochidion ferdinandi		Cheese Tree		1	3	1	5	2	30
Glycine spp.				0.1	3				
Gonocarpus teucrioides		Germander Raspwort				0.1	10		
Goodenia hederacea		Ivy Goodenia		0.1	1	0.5	70		
Homalanthus populifolius								2	1
Hymenosporum flavum		Native Frangipani				0.3	10	3	3
Hypochoeris radicata	*	Catsear		0.1	1				
Imperata cylindrica		Blady Grass		0.1	15	0.3	50		
Kunzea spp.						1	5		

Scientific name	Exotic	Common name	HTW	Plot 1 cover	Plot 1 Abundance	Plot 2 cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance
Lantana camara	*	Lantana	Yes	0.2	3	0.2	5	0.2	10
Lastreopsis decomposita		Trim Shield Fern						0.5	10
Lastreopsis microsora		Creeping Shield Fern		0.1	5				
Lepidosperma laterale		Variable Sword-sedge				0.4	10		
Leptospermum polygalifolium		Tantoon				5	25		
Leucopogon spp.						0.5	5		
Lindsaea linearis		Screw Fern				0.1	5		
Lindsaea microphylla		Lacy Wedge Fern		0.1	5	0.2	5		
Lobelia purpurascens		whiteroot		0.1	10	0.1	25		
Lomandra longifolia		Spiny-headed Mat-rush		0.5	10	0.5	5		
Lomandra obliqua						0.1	5		
Melaleuca linariifolia		Flax-leaved Paperbark		30	30	15	20	5	10
Myrsine variabilis				0.2	1	0.1	1		
Oplismenus imbecillis				0.5	60	0.2	20	0.5	100
Oxalis perennans				0.1	30	0.1	8	0.1	30
Pandorea pandorana		Wonga Wonga Vine		0.2	10	0.3	15		
Parsonsia straminea		Common Silkpod		0.2	25	0.2	20	0.3	20
Pittosporum undulatum		Sweet Pittosporum		5	15	3	10	10	40
Poaceae indeterminate	*	Grasses, reeds and bamboos				0.1	5		
Pseuderanthemum variabile		Pastel Flower				0.1	5		
Rubus fruticosus	*	Blackberry complex		0.3	10			0.2	10

Scientific name	Exotic	Common name	HTW	Plot 1 cover	Plot 1 Abundance	Plot 2 cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance
Senecio madagascariensis	*	Fireweed	Yes	0.2	10				
Senna pendula var. glabrata	*					0.1	1	0.4	8
Solanum mauritianum	*	Wild Tobacco Bush						0.1	2
Tradescantia fluminensis	*	Wandering Trad	Yes	0.1	5			0.2	30
Veronica plebeia		Trailing Speedwell						0.1	10
Viola hederacea		Ivy-leaved Violet				0.2	30		
Viola spp.								0.1	5
Xanthosia pilosa		Woolly Xanthosia				0.1	3		

* Exotic Species

High Threat Weeds (HTW)

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