BHP Mitsubishi Alliance

Appendix D

Noise and Vibration Assessment

Blackwater Mine – North Extension Project

Noise and Vibration Impact Assessment

BM Alliance Coal Operations Pty Ltd

480 Queen Street, Brisbane QLD 4001

Prepared by:

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Level 16, 175 Eagle Street, Brisbane QLD 4000,
Australia

SLR Project No.: 620.014601.00000

16 November 2023

Revision: 04

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
01	13 September 2023	Steve Henry	Shane Elkin	DRAFT
02	20 October 2023	Steve Henry	Shane Elkin	DRAFT
03	8 November 2023	Steve Henry	Shane Elkin	Peter Allen
04	16 November 2023	Steve Henry	Shane Elkin	Peter Allen
	Click to enter a date.			

Basis of Report

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with BM Alliance Coal Operations 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.

Executive Summary

Introduction

The Blackwater Mine (BWM) is located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland and is owned and operated by BM Alliance Coal Operations Pty Ltd (BMA), on behalf of the Central Queensland Coal Associates Joint Venture (CQCA JV) and South Blackwater Coal Pty Limited.

The BWM, currently produces up to 19 million tonnes per annum of (Mtpa) of Run-of-Mine (RoM) coal equating to approximately 16 Mtpa of product coal. The BWM - North Extension Project (the Project) proposes to extend mining at BWM into Surface Area (SA)10 on ML1759 and SA7 on ML1762. The Project area includes SA7 on ML1762 and SA10 on ML1759, with a total Project area of 9,048 hectares (ha) and Project footprint of approximately 3,761 ha.

This technical assessment has considered noise and vibration impacts from the Project operations on the surrounding sensitive receptors. The assessment has been prepared to support an application for an Environmental Authority (EA) Amendment for the Project.

Existing Environment

To assist with defining the existing (pre-Project) acoustic environment, baseline noise monitoring (both operator-attended and unattended) was conducted (in April and May 2020) by EMM Consulting Pty Ltd (EMM) at seven (7) receptor locations surrounding BWM.

Noise and Vibration Assessment Criteria

In relation to noise and vibration, BWM's Environmental Authority (EA) (EPML00717813) Conditions C1 and C5 (noise and vibration nuisance) requires BWM not to cause an environmental nuisance at any sensitive place or commercial place. Condition C4 requires noise monitoring when requested by the Administering Authority (EA Condition A14). Conditions C2, C6 and C8 specify the noise levels and vibration/airblast overpressure nuisance levels that are not to be exceeded when monitored in accordance with Condition A14. Potential noise and vibration (blasting) impacts from the Project have been assessed against the noise and vibration limits prescribed in the current BWM EA (EPML00717813).

Table E-1 below outlines the operational mining noise criteria referenced in this assessment.

Table E-1 BWM EA Schedule C Table C1 (Noise Limits)

Noise Level (dBA)	Monday to Sunday (including public holidays)		
	Daytime 7 am – 6 pm	Evening 6 pm – 10 pm	Night-time 10 pm – 7 am
$L_{Aeq, adj,15mins}$	40	40	40
$L_{A1, adj, 15mins}$	N/A	N/A	45

For assessment of potential blasting impacts (i.e. airblast overpressure and ground vibration), the current BWM EA blasting limits have been applied to the assessment of the Project. The blasting limits are summarised in **Table E-2**.

Table E-2 BWM EA Schedule C Table C2 and C3 - Blasting Vibration and Airblast Overpressure Limits

Parameter	Sensitive or Commercial Place Blasting Limits
Ground vibration peak particle velocity	5 mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts and not greater than 10 mm/s peak particle velocity at any time.
Airblast overpressure level	115 dB (Linear peak) for nine (9) out of ten (10) consecutive blasts and not greater than 120 dB (Linear peak) at any time.

Mine Operation

The technical assessment has modelled the Project noise emission levels from three (3) operational mining scenarios coinciding with FY2027, FY2039 and FY2044 (summarised in **Table E-3**). Through a review of the Project information supplied by BMA as part of the assessment, these three modelled scenarios were selected to represent various stages of operational intensity including the maximum fleet size, as well as targeting proximity of mining operations to noise sensitive receptors surrounding the Project.

Project noise emission levels predicted at the receptors surrounding BWM are presented in the table below.

Table E-3 Predicted BWM Operational Noise Levels – Neutral and Adverse Weather

ID	Description	Predicted Noise Level (adj, 15 mins dBA)					
		FY2027		FY2039		FY2044	
		L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}
Neutral Weather: 10 ^{o}C temperature, 70% humidity, 'D' Pascal stability class, 0 m/s wind speed							
EPML00717813 noise limits		**40**	**45**	**40**	**45**	**40**	**45**
R1	BMA	33	41	36	44	41	49
R2	BMA	36	44	38	46	45	53
R3	Private - Tolmies Creek	28	36	31	39	34	42
R4	Private - Tolmies Creek	27	35	30	38	33	41
R5	Private - Ausbute	39	**47**	**42**	**50**	**43**	**51**
R6	Private	33	41	35	43	37	45
R7	Private - Burngrove	29	37	30	38	32	40
R8	Private (Blackwater town)	22	30	24	32	23	31
R9	Private - Minyango	22	30	24	32	23	31
R10	Private - Cardona	17	25	17	25	18	26
R11	Private - Tantallon	23	31	25	33	25	33
R12	BMA	29	37	29	37	30	38
R13	Private - Yarrawonga	23	31	26	34	24	32
R14	Qcoal (Cook Colliery)[#]	26	34	30	38	27	35
R15	Private - Taurus	36	44	42	50	40	48
R16	Private - Stewerton	30	38	38	46	34	42
R17	Private - Retreat	30	38	38	**46**	34	42

ID	Description	Predicted Noise Level (adj, 15 mins dBA)					
		FY2027		FY2039		FY2044	
		L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}
R18	BMA - BWM MIA Admin	42	50	47	55	45	53
R19	Private - Tannyfoil	27	35	27	35	24	32
R20	Private	34	42	27	35	29	37
R21	Private	33	41	27	35	28	36
R22	Private	32	40	26	34	28	36
R23	Private	32	40	26	34	27	35
R24	Private	30	38	25	33	26	34
R25	Private	30	38	25	33	26	34
R26	Private	29	37	25	33	26	34
R27	Private	28	36	24	32	26	34
R28	Private	28	36	25	33	25	33
R29	Private	27	35	25	33	25	33
R30	Private - Tulloch Ard	23	31	22	30	23	31
R31	Private	22	30	22	30	23	31
R32	Private - Maryvale	19	27	20	28	22	30
R33	Private - Malamy	19	27	20	28	21	29
R34	Private - Malamy	19	27	20	28	21	29
R35	Private - Sherborne	19	27	19	27	21	29
R36	Private	18	26	19	27	20	28
R37	Private	18	26	19	27	20	28
R39	Private	22	30	20	28	21	29
R40	Private	20	28	20	28	22	30
R41	Private	22	30	20	28	21	29
R42	Private - Monash	15	23	18	26	16	24
R43	Private	17	25	19	27	18	26
R46	Qcoal (Cook Colliery)[#]	**46**	**54**	32	40	27	35
R47	Blackwater Cemetery	24	32	26	34	25	33
R48	Resource recovery centre	25	33	27	35	27	35
R49	Quarry	23	31	26	34	28	36
R50	BWM Airport	43	51	38	46	38	46
Adverse Weather: 10 ^{o}C temperature, 90% humidity, 'F' Pascal stability class, 0 m/s wind speed							
R1	BMA	39	47	42	50	47	55
R2	BMA	42	50	43	51	50	58
R3	Private - Tolmies Creek	35	43	38	**46**	**41**	**49**

ID	Description	Predicted Noise Level (adj, 15 mins dBA)					
		FY2027		FY2039		FY2044	
		L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}
R4	Private - Tolmies Creek	34	42	37	45	39	**47**
R5	Private - Ausbute	**44**	**52**	**47**	**55**	**48**	**56**
R6	Private	39	**47**	**41**	**49**	**44**	**52**
R7	Private - Burngrove	35	43	36	44	39	**47**
R8	Private (Blackwater town)	30	38	32	40	31	39
R9	Private - Minyango	29	37	32	40	30	38
R10	Private - Cardona	25	33	25	33	26	34
R11	Private - Tantallon	30	38	32	40	32	40
R12	BMA	36	44	36	44	38	46
R13	Private - Yarrawonga	31	39	33	41	32	40
R14	Qcoal (Cook Colliery)[#]	33	41	37	45	35	43
R15	Private - Taurus HS	42	50	48	56	46	54
R16	Private - Stewerton	37	45	45	53	41	49
R17	Private - Retreat	37	45	**44**	**52**	40	**48**
R18	BMA - BWM MIA Admin	47	55	52	60	50	58
R19	Private - Tannyfoil	34	42	34	42	32	40
R20	Private	39	**47**	34	42	35	43
R21	Private	38	**46**	33	41	35	43
R22	Private	38	**46**	33	41	34	42
R23	Private	38	**46**	32	40	34	42
R24	Private	36	44	32	40	33	41
R25	Private	36	44	32	40	33	41
R26	Private	36	44	32	40	33	41
R27	Private	35	43	31	39	33	41
R28	Private	34	42	32	40	32	40
R29	Private	34	42	32	40	32	40
R30	Private - Tulloch Ard	30	38	29	37	30	38
R31	Private	29	37	29	37	31	39
R32	Private - Maryvale	26	34	28	36	29	37
R33	Private - Malamy	27	35	27	35	28	36
R34	Private - Malamy	27	35	27	35	28	36
R35	Private - Sherborne	26	34	26	34	28	36
R36	Private	26	34	26	34	27	35
R37	Private	26	34	26	34	27	35

ID	Description	Predicted Noise Level (adj, 15 mins dBA)					
		FY2027		FY2039		FY2044	
		L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}
R39	Private	29	37	28	36	28	36
R40	Private	28	36	28	36	29	37
R41	Private	29	37	28	36	28	36
R42	Private - Monash	23	31	25	33	24	32
R43	Private	24	32	26	34	26	34
R46	Qcoal (Cook Colliery)#	**51**	**59**	38	**46**	34	42
R47	Blackwater Cemetery	31	39	33	41	33	41
R48	Resource recovery centre	33	41	34	42	34	42
R49	Quarry	30	38	34	42	35	43
R50	BWM Airport	47	55	43	51	43	51

Bold and highlighted noise levels represent an exceedance of the **LAeq, adj, 15 min 40 dBA** or **LA1, adj, 15min 45 dBA** noise limit for noise sensitive receptors only.

Greyed cells indicate that the receptor is not considered "sensitive" as defined in the EA.

A commercial receptor by definition of the EA however is an existing coal mine operating under its own EA and therefore very unlikely to be impacted by noise from BWM.

The assessment for the Project identified the following potential noise impacts:

- Under neutral weather conditions, only noise sensitive receptors R5 and R17 are predicted to experience BWM noise levels that exceed the EA noise limits. For sensitive receptor R5, exceedances of the 40 dBA L_{Aeq} and 45 dBA L_{A1} limits are predicted for the FY2039 and FY2044 scenarios (i.e. up to 43 dBA L_{Aeq} and 46 dBA L_{A1} for the FY2044 scenario only). The predicted exceedances are primarily attributed to:
  - Coal haulage trucks operating along the main haul route from pits north of the R20N (i.e. up to 37 dBA L_{Aeq}) and waste haulage trucks operating between pit and waste dumps at ramps east of R5 including R16S, R16N, R20S and R20N (i.e. up to 38 dBA L_{Aeq}).
  - Noise levels at R5 associated with the plant and equipment operating at the Thermal Coal Plant (TCP) have been predicted in the order of 30 dBA, which is likely to be audible at R5 in the absence of other significant ambient noises.

  For sensitive receptor R17, a marginal 1 dBA exceedance of the 45 dBA L_{A1} noise limit is predicted for the FY2039 scenario. The predicted exceedance is attributed to Komatsu 930 waste haul trucks operating in R46S, R46N and R42S.
- Under adverse weather conditions (i.e. temperature inversion), noise limit exceedances have been predicted for the following sensitive receptors:
  - R5 under all three modelled scenarios with exceedances predicted against both the 40 dBA L_{Aeq} and 45 dBA L_{A1} noise limits. The highest predicted exceedance was 48 dBA L_{Aeq} (i.e. 8 dBA above the noise limit) and 56 dBA L_{A1} (i.e. 11 dBA exceedance) for the FY2044 scenario.
  - R6 for the FY2027 scenario (i.e. 2 dBA exceedance of the 45 dBA L_{A1} limit) and for FY2039 and FY2044 scenarios exceedances were predicted against both the 40 dBA L_{Aeq} and 45 dBA L_{A1} noise limits (i.e. by up to 7 dBA). The highest

predicted exceedance was 52 dBA L_{A1} for the FY2044 scenario. Consistent with R5, the exceedances are primarily attributed to coal and waste haulage from ramps to the east and north-east of R6.

- R3 for the FY2044 modelled scenario by a marginal 1 dBA against the 40 dBA L_{Aeq} noise limit and 4 dBA against the 45 dBA L_{A1} noise limit. A marginal 1 dBA exceedance of the L_{A1} noise limit is also predicted for the FY2039 scenario. The predicted exceedances are primarily attributed to waste haulage from ramp R16N and R16S and coal haulage from ramp R14N (i.e. from Komatsu 830s travelling along the main haul road).
- R17 under modelled scenario FY2039 by 4 dBA against the 40 dBA L_{Aeq} noise limit and 7 dBA against the 45 dBA L_{A1} noise limit, and by 3 dBA against the L_{A1} noise limit for the FY2044 scenario. As noted above with the neutral weather predictions, the predicted adverse weather exceedances are primarily attributed to waste haulage from ramps R46N, R46S and R42N.
- For the FY2044 scenario, marginal 2 dBA exceedances of the 45 dBA L_{A1} noise limit has been predicted for sensitive receptors R4 and R7. The exceedances are primarily attributed to coal haulage from the main haul road and waste haulage from the closest ramps.
- For the FY2027 scenario, marginal 1 to 2 dBA exceedances have been predicted for sensitive receptors R20, R21, R22 and R23 (i.e. 46 to 47 dBA L_{A1}), which are all located on the northern side of the Capricorn Highway. However, impacts associated with the Project are not expected for these receptors given the existing high ambient noise levels from the Capricorn Highway.

Considering the above predicted noise limit exceedances, noise mitigation options have been investigated as part of this study. The key noise mitigation options include:

- Using pit and waste dump landform for shielding of waste dump trucks and dozers operating from Pits 16 and 20, when pits are concurrently operated under neutral or adverse weather conditions.
- Mitigation of noise from coal haulage activities near sensitive receptors R5 and R6 via either:
  - Option 1 - use of quieter coal haul trucks on the main haul road such as CAT793s or Kress haulers instead of the Komatsu 830 haul trucks.
  - Option 2 - construction of an acoustic bund/barrier adjacent the main haul road between the TCP and Pit 16 would be effective at reducing mine noise levels at R5, R6 and potentially at R3 and R4.
- Using the pit wall or intervening landform to shield waste dump trucks and dozers operating from Pit 46 and 42 during adverse weather conditions. Alternatively, limiting Komatsu 930 waste haul trucks operating simultaneously from Pits 46 and 42.

While the above noise mitigation measures represent the current leading options for sensitive receptors this doesn't prohibit the BWM from exploring and implementing further alternatives (modelled) that achieve the noise limits (i.e. haul road placement/incline, speed restrictions, landholder agreements and/or land acquisitions).

Cumulative Noise

The technical assessment has also considered the potential for cumulative mine noise impacts for the following:

- Sensitive receptors surrounding the Cook Colliery and potentially impacted by combined noise from the Cook Colliery and BWM.
- Sensitive receptors located between BWM and Curragh Mine.

The assessment has identified the potential for mine noise from BWM and Cook Colliery to result in a combined noise level of 45 dBA L_{Aeq} at sensitive receptor R17. The predicted cumulative noise level is clearly dominated by BWM (i.e. 44 dBA) with the contribution from Cook Colliery (i.e. 34 dBA) increasing the cumulative noise level by a marginal 1 dBA. The noise mitigation options have been designed to ensure that cumulative noise levels at R17 achieve compliance with the 40 dBA noise limit for BWM.

Based on the predicted BWM noise levels at Blackwater township and the existing Curragh Mine EA noise limits, it is anticipated that cumulative noise would not impact the Blackwater township sensitive receptors.

For sensitive receptors located along the Capricorn Highway (west of the township), it is anticipated that cumulative noise impacts would be avoided if noise intensive Curragh Mine operations in the southern extent of ML700006 commence after BWM operations have ceased in R08N.

Blasting

SLR understands that actual blast design parameters, predictive modelling and monitoring of impacts are regularly reviewed and completed for existing blasting activities at BWM, which would continue as part of the Project. Based on the current and future site practices and the conservative AS 2187 calculated Maximum Instantaneous Charges (MICs) completed for this technical assessment (presented in **Table E-4** as MIC to comply with the criteria), it is anticipated that airblast overpressure and ground vibration from the Project can be controlled to acceptable levels at the sensitive receptor locations using current BWM blasting practices.

Table E-4 MICs Calculated to Comply with the 5 mm/s and 10 mm/s Peak Particle Velocity Limits

Sensitive Receptor	Closest Pit in Project Area	Distance to Receptor (m)	Calculated MIC (Kg) to Comply With	
			5 mm/s Criterion (with 10% Exceedance Allowance)	10 mm/s Criterion (Maximum)
R5	16	2,900	3,805	4,275
R8	12	5,000	11,315	12,715
R17	46	1,000	450	505
R19	47	5,400	13,195	14,835

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Appendices

1.0 Introduction

1.1 Overview

The Blackwater Mine (BWM) is located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland. BWM's Mining Leases (MLs) include ML1759, ML1760, ML1761, ML1762, ML1767, ML1771, ML1772, ML1773, ML1792, ML1800, ML1812, ML1829, ML1860, ML1862, ML1907, ML70091, ML70103, ML70104, ML70139, ML70167 and ML70329 (**Figure 1-1**).

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, Environmental Authority (EA) EPML00717813, granted under the Environmental Protection Act 1994 (Qld) (EP Act). The BWM produces up to 16 million tonnes per annum (Mtpa) of product coal.

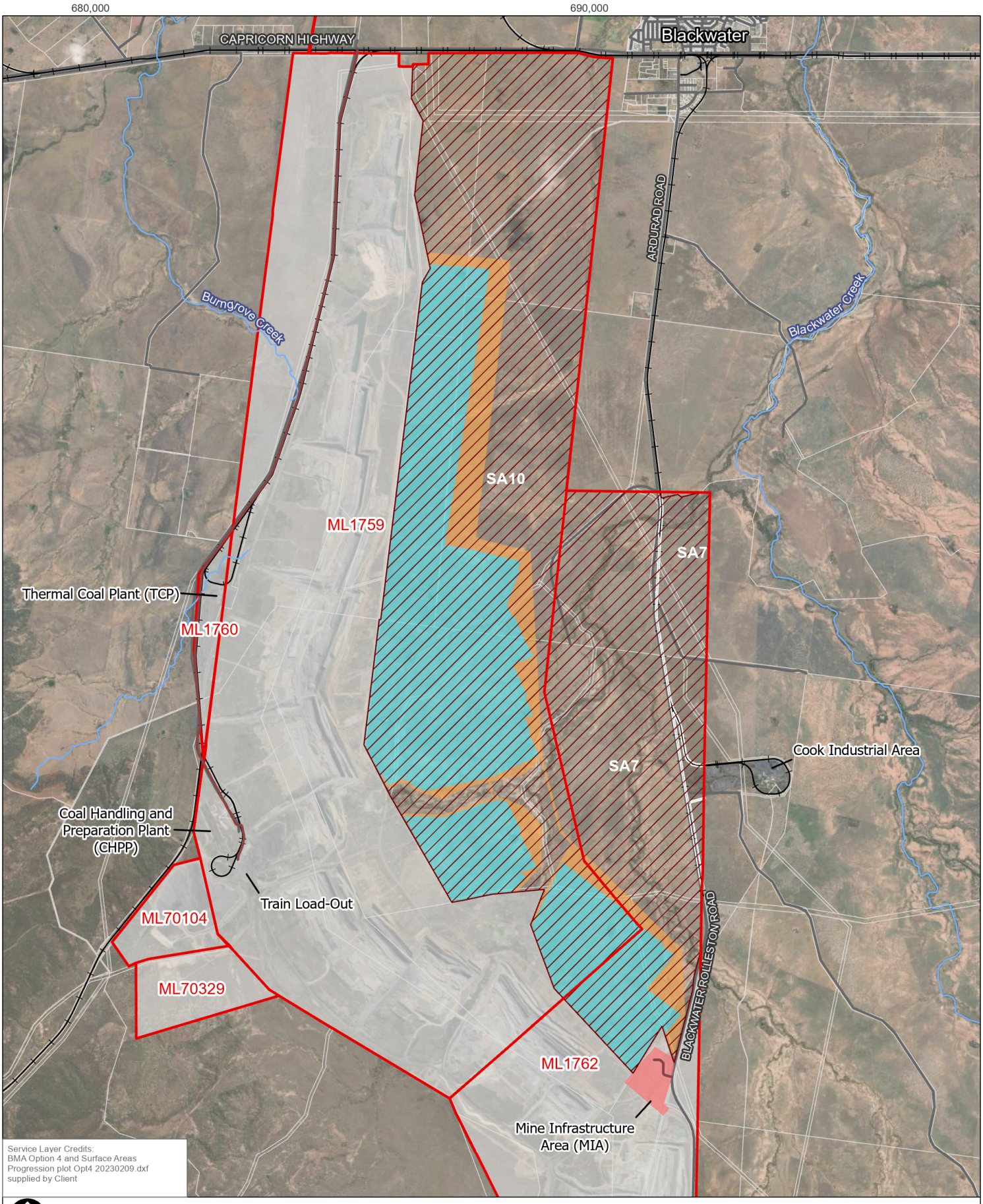
1.2 Purpose and Structure

This Noise and Vibration Impact Assessment Technical Report (the Report) has been prepared by SLR Consulting Australia Pty Ltd (SLR) on behalf of BMA to provide supporting information to the EA Amendment Application under *Section 226* of the *Environmental Protection Act 1994* (EP Act). The structure of the Report is outlined in **Table 1-1**.

Table 1-1 Report Structure

Section	Description
1.0: Introduction	Provides an overview of the purpose of the Report and outlines the structure and supporting documentation.
2.0: Project Description	Provides an overview of the Project, including site description and key noise and vibration generating Project activities.
3.0: Existing Environment	Provides an overview of the assessed sensitive receptors (noise and vibration), and a summary of baseline noise monitoring completed.
4.0: Assessment Criteria	Provides an overview of the noise and vibration assessment criteria that have been prepared for the Report based on the existing EA.
5.0: Assessment Methodology	Presents the noise and vibration impact assessment methodology including assumptions and inputs for both the operational noise modelling and the development of blast site laws to conduct the blasting assessment.
6.0: Noise and Vibration Impact Assessment	Presents the results from both the operational noise modelling and blast impact assessment, including the identification of any receptors where noise/vibration criteria are predicted to be exceeded under one or more of the assessment scenarios.
7.0: Recommendations	Provides noise and vibration management recommendations for the Project based on the outcomes of the noise and vibration impact assessment.
8.0: Conclusion	Summarises the key findings of the Report.

Acoustic terminology used through this Report is explained in further detail in **Appendix A**.



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	620.014601
Date Drawn:	07-Dec-2023
Drawn by:	NT

LEGEND

- Railway
- Road
- Mine Acces Road
- Watercourse
- BWM Mining Lease
- BWM North Extension Project Area
- Cadastre
- Existing Blackwater Mine
- Existing Mine Infrastructure Area

Indicative Project Footprint

- Proposed Out of Pit Disturbance
- Proposed Pit Extent
- SA7/SA10 Extent

BLACKWATER MINE - NORTH EXTENSION PROJECT

PROJECT OVERVIEW

SLR

FIGURE 1-1

Path: H:\Projects-SLR\620-BNE\620-BNE\620.014601.00001 Blackwater NEP\08 GIS\BWM NEP Pro\BWM NEP Pro v1.aprx\620014601_NV_F01_1_Project Overview

2.0 Description of the Project

BM Alliance Coal Operations Pty Ltd (BMA) seek relevant State and Federal approvals to extend the current mining operation through the BWM – North Extension Project (the Project). The Project would extend the mining area of the existing BWM to within Surface Area (SA)10 on ML1759 and SA7 on ML1762 **Figure 1-1**) and increase BWM production to up to 17.6 Mtpa (product coal). Importantly, the Project should be viewed in the context that it is an extension and continuation of ongoing mining operations on a portion of the significantly larger BWM mining operation.

The key elements of the Project include, but are not limited to, the following:

- Vegetation clearing, the removal and stockpiling of topsoil material, drilling and blasting of overburden and interburden material.
- Removal of overburden and interburden material (dragline and truck and shovel/excavator methods) to uncover coal, which is placed as back fill in the mined-out pit voids (in-pit spoil dumps) as mining advances.
- Open cut mining (truck and shovel/excavator methods) of RoM coal from the coal measures in SA10 on ML1759 and SA7 on ML1762.
- Continued use of BWM infrastructure (e.g. Coal Handling and Preparation Plant [CHPP], Thermal Coal Plant [TCP], RoM and product stockpiles, train load-out, water management system and other supporting infrastructure).
- Continued disposal of rejects and tailings in accordance with the EA.
- Construction and operation of new or relocated infrastructure within SA10 on ML1759 and SA7 on ML1762 to facilitate and/or support the open cut mining extension such as back access roads, access tracks, water management infrastructure and powerlines, laydown areas and build pads.
- A new dragline crossing across Deep Creek.
- Ongoing exploration activities within ML1759 and ML1762.
- Progressive rehabilitation of the mine site.

Surface Area SA7 on ML1762 and SA10 on ML1759 cover a total area of approximately 9,010 hectares (ha). The extent of the proposed Project open cut mining area and out of pit disturbance areas is approximately 3,761 ha. If approved, and subject to customer demand, the extension is projected to extend mining at the BWM to within SA7 on ML1762 and SA10 on ML1759 from 2025 to 2085.

2.1 Noise and Vibration Generating Project Activities

The Project mining operations with the potential to generate noise emissions, which form the basis for this assessment, are as follows:

- Progressive land clearing and topsoil removal.
- Stockpiling topsoil from disturbed areas for storage and use in future rehabilitation of the site.
- Drill and blasting of overburden/interburden material (including coal seam blasting).
- Pre-stripping/excavation of overburden material using excavators/shovels and trucks, and dozers.
- Side casting of lower overburden into the previously mined strip using draglines.
- Removal of overburden/interburden and placement in in-pit spoil dumps (IPD).
- Loading and hauling of RoM coal using a combination of excavators, loaders and trucks.
- Progressive rehabilitation by overburden placement, reshaping spoil dumps, topsoiling and revegetation.

New or relocation of existing infrastructure will be required for the Project, however, they are not considered acoustically significant sources of noise in the context of an operational mine and therefore have not been included in this assessment.

There is only one activity, namely blasting, that can produce measurable or perceptible vibration levels at assessed sensitive receptors due to the offset distances between the Project operations and sensitive receptors. **Section 6.3** includes assessment of blasting ground vibration (and airblast overpressure) impacts from the Project.

Potential impacts associated with cumulative mine noise emissions from BWM, Cook Colliery and Curragh Mine have also been considered in the assessment (**Section 6.2**).

3.0 Existing Environment

3.1 Existing Sensitive Receptors

The BWM EA provides the following definitions regarding sensitive and non-sensitive places:

a. A sensitive place means any of the following:

i. a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or

ii. a motel, hotel or hostel; or

iii. an educational institution; or

iv. a medical centre or hospital; or

v. a protected area; or

vi. a public park or gardens.

b. Despite paragraph (a), the following places are not sensitive places:

i. subject to paragraph (c), a place that is the subject of an alternative arrangement; or

ii. *a mining camp (i.e., accommodation and ancillary facilities for mine employees or contractors or both, associated with the mine the subject of the environmental authority), whether or not the mining camp is located within a mining tenement that is part of the mining project the subject of the environmental authority. For example, the mining camp might be located on neighbouring land owned or leased by the same company as one of the environmental authority holders for the mining project, or a related company; or*

iii. *a property owned or leased by one or more of the environmental authority holders, or a related company, whether or not it is subject to an alternative arrangement.*

c. *A place that is the subject of a current alternative arrangement in relation to a particular type(s) of environmental nuisance, is not a sensitive place for the purposes of that type(s) of environmental nuisance, however remains a sensitive place for the purpose of other types of environmental nuisances.*

The BWM EA also provides the following definitions regarding commercial places and non-sensitive places:

a. *A work place that is used as:*

i. *An office; or*

ii. *a place of business; or*

iii. *a place used for commercial purposes.*

b. *Despite paragraph (a), the following places are not commercial places:*

i. *subject to paragraph (c), a place that is the subject of an alternative arrangement; or*

ii. *places that are part of the mining activity; or*

iii. *employees accommodation or public roads; or*

iv. *a property owned or leased by one or more of the environmental authority holders, or a related company, whether or not it is subject to an alternative arrangement.*

c. *A place that is the subject of a current alternative arrangement in relation to a particular type(s) of environmental nuisance, is not a commercial place for the purposes of that type(s) of environmental nuisance, however remains a commercial place for the purpose of other types of environmental nuisances.*

Based on the above definitions, noise and vibration receptors (sensitive and non-sensitive) surrounding and potentially impacted by the Project are listed in **Table 3-1** and identified on **Figure 3-1**.

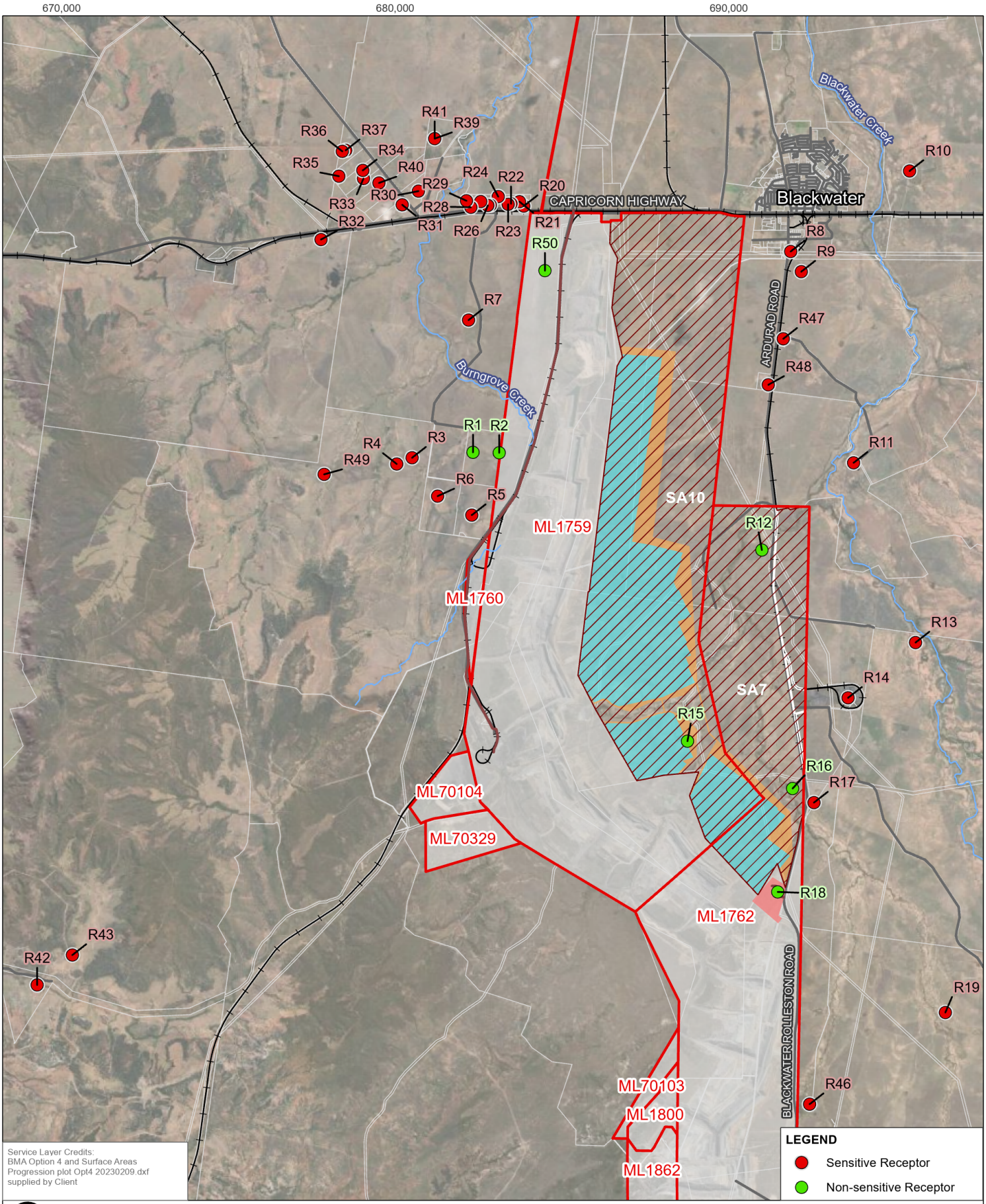
Table 3-1 Noise and Vibration Receptors

ID	Easting (m) [A]	Northing (m) [A]	Description
R1	682,332	7,383,198	BMA
R2	683,118	7,383,184	BMA
R3	680,506	7,383,036	Private - Tolmies Creek Homestead (HS)
R4	680,046	7,382,848	Private - Tolmies Creek HS

ID	Easting (m) [A]	Northing (m) [A]	Description
R5	682,295	7,381,314	Private - Ausbute HS
R6	681,271	7,381,884	Private
R7	682,199	7,387,165	Private - Burngrove HS
R8	691,856	7,389,223	Private (edge of Blackwater township)
R9	692,174	7,388,618	Private - Minyango HS
R10	695,420	7,391,637	Private - Cardona HS
R11	693,741	7,382,883	Private - Tantallon HS
R12	690,992	7,380,267	BMA
R13	695,598	7,377,492	Private - Yarrawonga HS
R14	693,576	7,375,833	Qcoal (Cook Colliery - north)
R15	688,762	7,374,534	Private - Taurus HS
R16	691,913	7,373,114	Private - Stewerton HS
R17	692,554	7,372,690	Private - Retreat HS
R18	691,468	7,370,011	BMA - BWM MIA & Administration
R19	696,492	7,366,393	Private - Tannyfoil HS
R20	683,854	7,390,585	Private
R21	683,725	7,390,717	Private
R22	683,471	7,390,656	Private
R23	683,386	7,390,637	Private
R24	683,088	7,390,869	Private
R25	682,852	7,390,613	Private
R26	682,776	7,390,604	Private
R27	682,564	7,390,721	Private
R28	682,268	7,390,548	Private
R29	682,136	7,390,744	Private
R30	680,696	7,391,034	Private - Tulloch Ard HS
R31	680,210	7,390,623	Private
R32	677,776	7,389,581	Private - Maryvale HS
R33	679,048	7,391,412	Private - Malamy HS
R34	679,029	7,391,655	Private - Malamy HS
R35	678,311	7,391,482	Private - Sherborne HS
R36	678,413	7,392,228	Private
R37	678,517	7,392,258	Private
R39	681,182	7,392,608	Private
R40	679,512	7,391,279	Private
R41	681,184	7,392,609	Private

ID	Easting (m) [A]	Northing (m) [A]	Description
R42	669,266	7,367,221	Private - Monash HS
R43	670,323	7,368,118	Private
R46	692,423	7,363,643	Qcoal (Cook Colliery - south)
R47	691,633	7,386,604	Blackwater Cemetery
R48	691,184	7,385,223	Resource recovery centre
R49	677,869	7,382,537	Quarry
R50	684,392	7,388,504	BWM Airport

[A] Based on GDA 2020 MGA Zone 55 coordinate reference.


670,000
680,000
690,000
7,390,000
7,380,000
7,370,000
Blackwater Creek
Blackwater
CAPRICORN HIGHWAY
ARDURAD ROAD
Burngrove Creek
BLACKWATER ROLLESTON ROAD
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
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R41
R42
R43
R46
R47
R48
R49
R50
ML1759
ML1760
ML1762
ML70104
ML70329
ML70103
ML1800
ML1862
SA10
SA7
LEGEND
Sensitive Receptor
Non-sensitive Receptor
Service Layer Credits:
BMA Option 4 and Surface Areas
Progression plot Opt4 20230209.dxf
supplied by Client
0
2.5
5
km
LEGEND
Railway
Road
Watercourse
Mine Acces Road
BWM Mining Lease
BWM North Extension Project Area
Cadastre
Existing Blackwater Mine
Existing Mine Infrastructure Area
Indicative Project Footprint
Proposed Out of Pit Disturbance
Proposed Pit Extent
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:150,000 at A4
Project Number: 620.014601
Date Drawn: 07-Dec-2023
Drawn by: NT
BLACKWATER MINE -
NORTH EXTENSION PROJECT
PROJECT AREA AND
RECEPTOR LOCATIONS
SLR
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.
FIGURE 3-1
Path: H:\Projects-SLR\620-BNE\620-BNE\620.014601.00001 Blackwater NEP\08 GIS\BWM NEP Pro\BWM NEP Pro v1.aprx\620014601_NV_F03_1_Project_Receptors

3.2 Existing Noise Levels

3.2.1 Background

In April and May 2020, EMM Consulting Pty Ltd (EMM) conducted a baseline noise monitoring survey primarily at four receptor locations surrounding the BWM to quantify and characterise the existing noise environment at the time of the measurements. Supplementary attended noise measurements were conducted in 2021 (EMM 2021) at a further five locations to support the baseline noise monitoring data collected at the four primary receptor locations.

The baseline noise monitoring surveys were completed with Type 1 noise monitoring equipment including a Brüel & Kjær 2250 sound level meter for attended measurements, and Acoustic Research Labs (ARL) Ngara environmental noise loggers for unattended noise measurements. The baseline noise monitoring surveys were conducted in general accordance with the requirements of:

- The Department of Environment and Science's (DES) Noise Measurement Manual 2020.
- Australian Standards (AS) 1055-1997 *Acoustics – Description and Measurement of Environmental Noise.*

3.2.2 Noise Monitoring Locations

The EMM baseline noise monitoring survey consisted of four receptor locations where both unattended and attended noise measurements were conducted, with a further five additional locations where supplementary attended noise measurements were conducted (no unattended measurements). These locations are summarised in **Table 3-2** and referenced on **Figure 3-2**.

Monitoring locations NM7 and NM11 were used by EMM for noise model verification purposes only and as such have not been discussed further in this Report.

Table 3-2 EMM Baseline Noise Monitoring Survey Locations

Location ID (SLR ID)	Monitoring Location [1]	Noise Monitoring Method	Coordinates (MGA 55)	
			Easting	Northing
NM1 (R19)	Tannyfoil Homestead	Unattended and attended	697,016	7,368,303
NM2 (R2)	'Bestgrove' BMA and Others	Unattended and attended	683,482	7,383,106
NM3 (R20)	South of Homestead 1	Unattended and attended	684,074	7,390,392
NM6	Ausco Stayover Camp, Blackwater	Unattended and attended	690,925	7,390,392
NM8	Alternative location 2 (within ML1759, approx. 1.75 km west of Mountain View & Stewerton receptor, east of R16S)	Attended only	689,250	7,380,257
NM9	Alternative location 3 (at the edge of ML1762, approx. 0.5 km WNW of Cook Colliery, east of R52S)	Attended only	691,900	7,363,829

Location ID (SLR ID)	Monitoring Location [1]	Noise Monitoring Method	Coordinates (MGA 55)	
			Easting	Northing
NM10	Alternative location 4 (within ML1759, approx. 1.45 km SSE of NM2, west of R16S)	Attended only	683,428	7,381,676

Note 1: Details provided in brackets are supplementary information SLR has added for the purpose of this Report.

Figure 3-2 EMM Noise Monitoring Locations (EMM 2021)

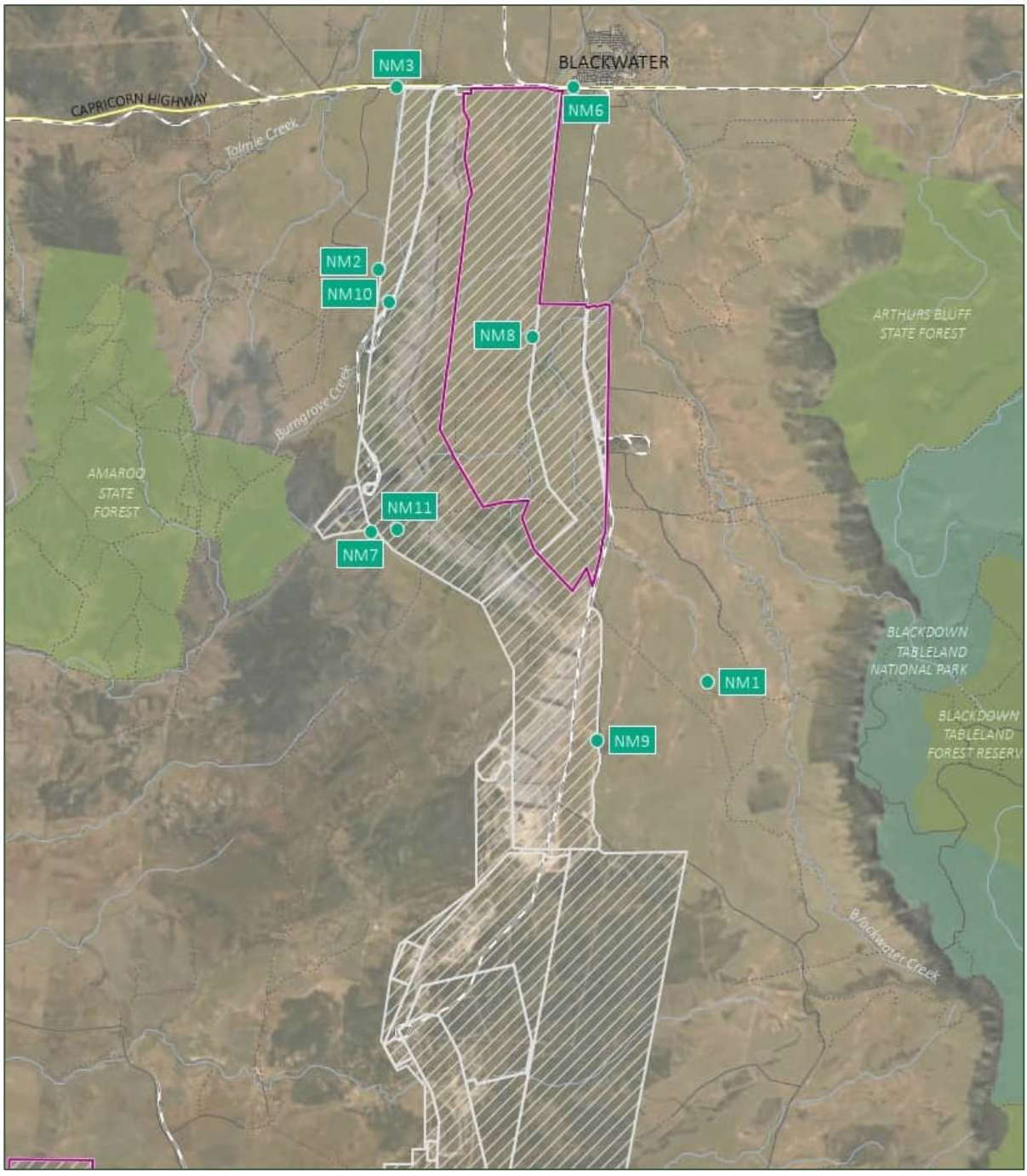


Image source: EMM (note: NM7 and NM11 were used for noise model validation and do not represent receptor locations).

3.2.3 Noise Monitoring Results

The following section documents the attended and unattended noise monitoring results completed as part of EMM's baseline noise monitoring survey.

3.2.3.1 Attended Noise Measurement Results

The results of EMM's attended noise measurements are summarised in **Table 3-3**.

Table 3-3 Summary of Attended Noise Monitoring Results (EMM 2021)

Location ID (SLR ID)	Start Date and Time	Measured Noise Levels (15min, dBA)				BWM Contribution ($L_{Aeq,15min}$ dBA) [1]	Comments
		L_{A90}	L_{Aeq}	L_{A10}	L_{A1}		
NM1 (R19)	17/04/20 09:53	21	27	28	37	Inaudible	BWM noise inaudible. Noise sources include occasional wind, birdsong and insects.
NM2 (R2)	17/04/20 14:02	34	35	37	38	<20	BWM noise occasionally audible. Mine noise includes distant engine revs (approx. 20 dBA) and horn blasts (approx. 22 dBA). Other noise sources include occasional wind, passing vehicles on Blackwater Airport Road, birdsong and insects.
NM3 (R20)	17/04/20 14:54	34	47	50	58	Inaudible	BWM noise inaudible. Noise sources include occasional wind, passing vehicles on Capricorn Highway, birdsong and insects.
NM6	20/04/20 06:30	58	70	74	80	Inaudible	BWM noise inaudible. Noise sources include vehicles passing on Capricorn Highway, birdsong and insects.
NM8	19/04/20 16:14	28	31	34	37	26	BWM noise audible. Mine noise includes distant engine revs (28 dBA) and horn blasts (32 dBA). Other noise sources include wind, birdsong and insects.
NM9	19/04/20 16:47	42	50	46	63	42 [2]	BWM noise audible. Mine noise includes engine revs (45 dBA), light vehicles on mine (49 dBA), dozer tracks (43 dBA) and horn blasts (45 dBA). Other noise sources include vehicles passing on Blackwater Rolleston Road, birdsong and insects.
NM10	19/04/20 17:42	47	59	54	73	42 [2]	BWM noise audible. Mine noise includes engine revs (50 dBA), bucket noise (50 dBA),

Location ID (SLR ID)	Start Date and Time	Measured Noise Levels (15min, dBA)				BWM Contribution ($L_{Aeq,15min}$ dBA) [1]	Comments
		L_{A90}	L_{Aeq}	L_{A10}	L_{A1}		
							haul trucks (59 dBA) and horn blasts (48 dBA). Other noise sources include vehicles passing on Blackwater Airport Road, birdsong and insects.

Note 1: BWM noise contribution was determined using in-field observations and post-analysis of data as required.

Note 2: Although the stated BWM contribution noise level is above the applicable day-time noise limit (see **Table 4-1**, **Section 4.1**), this noise monitoring location does not represent a noise sensitive receptor.

For monitoring locations NM1, NM2 and NM3, the measured attended noise levels and identified sources are representative of daytime noise levels for a rural environment. At the time of the noise measurement at NM6 which is on the outskirts of the Blackwater township, BWM operations were inaudible at this location with the acoustic environment being dominated by road traffic noise from the Capricorn Highway as well as bird song.

EMM noted that at most long-term noise measurement locations, attended measurements showed that BWM was generally inaudible, and where mine noise was audible, other nearby environmental sources were noted as the dominant feature.

3.2.3.2 Unattended Noise Measurement Results

A summary of the EMM unattended noise monitoring carried out between Friday 17 April and Sunday 26 April 2020 is provided in **Table 3-4**. The reported L_{A90} noise levels are interpreted to be Rating Background Levels (RBL).

Table 3-4 Summary of Unattended Noise Logging Results (EMM 2021)

Monitoring Location	L_{A90} Noise Levels (dBA)[1]			L_{Aeq} Noise Levels (dBA)[1,2]			L_{A1} Noise Levels (dBA)[1]		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
NM1	25	32	28	40	47	46	57	55	58
NM2	27	27	24	47	46	43	57	55	57
NM3 [3]	30	33	27	63	59	59	79	77	82
NM6 [3]	43	42	38	68	65	64	81	79	85

Note 1: Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: 10 pm to 7 am.

Note 2: The energy averaged noise level over the measurement period and representative of general ambient noise.

Note 3: These locations are positioned near Capricorn Highway, hence the relatively higher noise levels compared to others.

Like the attended measurements, for monitoring locations NM1, NM2 and NM3, the unattended L_{A90} noise levels presented in **Table 3-4** are typical of a rural setting. The L_{Aeq} and L_{A1} noise levels for NM3 are higher than both NM1 and NM2, and higher than typically observed for a rural setting noting (from **Table 3-3**) that NM3 was influenced by road traffic noise from the Capricorn Highway.

4.0 Assessment Criteria

Under the current BWM EA (EPML00717813), BWM is required to operate in accordance with Schedule C Noise and Vibration Conditions C1 to C10. The current EA conditions have been used for the purpose of setting assessment criteria for this Report.

4.1 Noise – BWM EA Noise Limits

Conditions relevant to noise are contained within Conditions C1 to C4, with numerical noise limits prescribed in Table C1 (Noise Limits) of the EA. Conditions C1 and C2 (which relate to noise nuisance) and Table C1 are reproduced below and in **Table 4-1**.

C1 ***Noise nuisance*** *– Noise from the mining activity must not cause a noise nuisance, at any noise-sensitive place or commercial place.*

C2 *Noise is not considered an environmental nuisance under condition* ***C1*** *if monitoring shows that noise does not exceed the limits in* ***Table C1 (Noise Limits)*** [**Table 4-1**]*, at any sensitive place or commercial place.*

Table 4-1 BWM EA Schedule C Table C1 (Noise Limits)

Noise Level (dBA)	Monday to Sunday (including public holidays)		
	Daytime 7 am – 6 pm	Evening 6 pm – 10 pm	Night-time 10 pm – 7 am
$L_{Aeq, adj,15mins}$	40	40	40
$L_{A1, adj,15mins}$	N/A	N/A	45

The noise limits in **Table 4-1** form the basis for the noise criteria assessed in this Report.

4.2 Blasting – BWM EA Airblast and Vibration Limits

Conditions relevant to vibration and airblast overpressure (from blasting) are contained within Conditions C5 to C10, with numerical blasting vibration and airblast overpressure limits stated in Tables C2 and C3 respectively. Conditions C5 to C8 (which relate to vibration and airblast overpressure nuisance) and Tables C2 and C3 are reproduced below and in **Table 4-2**.

C5 ***Vibration nuisance*** *– Vibration from the mining activities must not cause an environmental nuisance, at any sensitive place or commercial place.*

C6 *Vibration is not considered an environmental nuisance under condition* ***C5*** *if monitoring shows that vibration does not exceed the limits specified in* ***Table C2 (Vibration Limits)*** [**Table 4-2**].

C7 ***Airblast overpressure nuisance*** *– The airblast overpressure level from blasting operations on the mining leases must not cause an environmental nuisance, at any sensitive place or commercial place.*

C8 *Airblast overpressure is not considered an environmental nuisance under condition* ***C7*** *if monitoring shows that airblast overpressure does not exceed the levels specified in* ***Table C3 (Airblast Overpressure Level)*** [**Table 4-2**].

Table 4-2 EA Table C2 and C3 - Blasting Vibration and Airblast Overpressure Limits

Parameter	Sensitive or Commercial Place Blasting Limits
Ground vibration peak particle velocity	5 mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts and not greater than 10 mm/s peak particle velocity at any time.
Airblast overpressure level	115 dB (Linear peak) for nine (9) out of ten (10) consecutive blasts and not greater than 120 dB (Linear peak) at any time.

The blasting vibration and airblast overpressure limits form the basis for the blasting criteria applied to this assessment.

5.0 Assessment Methodology

5.1 Assessed Mining Activities and Assumptions

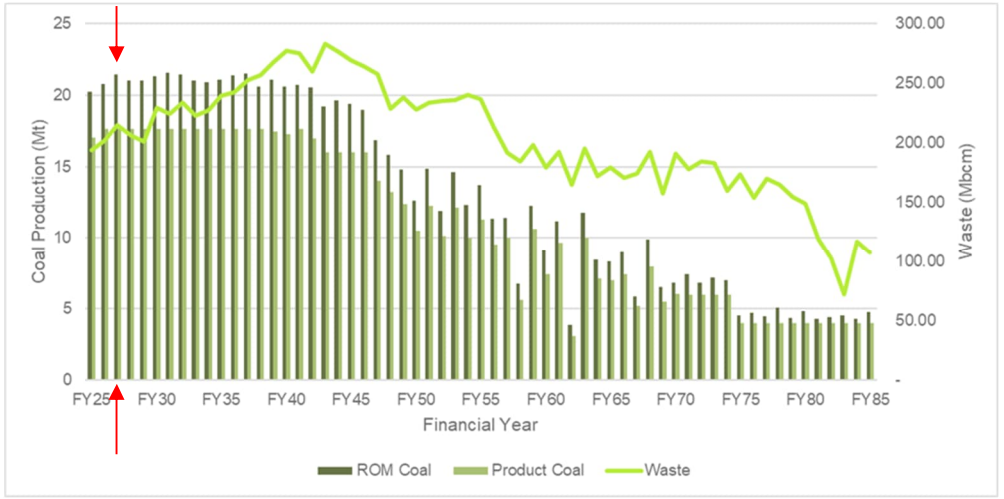
The selection of noise modelling/assessment scenarios for the Project was based on activities with the greatest potential to result in noise at the identified sensitive receptors. This included when plant and equipment (noise sources) would be at the closest proximity to receptors (i.e. due to active mining pits and in-pit spoil dumps) and where there would be limited screening of noise from on-site structures or topography.

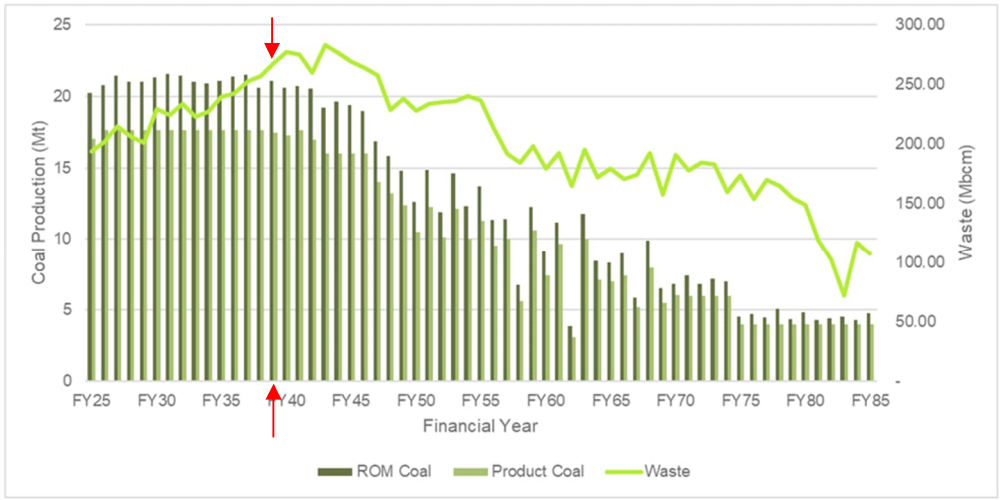
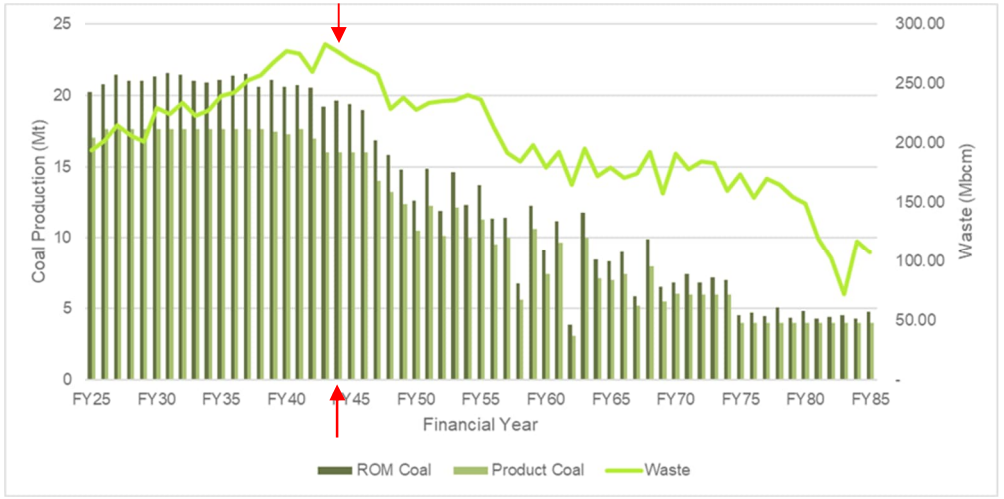
The assessment scenarios in **Table 5-1** were developed to assess potential 'typical worse-case' noise levels with consideration of the following:

- Progressive mining within the Project footprint including the eastward progression of active BWM pits and adjacent in-pit spoil dumps.
- Consideration of peak extraction years for both coal and waste (which occur at different times), and peak mobile mining equipment numbers.

We note that the assessment scenarios are biased towards the initial 20 years of the Project life, however, as indicated in **Table 5-1**, equipment numbers and production rates are progressively reduced from circa FY2045 and only one sensitive receptor east of BWM (i.e. R17) is close enough to potentially be impacted by the Project. When the Project is at its closest to R17 (i.e. approximately 1 km) all mining equipment would be within the pit operating behind the High Wall (HW) and be significantly shielded from R17.

Table 5-1 Assessed Operational Scenarios and Associated Mining Activities

Scenario	Scenario Justification	Mine Plan Diagram
FY2027	The FY2027 mine plan coincides with an increase in Komatsu 930 and 830 haul trucks (i.e. 62 (in FY2026) to 77 for the 930s, and 6 to 19 for the 830s). FY2027 also aligns well with the BWM (including Project) production and RoM rates shown below.	

Scenario	Scenario Justification	Mine Plan Diagram
FY2039	The FY2039 mine plan coincides with another increase in Komatsu 930 haul trucks (i.e. 108 (in FY2038) to 122), and minor increases in D11 dozers, waste shovel and water truck. The FY2039 will also be representative of worst-case mining in the southern extent of SA7 closest to sensitive receptor R17.	
FY2044	The FY2044 mine plan coincides with the peak total fleet of 324 items and aligns with the prime stripping volumes as shown in the figure below.	

The noise assessment was based on the key assumptions and exclusions outlined below:

- New or relocation of existing infrastructure will be required for the Project, however, they are not considered acoustically significant sources of noise and therefore have not been included in this assessment.
- For all three modelled scenarios, the noise assessment involved the modelling of noise sources associated with:
  - All acoustically significant mine equipment proposed to be operated in the north of BWM including equipment operating within SA10 on ML1759 and SA7 on ML1762 where applicable to each scenario.
  - Fixed plant operating at the CHPP and TCP as well as associated mobile mining equipment assigned to these areas.
- With the exception of coal haulage trucks, mining equipment assigned to pits south of Pit 63 have not been modelled since these pits are further than 10 km from SA10 and SA7 and 12 km from the closest sensitive receptor (i.e. R19) and any noise contribution from these pits would be acoustically negligible at sensitive receptors surrounding the Project footprint (i.e. shown in **Figure 3-1**). Where applicable, coal haulage trucks to/from pits south of Pit 63 have been included in the noise modelling.
- 3-D mine plans for BWM were provided by BMA for the FY2027, FY2039 and FY2044 modelled scenarios.
- With regard to mobile mining equipment, BMA advised the type and quantity of equipment proposed to be operated for BWM for the modelled scenarios (further details provided in **Section 5.2.3**).
- Haul trucks (coal and waste), graders, water carts have been modelled as line sources to reflect the mobile nature of these sources. Line sources contain all acoustic energy spread across the line source representing a path each source would travel over a representative 15-minute assessment period. To calculate the path travelled over the assessment period, the following average speeds have been assumed in consultation with BMA:
  - For CAT and Komatsu haul trucks, approximately:
    - 35 to 40 km/hr for flat haul roads.
    - 10 km/hr for pit ramps (i.e. loaded ascents and unloaded descents).
  - Water Carts – 15 km/hr.
  - Graders – 5 km/hr.
- To account for the total number of waste and coal haulage trucks proposed for each pit/activity, an assumption has been made that one idle haul truck would be located next to the active loader (with relatively insignificant noise emission levels) and the remaining number of trucks are considered in calculating a total line source to simulate the haulage circuit.
- All remaining equipment (i.e. draglines, excavators, shovels, loaders, dozers, drills) has been modelled as point sources in a typical location for the pit/activity. For waste dozers, the modelled point source location was conservatively biased towards the more exposed end of the push journey.
- All operations will be continuous 24-hours a day and seven days a week. As such, no allowance was made for periods when plant would be temporarily idle or not in use.
- To assess L_{A1} noise levels, a +8 dB relationship between the L_{Aeq} and L_{A1} has been applied where mobile mining equipment was identified as the dominant noise source. This theoretical

maximum (+8 dB) relationship is considered conservative in that it is based on the 'cumulative' L_{Aeq} noise level (i.e. all modelled equipment considered) where, in reality, the L_{A1} is likely to result from more isolated events such as excessive engine revving from a single haul truck, overburden dumping or dozer track slap.

- The Project would not require any material change to existing fixed plant operating at BWM. As such, modelling of these sources has been based on typical noise source data for the acoustically significant fixed plant items at BWM, including both the BWM CHPP and TCP.
- Rail noise has been excluded from this assessment as rail operations are not proposed to change as a result of the Project. Further, given it's an existing noise source, sensitive receptors are unlikely to associate future rail noise as part of the Project.
- Progressive rehabilitation activities are inherently assessed through the reported assessment of mining operations. Assessment of final rehabilitation activities (i.e. post mine closure) has not been considered. Noise emissions during this final rehabilitation would be minor in comparison to predicted noise levels from coal mining operations.

5.2 Noise Prediction Modelling

5.2.1 Modelling Software and Algorithm

A SoundPLAN (version 8.2) computer noise model was developed to predict mine noise levels at the nominated noise sensitive receptors. SoundPLAN is a computer model software package enabling calculation of environmental noise by combining a digitised ground map (topography), the location and acoustic sound power levels of potentially critical noise sources on site and the location of receivers for assessment purposes.

The model can calculate noise levels taking into account such factors as the sound power levels and locations of noise sources, distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions, including wind effects.

The *Conservation of Clean Air and Water Europe* (CONCAWE 1981) prediction methodology was utilised within SoundPLAN. The CONCAWE prediction method is specifically designed for large industrial facilities and incorporates the influence of wind effects and the stability of the atmosphere.

The statistical accuracy of environmental noise predictions using CONCAWE was investigated by Marsh (Applied Acoustics 15 – 1982). Marsh concluded that CONCAWE was accurate to ±2 dBA in any one octave band between 63 hertz (Hz) and 4 kHz and ± 1 dBA overall.

In relation to the modelling of atmospheric conditions, DES's (currently under review) Ecoaccess Guideline '*Planning for Noise Control'* (PNC) provides guidance with respect to assessing the potential for noise enhancements due to prevailing atmospheric conditions. This is discussed in **Section 5.2.2**.

5.2.2 Modelled Weather Parameters

5.2.2.1 Wind

In accordance with PNC, meteorological data for BWM for the 12-month period of 1 January 2019 to 31 December 2019[1] was analysed for the following wind parameters to confirm whether a 'prevailing' wind component was a feature of the area:

[1] Data provided by AED Pty Ltd who completed the Air Quality Impact Assessment for the Project.

- 30% occurrence in any assessment period (day, evening or night) in any season.
- 3 m/s or less source to receptor component.
- 10 m height for wind speed.

The wind analysis, presented as wind roses in **Appendix B**, indicated that for the analysed 12-month period of meteorological data, there were no calculated periods of wind of up to 3 m/s (from a particular direction) occurring at least 30 per cent of the time in any one season and assessment period. Peak wind occurred during the evening period in autumn (i.e. up to 20 percent from an easterly direction). Therefore, a prevailing wind component has not been considered a feature of the Project area and has not been included as an assessable weather condition scenario for this assessment.

5.2.2.2 Temperature Inversion

In accordance with PNC, meteorological data for BWM was analysed for the following temperature inversion parameters (non-arid) to confirm whether temperature inversions are a feature of the area:

- 30% occurrence of temperature inversions for the time period of (6:00 pm to 7:00 am during winter (June, July, August).

As noted in Fact Sheet D of the New South Wales *Noise Policy for Industry* (NPfI), the frequency of occurrence of temperature inversions may be determined either by direct measurement of inversion parameters, or by using indirect methods that allow the prediction of wind and temperature profiles to within a moderately narrow range using readily available meteorological data. The indirect method, used for the Project, allows the susceptibility of an area to inversions to be determined through the use of the relationship between atmospheric stability categories and inversions developed by the US Atomic Energy Commission.

The relationship, shown in **Table 5-2** together with the modelling results for the Project (of vertical temperature gradient between 10 m and 100 m above ground level), outlines the range of temperature gradients that can be expected within each stability class with a positive temperature gradient (i.e. stability categories “E”, “F” and “G”) indicating a temperature inversion.

Table 5-2 Stability Categories and Frequency of Occurrence at the Project – Winter Months (6:00 pm – 7:00 am)

Stability Category	Range of Vertical Temperature Gradient (°C/100 m)	Percentage of Occurrence
A	DT/DZ < –1.9	0.0%
B	–1.9 ≤ DT/DZ < –1.7	0.2%
C	–1.7 ≤ DT/DZ < –1.5	3.8%
D	–1.5 ≤ DT/DZ < –0.5	11.8%
E	– 0.5 ≤ DT/DZ < 1.5	7.9%
F	1.5 ≤ DT/DZ < 4.0	76.3%
G	4.0 ≤ DT/DZ	Considered as part of the F class percentage

The results of the modelling of temperature gradient over the Project area indicated a 76% occurrence of temperature inversions during the winter evening and night-time period. Therefore, temperature inversions are considered to be a characteristic of the Project area and have been considered as part of this assessment.

5.2.2.3 Project Modelled Weather Parameters

Based on the meteorological analysis presented in **Sections 5.2.2.1** and **5.2.2.2**, the default weather parameters recommended by PNC have been referenced to determine the effects of meteorology on noise emissions from the Project. The weather parameters applied to this assessment are summarised **Table 5-3**.

Table 5-3 Modelled Meteorological Conditions – Neutral and Adverse Scenarios

Parameter	Neutral Weather	Adverse Weather – Temperature Inversion
Temperature	10 °C	10 °C
Humidity	70%	90%
Pasqual stability class	D	F (representative of temperature inversion)
Wind speed	0 m/s	0 m/s

5.2.3 Noise Sources, Sound Power Levels and Location

With reference to the modelled mine scenarios (refer to **Table 5-1**), **Table 5-4** and **Table 5-5** summarise the following model inputs:

- Mine equipment make, model and numbers relevant to the assessed operational scenarios as provided by BMA. As noted in **Section 5.1**, this does not translate to the exact number of mine equipment included in the noise model as the equipment/sources assigned to pits south of Pit 63 have not been included in the noise model except for coal haulage trucks where applicable.
- Assumed overall sound power level (SWL) data and source emission heights for each equipment item - developed by SLR based on details from similar recently assessed coal mining projects.

Table 5-4 BWM Equipment and Sound Power Levels

Equipment type	Make and Model	SWL (dBA, L_{Aeq})	Source Height (m) [1]	Total BWM Quantity per Scenario Year		
				FY2027	FY2039	FY2044
Dragline	2x Marion 8200 3x Marion 8050 2x BucyrusErie 1370W Additional units shall be Marion 8050	118 (each unit)	20	7	7	7
Waste Shovel/ 800t Excavator	CAT 7495 HD P&H 4100XPC-AC Liebherr 9800	123 to 126	6 to 15	5	9	10
Waste Excavator (600t)	2x CAT 6060 2x Terex RH340B Additional units shall be CAT 6060	124 to 125	4	5	5	3
Waste Excavator (400t)	1x CAT 6040 1x Hitachi EX3600	117 to 118	4	2	2	2

Equipment type	Make and Model	SWL (dBA, L_{Aeq})	Source Height (m) [1]	Total BWM Quantity per Scenario Year		
				FY2027	FY2039	FY2044
Coal Excavator (400t)	1x Terex RH170B 1x Hitachi EX3600 2x Komatsu WA1200	117 to 119	3 to 4	4	4	4
Shovel – Reject (CHPP and TCP)	CAT 988G	113	3	1	1	1
Dozers at CHPP	CAT D11T	119	3	2	2	2
Dozer at TCP	CAT 854 wheeled dozer	112	3	1	1	1
Waste Dozer Fleet (on dumps)	CAT D11T	119	3	19	26	26
Dozers with Waste Draglines, Shovels, Excavator	CAT D10T	116	3	10	10	10
	CAT D11T	119	3	17	23	21
Dozer with Coal Excavator, Loaders	CAT D11T	119	3	4	4	4
Dozer on Rejects	CAT D11T	119	3	2	2	2
Dozer on topsoil	CAT D11T	119	3	2	2	2
Wheel dozer	CAT 854	118	3	2	2	2
Waste Haul Trucks	Komatsu 930	124	3	77	122	152
Coal Haul Trucks	CAT 793	119	3	7	0	0
	Komatsu 830	123	3	19	23	24
Drill	Sandvik D90K, Epiroc DM-M3, Epiroc PV275	118 (each unit)	3	11	13	14
Watercarts	CAT 789D-W-HDAL	118	3	16	20	19
Graders	CAT 24M CAT 18M CAT 16M	113 to 116	3 to 4	12	14	14

Note 1: Based on acoustic centre of equipment as distinct from the maximum height of the equipment.

Table 5-5 Octave Band SWL for Modelled Noise Sources

Source	SWL, dBA LAeq									
	Overall	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Dragline (all)	118	83	97	102	110	112	113	109	102	94
CAT 7495	123	86	94	112	116	117	117	115	111	99
P&H 4100XPC-AC	123	86	94	112	116	117	117	115	111	99
Liebherr 9800	126	87	95	114	118	120	120	118	113	100
CAT 6060	125	86	94	113	117	119	119	117	112	99
Terex RH340B	124	85	93	112	116	118	118	116	111	98
CAT 6040	118	78	86	106	109	112	111	111	105	97
Hitachi EX3600	117	78	86	106	109	111	111	111	105	97
Terex RH170B	118	78	86	106	109	112	111	111	105	97
Komatsu WA1200	119	81	89	108	111	113	113	112	107	100
CAT 988G/K	113	74	82	101	105	107	107	105	100	93
CAT D10T	116	78	89	104	106	110	113	107	101	97
CAT D11T	119	84	98	99	109	114	112	111	109	103
CAT 854	112	80	89	104	97	106	107	107	92	80
CAT 793	119	77	98	100	108	113	113	113	107	97
Komatsu 830	123	78	102	112	114	117	117	117	111	102
Komatsu 930	124	79	103	113	115	118	118	118	112	103
Drill	118	83	97	102	110	113	113	110	105	94
CAT 789D-W-HDAL	118	76	97	99	107	112	112	112	106	96
CAT 16M	113	71	94	100	106	103	109	106	102	90
CAT 18M	113	71	94	100	106	103	109	106	102	90
CAT 24M	116	74	97	103	109	106	112	109	105	93

5.3 Cumulative Noise Impact Assessment

The assessment has also considered the potential for cumulative mine noise impacts for the following:

- Sensitive receptors surrounding the Cook Colliery and potentially impacted by combined noise from the Cook Colliery and BWM.
- Sensitive receptors located between BWM and Curragh Mine.

The location of Curragh Mine and Cook Colliery in relation to BWM is shown in **Figure 5-1**.

The cumulative noise assessment has been based on the following information sources:

- Noise modelling predictions for the Project which quantifies the contribution from BWM.
- Curragh Extension Project footprint and existing Curragh Mine EA (EPML00643713).

- SLR predicted Cook Colliery noise levels estimated from surface equipment operating at the mine identified from review of aerial imagery.

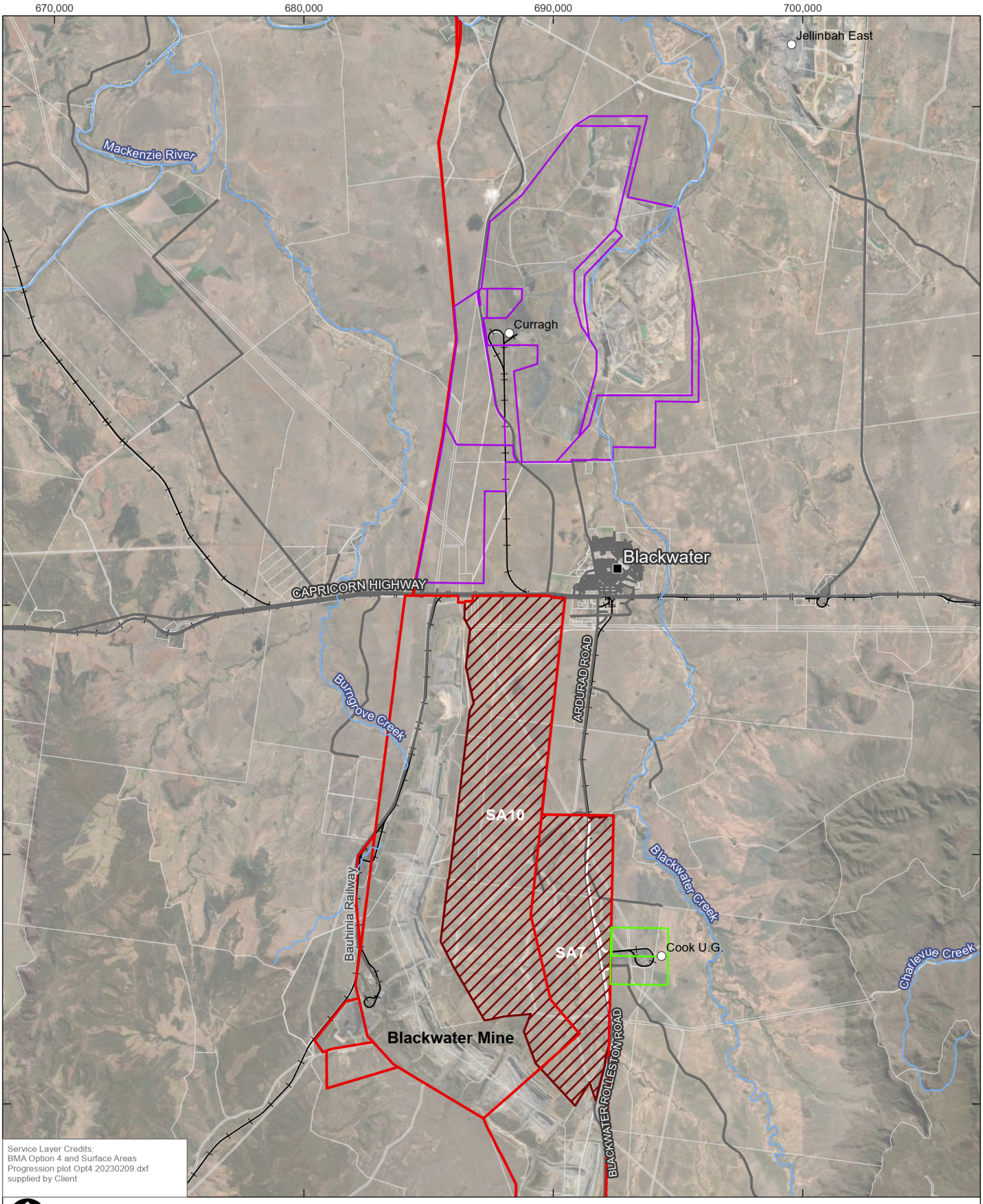
5.4 Blasting

Blasting will continue for the Project as currently employed at BWM, that is approximately one to three times per week. Blasting at BWM is utilised for overburden and interburden, including through seam blasting as necessary, at depths typically ranging from 6 m to 65 m. Subject to operational requirements, blasting occurs on any day of the week during daylight hours. The predominate explosive used in blasting activities at the BWM is ammonium nitrate/fuel oil (ANFO), which is the most common explosive used in the mining industry in Queensland.

SLR understands that existing BWM blasting is informed by modelling carried out using Blast Logic software and this would continue to be the case for future blasts within the Project disturbance areas. Notwithstanding this, BMA have provided the following blasting inputs advice to enable an assessment of the potential for BWM blast impacts in accordance with the attenuation formula in Australian Standard AS 2187.2 – 2006 *Explosives- Storage, Transport and Use – Part 2 Use of Explosives* (AS 2187):

- Typical maximum instantaneous charge mass (MIC, kgs) of 100 to 200 kg for a 1 millisecond (ms) window with a maximum of 1,000 kg for an 8 ms window for coal blasting.
- Typical MICs of 250 to 550 kg for a 1 ms window for pre-split blasts.
- Typical MICs of 1,000 to 4,500 kg for a 1 ms window for production blasts.

Section 6.3 includes assessment of air blast overpressure and ground vibration impacts from the Project.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:200,000 at A4
Project Number:	620.014601
Date Drawn:	07-Dec-2023
Drawn by:	NT

LEGEND

- City/Town
- Coal Mine
- Railway
- Road
- Watercourse
- BWM Mining Lease
- BWM North Extension Project Area
- Constellation Mining Pty Ltd.
- Coronado Curragh Pty Ltd.
- Cadastre

BLACKWATER MINE - NORTH EXTENSION PROJECT

LOCATION OF CURRAGH MINE AND COOK COLLIERY IN RELATION TO BWM

SLR

FIGURE 5-1

Path: H:\Projects-SLR\620-BNE\620-BNE\620.014601.00001 Blackwater NEP\08 GIS\BWM NEP Pro\BWM NEP Pro v1.aprx\620014601_NV_F05_1_Cumulative Noise

6.0 Noise and Vibration Impact Assessment

6.1 Mine Operational Noise Emission

6.1.1 Predicted Operational Noise Levels

The predicted noise levels from the modelled operational scenarios (i.e. FY2027, FY2039 and FY2044) are summarised in **Table 6-1** for neutral weather conditions and **Table 6-2** for adverse weather conditions, with noise level contour maps presented in **Appendix C**. As noted in **Section 5.1**, the predicted noise levels include all acoustically significant equipment operating in the north of BWM including within the extension areas of SA10 and SA7.

Table 6-1 Predicted BWM Operational Noise Levels – Neutral Weather

ID	Description	Predicted BWM Noise Level (adj, 15 mins dBA)					
		FY2027		FY2039		FY2044	
		L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}
EPML00717813 noise limits		**40**	**45**	**40**	**45**	**40**	**45**
R1	BMA	33	41	36	44	41	49
R2	BMA	36	44	38	46	45	53
R3	Private - Tolmies Creek HS	28	36	31	39	34	42
R4	Private - Tolmies Creek HS	27	35	30	38	33	41
R5	Private - Ausbute HS	39	**47**	**42**	**50**	**43**	**51**
R6	Private	33	41	35	43	37	45
R7	Private - Burngrove HS	29	37	30	38	32	40
R8	Private (edge Blackwater township)	22	30	24	32	23	31
R9	Private - Minyango HS	22	30	24	32	23	31
R10	Private - Cardona HS	17	25	17	25	18	26
R11	Private - Tantallon HS	23	31	25	33	25	33
R12	BMA	29	37	29	37	30	38
R13	Private - Yarrawonga HS	23	31	26	34	24	32
R14	Qcoal (Cook Colliery - north)[#]	26	34	30	38	27	35
R15	Private - Taurus HS	36	44	42	50	40	48
R16	Private - Stewerton HS	30	38	38	46	34	42
R17	Private - Retreat HS	30	38	38	**46**	34	42
R18	BMA - BWM MIA Administration	42	50	47	55	45	53
R19	Private - Tannyfoil HS	27	35	27	35	24	32
R20	Private	34	42	27	35	29	37
R21	Private	33	41	27	35	28	36
R22	Private	32	40	26	34	28	36

ID	Description	Predicted BWM Noise Level (adj, 15 mins dBA)					
		FY2027		FY2039		FY2044	
		L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}
R23	Private	32	40	26	34	27	35
R24	Private	30	38	25	33	26	34
R25	Private	30	38	25	33	26	34
R26	Private	29	37	25	33	26	34
R27	Private	28	36	24	32	26	34
R28	Private	28	36	25	33	25	33
R29	Private	27	35	25	33	25	33
R30	Private - Tulloch Ard HS	23	31	22	30	23	31
R31	Private	22	30	22	30	23	31
R32	Private - Maryvale HS	19	27	20	28	22	30
R33	Private - Malamy HS	19	27	20	28	21	29
R34	Private - Malamy HS	19	27	20	28	21	29
R35	Private - Sherborne HS	19	27	19	27	21	29
R36	Private	18	26	19	27	20	28
R37	Private	18	26	19	27	20	28
R39	Private	22	30	20	28	21	29
R40	Private	20	28	20	28	22	30
R41	Private	22	30	20	28	21	29
R42	Private - Monash HS	15	23	18	26	16	24
R43	Private	17	25	19	27	18	26
R46	Qcoal (Cook Colliery - south)#	**46**	**54**	32	40	27	35
R47	Blackwater Cemetery	24	32	26	34	25	33
R48	Resource recovery centre	25	33	27	35	27	35
R49	Quarry	23	31	26	34	28	36
R50	BWM Airport	43	51	38	46	38	46

Bold and highlighted noise levels represent an exceedance of the **LAeq, adj, 15 min 40 dBA** and/or **LA1, adj, 15min 45 dBA** noise limit for noise sensitive receptors only.

Greyed cells indicate that the receptor is not considered "sensitive" as defined in the EA.

A commercial receptor by definition of the EA however is an existing coal mine operating under its own EA and therefore very unlikely to be impacted by noise from BWM.

Table 6-2 Predicted BWM Operational Noise Levels – Adverse Weather

ID	Description	Predicted BWM Noise Level (adj, 15 mins dBA)					
		FY2027		FY2039		FY2044	
		L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}
EPML00717813 noise limits		**40**	**45**	**40**	**45**	**40**	**45**
R1	BMA	39	47	42	50	47	55
R2	BMA	42	50	43	51	50	58
R3	Private - Tolmies Creek HS	35	43	38	**46**	**41**	**49**
R4	Private - Tolmies Creek HS	34	42	37	45	39	**47**
R5	Private - Ausbute HS	**44**	**52**	**47**	**55**	**48**	**56**
R6	Private	39	**47**	**41**	**49**	**44**	**52**
R7	Private - Burngrove HS	35	43	36	44	39	**47**
R8	Private (edge of Blackwater township)	30	38	32	40	31	39
R9	Private - Minyango HS	29	37	32	40	30	38
R10	Private - Cardona HS	25	33	25	33	26	34
R11	Private - Tantallon HS	30	38	32	40	32	40
R12	BMA	36	44	36	44	38	46
R13	Private - Yarrawonga HS	31	39	33	41	32	40
R14	Qcoal (Cook Colliery – north)	33	41	37	45	35	43
R15	Private - Taurus HS	42	50	48	56	46	54
R16	Private - Stewerton HS	37	45	45	53	41	49
R17	Private - Retreat HS	37	45	**44**	**52**	40	**48**
R18	BMA - BWM MIA Administration	47	55	52	60	50	58
R19	Private - Tannyfoil HS	34	42	34	42	32	40
R20	Private	39	**47**	34	42	35	43
R21	Private	38	**46**	33	41	35	43
R22	Private	38	**46**	33	41	34	42
R23	Private	38	**46**	32	40	34	42
R24	Private	36	44	32	40	33	41
R25	Private	36	44	32	40	33	41
R26	Private	36	44	32	40	33	41
R27	Private	35	43	31	39	33	41
R28	Private	34	42	32	40	32	40
R29	Private	34	42	32	40	32	40
R30	Private - Tulloch Ard HS	30	38	29	37	30	38

ID	Description	Predicted BWM Noise Level (adj, 15 mins dBA)					
		FY2027		FY2039		FY2044	
		L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}	L_{Aeq}	L_{A1}
R31	Private	29	37	29	37	31	39
R32	Private - Maryvale HS	26	34	28	36	29	37
R33	Private - Malamy HS	27	35	27	35	28	36
R34	Private - Malamy HS	27	35	27	35	28	36
R35	Private - Sherborne HS	26	34	26	34	28	36
R36	Private	26	34	26	34	27	35
R37	Private	26	34	26	34	27	35
R39	Private	29	37	28	36	28	36
R40	Private	28	36	28	36	29	37
R41	Private	29	37	28	36	28	36
R42	Private - Monash HS	23	31	25	33	24	32
R43	Private	24	32	26	34	26	34
R46	Qcoal (Cook Colliery - south)	**51**	**59**	38	**46**	34	42
R47	Blackwater Cemetery	31	39	33	41	33	41
R48	Resource recovery centre	33	41	34	42	34	42
R49	Quarry	30	38	34	42	35	43
R50	BWM Airport	47	55	43	51	43	51

Bold and highlighted noise levels represent an exceedance of the **LAeq, adj, 15 min 40 dBA** and/or **LA1, adj, 15min 45 dBA** noise limit for noise sensitive receptors only.

Greyed cells indicate that the receptor is not considered "sensitive" as defined in the EA.

A commercial receptor by definition of the EA however is an existing coal mine operating under its own EA and therefore very unlikely to be impacted by noise from BWM.

From the noise prediction modelling results presented in **Table 6-1** (neutral weather) and **Table 6-2** (adverse weather), the following is noted:

- Under neutral weather conditions, only noise sensitive receptors R5 and R17 are predicted to experience BWM noise levels that exceed the EA noise limits. For sensitive receptor R5, exceedances of the 40 dBA L_{Aeq} and 45 dBA L_{A1} limits are predicted for the FY2039 and FY2044 scenarios (i.e. up to 43 dBA L_{Aeq} and 46 dBA L_{A1} for the FY2044 scenario only). The predicted exceedances are primarily attributed to:
  - Coal haulage trucks operating from ramp R20N and travelling along the main haul route to the CHPP for the FY2039 scenario.
  - Coal haulage trucks operating from ramp R14N and travelling along the main haul route to the CHPP for the FY2044 scenario.
  - Waste mining activities occurring between ramps R16N to R20N, haulage trucks operating between pits and waste dumps at ramps east of R5 between ramps R16S and R16N.
  - Noise levels at R5 associated with the plant and equipment operating at the TCP have been predicted in the order of 30 dBA under neutral weather conditions, which is likely to be audible at R5 particularly in the absence of other significant ambient noises.

For sensitive receptor R17, a marginal 1 dBA exceedance of the 45 dBA L_{A1} noise limit is predicted for the FY2039 scenario. The predicted exceedance is attributed to Komatsu 930 waste haul trucks operating in R46S, R46N and R42S.

- Under adverse weather conditions (i.e. temperature inversion), noise limit exceedances have been predicted for the following sensitive receptors:
  - R5 under all three modelled scenarios with exceedances predicted against both the 40 dBA L_{Aeq} and 45 dBA L_{A1} noise limits. The highest predicted exceedance was 48 dBA L_{Aeq} (i.e. 8 dBA above the noise limit) and 56 dBA L_{A1} (i.e. 11 dBA exceedance) for the FY2044 scenario. As noted above, the exceedances are primarily attributed to coal and waste haulage from ramps to the east and north-east of R5.
  - R6 for the FY2027 scenario (i.e. 2 dBA exceedance of the 45 dBA L_{A1} limit) and for FY2039 and FY2044 scenarios exceedances were predicted against both the 40 dBA L_{Aeq} and 45 dBA L_{A1} noise limits (i.e. by up to 7 dBA). The highest predicted exceedance was 52 dBA L_{A1} for the FY2044 scenario. Consistent with R5, the exceedances are primarily attributed to coal and waste haulage from ramps to the east and north-east of R6.
  - R3 for the FY2044 modelled scenario by a marginal 1 dBA against the 40 dBA L_{Aeq} noise limit and 4 dBA against the 45 dBA L_{A1} noise limit. A marginal 1 dBA exceedance of the L_{A1} noise limit is also predicted for the FY2039 scenario. The predicted exceedances are primarily attributed to waste haulage from ramp R16N and R16S and coal haulage from ramp R14N (i.e. from Komatsu 830s travelling along the main haul road).
  - R17 under modelled scenario FY2039 by 4 dBA against the 40 dBA L_{Aeq} noise limit and 7 dBA against the 45 dBA L_{A1} noise limit, and by 3 dBA against the L_{A1} noise limit for the FY2044 scenario. As noted above with the neutral weather predictions, the predicted adverse weather exceedances are primarily attributed to waste haulage from ramps R46N, R46S and R42N.
  - For the FY2044 scenario, marginal 2 dBA exceedances of the 45 dBA L_{A1} noise limit has been predicted for R4 and R7. The exceedances are primarily attributed to coal haulage from the main haul road and waste haulage from the closest ramps.
  - For the FY2027 scenario, marginal 1 to 2 dBA exceedances have been predicted for sensitive receptors R20, R21, R22 and R23 (i.e. 46 to 47 dBA L_{A1}), which are all located on the northern side of the Capricorn Highway. The predicted exceedances are attributed to Komatsu 930 waste haul trucks operating from ramp R08N. We note the following in relation to these predicted exceedances:
    - The marginal 1 to 2 dBA exceedances have only been predicted for the FY2027 scenario and would be avoided when mining activities cease in the northern-most pits of BWM as reflected in the reduction in noise levels for the FY2039 and FY2044 scenarios compared to FY2027.
    - The noise monitoring completed near R20 by EMM in 2020 (i.e. NM3 summarised in **Table 3-3** and **Table 3-4**) indicate that these sensitive receptors currently experience high L_{A1} noise levels (i.e. 77 to 82 dBA) from vehicle passbys on the Capricorn Highway. Given the significant difference in L_{A1} noise levels between BWM and the Capricorn Highway (i.e. ≥30 dBA), L_{A1} noise levels from BWM are not expected to adverse impact these sensitive receptors.
- BWM noise levels that exceed the EA noise limits have been predicted for receptors R1, R2, R15, R16, R18 (BWM Admin) and R50 (BWM Airport), however these receptors are not considered to be “sensitive” under the definition provided in the EA and summarised in **Section 3.1**.

Regarding the above predicted noise limit exceedances, noise mitigation options have been considered as part of this study and are discussed in detail in **Section 7.1**.

Consideration of cumulative noise levels is discussed in **Section 6.2**.

6.1.2 Assessment of Noise Characteristics

The potential impacts from mine noise experienced at the sensitive receptors are not solely a function of the overall level of noise but also the characteristics of the noise. Consideration for the potential presence of tonal, impulsive and/or low frequency noise characteristics was investigated.

To complete a true tonal assessment, the inclusion of one-third octave data is required. As per **Table 5-5**, the spectrum data used for this assessment has been simplified at octave band data (which is widely accepted for an assessment of this nature). Consistent with the description of tonal noise in the PNC guideline and SLR's experience of noise from mine sites, there may be a distinguishable (non-tonal) "hum" associated with diesel powered equipment however the presence of tonal characteristics can often be attributed to mining plant with mechanical faults. For this assessment, no specific tonal correction has been considered on the assumption that all mining plant would be operated in good working order and that "buzzer", not "beeper", reversing alarms would likely be utilised on mobile equipment particularly if working in exposed areas of BWM such as the TCP and CHPP.

In the absence of specific low frequency noise assessment requirements in the existing BWM EA, the following two documents and associated criteria[2] are referenced to provide consideration of potential low frequency noise impact[3] from the Project onto the assessed receptors:

- DES's former Ecoaccess *Assessment of Low Frequency Noise* Guideline, which contains an initial screening test at noise sensitive receptors whereby the overall noise level should not exceed 50 dBL L_{eq} (internal) and the difference between the overall dBL and dBA L_{eq} (internal) noise levels should not exceed 15 dB. For this assessment, a (conservative) 5 dB façade reduction has been applied to convert the 50 dBL internal level to an external level (i.e. 55 dBL L_{eq} external) given that building facades generally do not attenuate low frequency noise as well as broader spectrum noise.
- DES's Streamlined *Model Conditions for Petroleum Activities* Guideline, which is relevant to operations of industrial noise sources operating in rural Queensland, contains the following external and internal criteria that must not be exceeded (L_{eq} unless noted otherwise). It is noted the internal criteria are generally consistent with the former Ecoaccess *Assessment of Low Frequency Noise* Guideline noted above.
    - 60 dBC measured outside the sensitive receptor, and
    - the difference between the external A-weighted and C-weighted noise levels is no greater than 20 dB.
    - 50 dBZ measured inside the sensitive receptor, and
    - the difference between the internal A-weighted and Z-weighted (Max $L_{pZ,\ 15\ min}$) noise levels is no greater than 15 dB.

[2] These criteria reference dBL/dBZ and dBC noise levels and comparison back to dBA noise levels – dBL/dBZ refer to decibels 'unweighted' (i.e. linear or zero-weighting)) or decibels 'C-weighted' (dBC). Both are common frequency 'weightings' (or lack thereof) for assessing low frequency noise.

[3] With reference to DES *Noise Measurement Manual* and the former Ecoaccess *Assessment of Low Frequency Noise Guideline*, low frequency noise is defined as noise from the 10 Hz to 200 Hz frequency range).

Consistent with the overall A-weighted predicted noise levels (presented in **Table 6-1** and **Table 6-2**), the highest predicted dBC and dBL external noise levels at a sensitive receptor are predicted to occur at R5 under the FY2044 scenario under adverse conditions. A BWM noise level of 59 dBC is predicted for R5 under adverse weather, and the difference between the C-weighted and A-weighted noise levels is only 11 dB (i.e. does not exceed 20 dB). Therefore, low frequency noise is not predicted to be an issue for BWM with the introduction of the Project.

There is potential for impulsive noise from track slap associated with the dozers. Measures to mitigate such noise events from the operation of the dozer, and mitigate impulsive noise, are provided in **Section 7.1**. If these mitigation measures are implemented effectively, impulsive noise characteristics can be managed such that adjustments (to predicted noise levels) to account for impulsive noise may not apply.

6.2 Cumulative Noise

6.2.1 BWM and Cook Colliery

The cumulative noise impact assessment for noise sensitive receptors surrounding the Cook Colliery (and exposed to BWM noise), is detailed in **Table 6-3**. Noting that the Cook Colliery is an underground mine and that surface operations are unlikely to change significantly over the life of the mine, the SoundPLAN predicted Cook Colliery noise levels have been compared against the highest predicted BWM noise level from the three modelled scenarios.

The cumulative noise assessment has considered only adverse weather conditions, that is temperature inversion with negligible wind (i.e. the highest predicted noise level).

Table 6-3 Cook Colliery and BWM Cumulative Mine Noise Under Adverse Weather Conditions

Receptor	Predicted L_{Aeq} (dBA) Noise Level from:		Predicted Cumulative Noise Level (L_{Aeq} dBA)
	Cook Colliery	BWM	
R11	22	32	33
R13	36	33	38
R17	34	**44**	**45**

Bold and highlighted noise levels represent an exceedance of the **LAeq, adj, 15 min 40 dBA**

Based on the cumulative noise impact assessment detailed in **Table 6-3**, cumulative mine noise levels from BWM and Cook Colliery have the potential to result in a combined noise level of 45 dBA L_{Aeq} at sensitive receptor R17. The predicted cumulative noise level is clearly dominated by BWM (i.e. 44 dBA) with the contribution from Cook Colliery increasing the cumulative noise level by a marginal 1 dBA.

As noted in **Section 6.1.1**, predicted BWM noise levels of up to 44 dBA represents an exceedance of the 40 dBA noise limit, and therefore noise mitigation measures would be required to address this predicted exceedance. In consideration of this potential cumulative noise impact, it is recommended that any such noise mitigation be designed to reduce BWM noise levels at R17 to 39 dBA or less to ensure that cumulative noise is 40 dBA L_{Aeq} or less. Noise mitigation measures are discussed in detail in **Section 0**.

The highest noise level from Cook Colliery (i.e. 36 dBA) was predicted for R13, which is the closest sensitive receptor to Cook Colliery. With the addition of BWM noise, the cumulative noise level is predicted to be 38 dBA which complies with the 40 dBA BWM EA noise limit.

6.2.2 BWM and Curragh Mine

Noise sensitive receptors potentially impacted by cumulative noise from BWM and Curragh Mine include:

- Blackwater township.
- Homesteads located along the Capricorn Highway west of Blackwater.

SLR has been unable to acquire any noise impact assessment reports for Curragh Mine, in particular assessment of the Curragh Extension Project, and instead has had to rely on publicly available information (i.e. relevant to Curragh Mine) together with the findings from this study to inform the potential for cumulative noise impacts.

With reference to the noise levels presented in **Table 6-2**, Blackwater township (R8) is predicted to experience BWM noise levels of up to 32 dBA, which is 8 dBA below the 40 dBA L_{Aeq} noise limit. The current Curragh Mine EA (EPML00643713) prescribes a night-time (10 pm to 7am) noise limit of 41 dBA L_{A10}, which is approximately equivalent to 38 dBA L_{Aeq} for a mine. Provided Curragh Mine achieves compliance with their EA noise limit, cumulative noise from Curragh Mine and BWM would not exceed 39 dBA L_{Aeq} and thereby comply with the 40 dBA noise limit.

For sensitive receptors located west of Blackwater along the Capricorn Highway, there is potential for these receptors to be exposed to noise from both BWM and Curragh Mine, particularly when mining commences in ML700006, which is approximately 750 m north-east of the closest homestead (i.e. R20). Regarding BWM, the following is noteworthy:

- Mining operations in the northernmost pit closest to these sensitive receptors (i.e. Pit 8, which is not part of the extension area in SA10 and SA7 but included for completeness) ceases from approximately FY2033, which is reflected in the predicted drop in noise levels from FY2027 to FY2039 for receptors R20 to R39 indicated in **Table 6-1** and **Table 6-2**.
- No mining operations are proposed for the Project in Pit 10 (i.e. which is also outside of the SA10 and SA7 extension area).

Based on the above, it is anticipated that cumulative noise impacts would be avoided if noise intensive Curragh Mine operations in the southern extent of ML700006 commence after BWM operations have ceased in Pit 8.

6.3 Blasting

6.3.1 Airblast Overpressure

As noted in **Section 4.2**, the airblast overpressure limits prescribed in the BWM EA cater for the inherent variation in emission levels from a given blast design by allowing a 10% (i.e. nine (9) out of ten (10) blasts) exceedance of the 115 dBL criterion up to a 120 dBL maximum (assumed at 1% exceedance to facilitate predictions through the below formula). Correspondingly, '1% exceedance' and '10% exceedance' airblast overpressure prediction formula was used for the assessment.

The blast emissions formula utilised for this assessment is as follows:

$$SPL = Ka - 24(\log_{10} R - 0.33 \log_{10} Q)$$

Where,

SPL = Peak airblast level (dBLinear)

K_a = Site constant (discussed below)

R = Distance between charge and receiver (m)

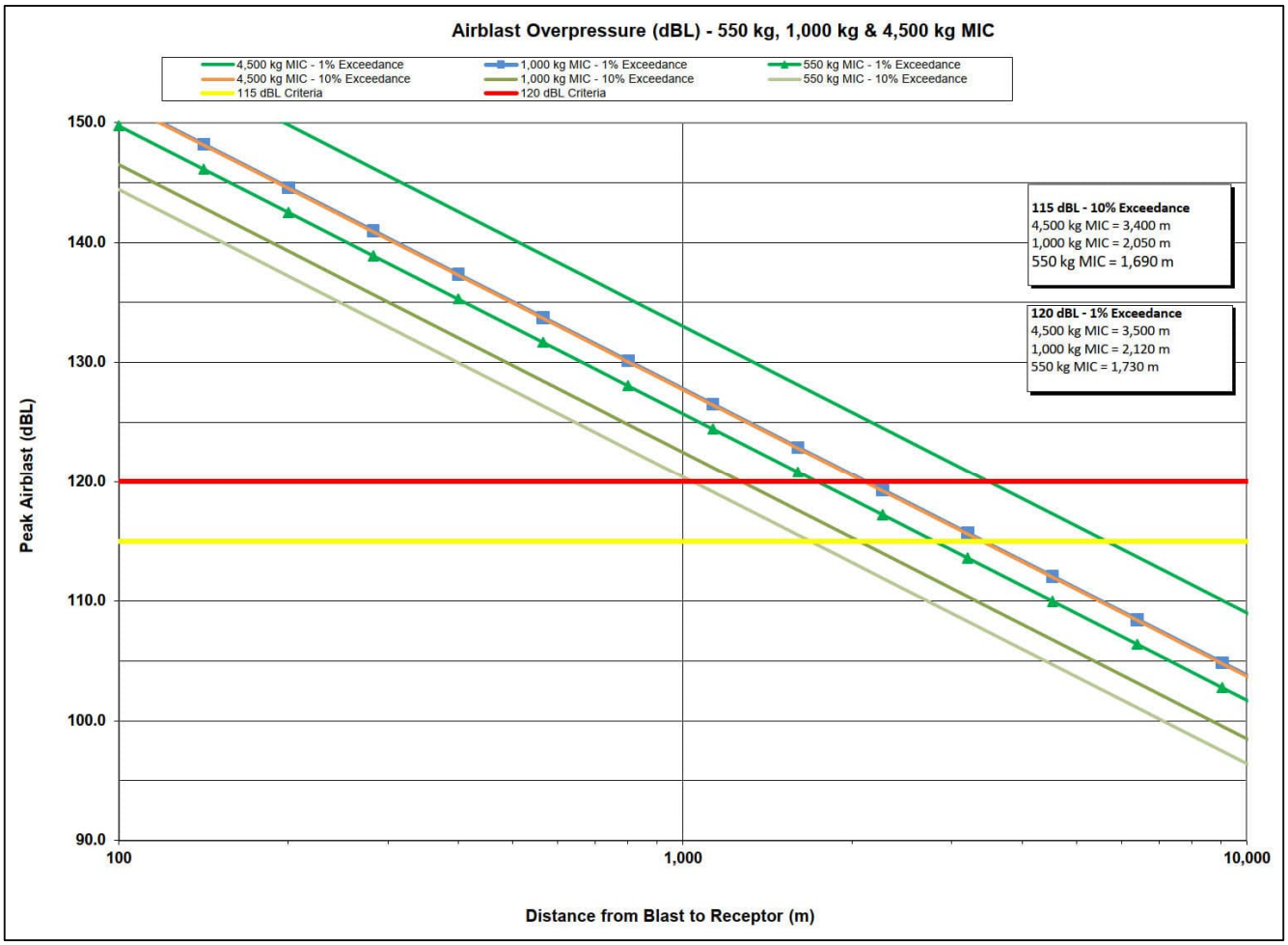
Q = Charge mass per delay (kg).

The site constant (K_a) in the above equation is an assumed constant, with the following constants derived from the percentage of exceedance and blast parameters applicable free-face blasting:

- 175.8 – 1% exceedance.
- 170.5 – 10% exceedance.

SPL represent the level of airblast overpressure (dBLinear or dBL), above which 1% or 10% of the total population (of data points) will lie respectively, assuming that the population has the same statistical distribution as the underlying measured sample. The relationship between distance and peak airblast overpressure (1% or 10% exceedances) from the proposed blasting site are presented in **Figure 6-1** for MICs of 550 kg (pre-split blasts), 1,000 kg (coal blasts) and 4,500 kg (production blasts).

Figure 6-1 Peak Airblast Overpressure Versus Distance Relationship for MICs of 550 kg, 1,000 kg and 4,500 kg



Applying the above scaling formula and the distance between the Project blasting areas and closest sensitive receptors in each direction from the BWM (i.e. R5 to the west, R17 to the east and R19 to the south-east) and the Blackwater township (i.e. R8 to the north-east), MICs have been calculated to comply with the 115 dBL 10% exceedance criterion and 120 dBL maximum criterion. The calculated MICs are summarised in **Table 6-4**.

Table 6-4 Predicted Airblast Overpressure Levels at the Closest Sensitive Receptors and Blackwater Township

Sensitive Receptor	Closest Pit in Project Area	Distance to Receptor (m)	Calculated MIC (kg) to Comply With	
			115 dBL Criterion (with 10% Exceedance Allowance)	120 dBL Criterion (Maximum)
R5	16	2,900	3,050	2,795
R8	12	5,000	15,900	14,575
R17	46	1,000	120	110
R19	47	5,400	20,075	18,400

6.3.2 Ground Vibration

Similar to the above airblast assessment, AS 2187 provides the following formula to conservatively estimate ground vibration:

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

where

V = ground vibration vector peak particle velocity (mm/s)

R = distance from charge (m)

Q = MIC per delay (Kg)

K_g , B = Constants related to average site and rock properties for estimation purposes.

According to AS 2187, when blasting is to be carried out to a free face in average field conditions, the following equation may be used to estimate the mean (50% probability of exceedance) vector Peak Particle Velocity (PPV):

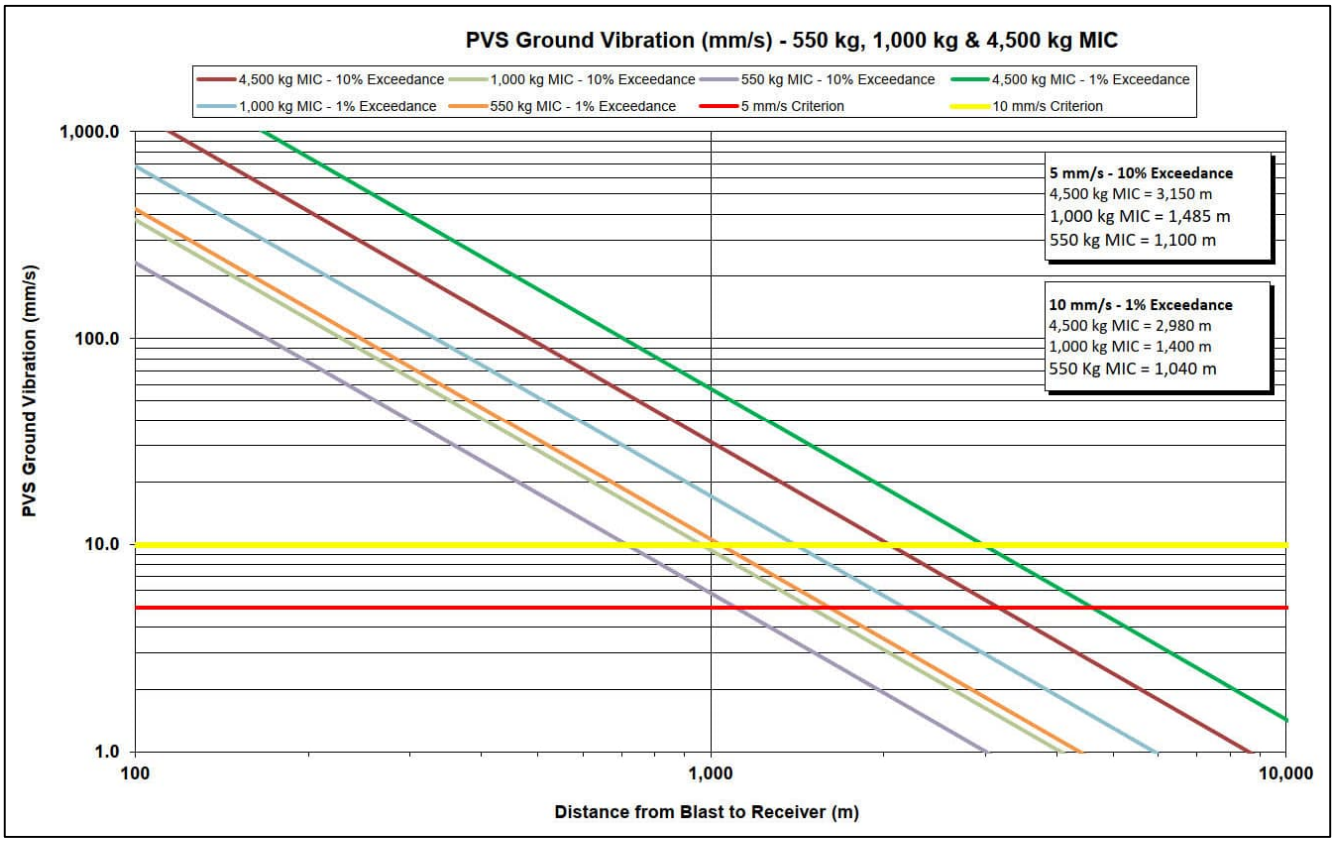
$$V = 1140 \left(\frac{R}{Q^{1/2}} \right)^{-1.6}$$

The '1,140' ground response factor has been scaled up for the assessment of ground vibration against the following criteria:

- '2,368' for assessment against the 5 mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts.
- '4,313' for assessment against the maximum limit of 10 mm/s peak particle velocity at any time.

The relationship between distance and ground vibration from the proposed blasting site are presented in **Figure 6-2** for MICs of 550 kg, 1,000 kg and 4,500 kg.

Figure 6-2 Ground Vibration Versus Distance Relationship for MICs of 550 kg, 1,000 kg and 4,500 kg



Applying the above AS 2187 formula and the distance between the Project blasting areas and closest sensitive receptors and Blackwater township, MICs have been calculated to comply with the 5 mm/s and 10 mm/s PPV vibration limits. The calculated MICs are summarised in **Table 6-5**.

Table 6-5 MICs Calculated to Comply with the 5 mm/s and 10 mm/s PPV Limits

Sensitive Receptor	Closest Pit in Project Area	Distance to Receptor (m)	Calculated MIC (Kg) to Comply With	
			5 mm/s Criterion (with 10% Exceedance Allowance)	10 mm/s Criterion (Maximum)
R5	16	2,900	3,805	4,275
R8	12	5,000	11,315	12,715
R17	46	1,000	450	505
R19	47	5,400	13,195	14,835

6.3.3 Blasting Assessment Summary

As noted in **Section 5.4**, actual blast design parameters, predictive modelling and monitoring of impacts are regularly reviewed and completed for existing blasting activities at BWM and this will continue as part of the Project.

The calculated MICs in **Table 6-4** and **Table 6-5** indicate that blast control measures, such as limiting MICs and careful blast design parameters, would be required for BWM blasting occurring in proximity to sensitive receptor R17. The calculated MICs for the Blackwater township and other surrounding

sensitive receptors are in the order of or above the advised production blast MICs of 1,000 to 4,500 kg and therefore specific controls would not be required.

Notwithstanding the above, based on the current and future site practices and the above conservative blasting assessment, it is anticipated that airblast overpressure and ground vibration from the Project can be controlled to acceptable levels at the sensitive receptor locations using current BWM blasting practices.

7.0 Recommendations

The following sub-sections detail proven and/or leading practice noise and vibration recommendations for the Project.

7.1 Operational Mine Noise

The assessment of predicted BWM noise levels presented in **Section 6.1.1** identified the potential for noise limit exceedances at sensitive receptors R3 and R4 (Tolmies Creek), R5 (Ausbute), R6, R7 (Burngrove) and R17 (Retreat). Marginal 1 to 2 dBA exceedances of the 45 dBA L_{A1} noise limit has been predicted for sensitive receptors R20, R21, R22 and R23, which it should be noted is not attributed to mining equipment operating in the extension areas of SA10 and SA7. Impacts are not expected at sensitive receptors R20, R21, R22 and R23 given the existing high ambient noise levels from the Capricorn Highway.

For noise sensitive receptors R3, R4, R5, R6 and R7 coal haulage trucks operating along the main haul road as well as waste haulage trucks operating from the closest ramps were found to be primarily responsible for the predicted exceedances. For noise sensitive receptor R17, the predicted exceedances are primarily attributed to waste haulage from ramps R46N and R46S.

In considering these predicted exceedances, the following good practice noise mitigation and management measures are recommended in conjunction with the exceedance-specific potential noise mitigation measures summarised in **Table 7-1**:

- Avoid clustering of mobile equipment on haul roads and other exposed/elevated areas, such as during shift changeovers. Haul truck arrival and departures from go lines should be staggered where possible.
- Dumping of material can include engineering controls to minimise the distance the material falls and lining bins and chutes with rubber to dampen the impact.
- Equipment should be shut down when not in use.
- All equipment should be operated in accordance with the manufacturer's instruction and in order to minimise noise impact events.
- Broadband "buzzer", not tonal "beeper", reversing alarms should be utilised on all mobile plant.
- In the event of a complaint regarding potential impulsive noise disturbance such as dozer track slap, this could be minimised through idle wheel modification, use of track slides and grousers, and management controls such as gear limitation (forward and reverse in 1st gear only).

Additional to **Table 7-1**, whilst it represents the current leading mitigation options for sensitive receptors this doesn't prohibit BWM from exploring and implementing further alternatives (modelled) that achieve the noise limits (i.e. haul road placement/incline, speed restrictions, landholder agreements and/or land acquisitions).

Table 7-1 BWM Exceedance Specific Noise Mitigation Measures

Receptor	Predicted Noise Level	Reason for Predicted Exceedance	Potential Noise Mitigation Options	Mitigated Noise Level
R5	44-48 dBA $L_{Aeq,adj,15min}$ 52-56 dBA $L_{A1,adj,15min}$ (adverse weather with temperature inversion)	Komatsu 930 haul trucks on R16S: up to 43 dBA L_{Aeq} (7 trucks) Komatsu 830 coal haul trucks on haul road: up to 42 dBA (2 trucks) Komatsu 930 haul trucks on R20N: up to 38 dBA (5 units) Komatsu 930 haul trucks on R16N: up to 36 dBA (5 trucks) CAT 854 wheeled dozer at TCP: up to 37 dBA Watercart on main haul road: up to 35 dBA BWM TCP: up to 34 dBA	<u>Mitigating waste haul truck noise in Pits 16 and 20:</u> • Komatsu 930 pre-strip (waste) haul trucks to remain shielded (i.e. no clear line of sight to R5) for the majority of operation whilst working between Pits 16 and 20 during temperature inversion conditions. Noise mitigation modelling has indicated reductions exceeding 20 dBA with shielded pre-strip activities. <u>Mitigating coal haul truck noise on the main haul road:</u> • Option 1: o Use of quieter coal haul trucks such as the Kress haulers. Noise mitigation modelling completed by SLR indicated a reduction of up to 5 dB with CAT793 haul trucks and up to 9 dB with Kress haulers operating along the main haul road. o Limiting watercart movements on the main haul road (near R5) to one every 15-minutes. • Option 2: o If limitations on equipment types, movements and/or after-market noise attenuation kits are not practicable, an acoustic bund/barrier adjacent the main haul road between the TCP and ramp 16 would be effective at reducing mine noise levels at R5 (and at R6 also). Modelling of bunds up to 10 m high indicated a 6 to 8 dB reduction in noise levels from mobile mining equipment operating on the haul road. It is also recommended that dozers operating on waste dumps in Pits 16 and 20	≤40 dBA $L_{Aeq,adj,15min}$ ≤45 dBA $L_{A1,adj,15min}$ Based on shielded waste trucks and either coal haulage (near R5) with Kress haulers and/or noise attenuated trucks or the main haul road acoustic bund/barrier

Receptor	Predicted Noise Level	Reason for Predicted Exceedance	Potential Noise Mitigation Options	Mitigated Noise Level
			remain shielded (by the waste dump) during temperature inversions.	
R6	41-44 dBA $L_{Aeq,adj,15min}$ 47-52 dBA $L_{A1,adj,15min}$ (adverse weather with temperature inversion)	Komatsu 930 haul trucks on R16S: up to 37 dBA L_{Aeq} (7 trucks) Komatsu 830 haul trucks on haul road: up to 35 dBA (2 trucks) Komatsu 930 haul trucks on R16N: up to 34 dBA (5 trucks) Komatsu 930 haul trucks on R20N: up to 33 dBA (5 units) BWM TCP: up to 28 dBA	Given the location of R6 relative to R5 (i.e. similar line of sight/acoustic view of BWM, but a further 1 km away), applying the above mitigation measures for R5 would result in compliance with the noise limit at R6.	<40 dBA $L_{Aeq,adj,15min}$ <45 dBA $L_{A1,adj,15min}$ (assuming noise mitigation measures applied to achieve compliance for R5)
R17	44 dBA $L_{Aeq,adj,15min}$ 46-52 dBA $L_{A1,adj,15min}$ (FY2039 and FY2044 adverse weather with temperature inversion scenario)	Komatsu 930 haul trucks on R42N: up to 38 dBA L_{Aeq} (10 trucks) Komatsu 930 haul trucks on R46S: up to 37 dBA (10 trucks) Komatsu 930 haul trucks on R46N: up to 36 dBA	• Komatsu 930 waste haul trucks to remain shielded (i.e. no clear line of sight to R17) for the majority of operation whilst working between Pits42 and 46 during temperature inversion conditions. • If options for shielding are limited due to work location, the alternative would be to restrict the numbers of Komatsu 930 waste haul trucks operating simultaneously from Pits 46 and 42 (note, noise attenuation kit options are able to reduce the restriction). This could potentially be achieved by avoiding the 800t and 600t shovels operating from the same pit during temperature inversion conditions, as was modelled in Pit 46 for the 2039 scenario.	<40 dBA $L_{Aeq,adj,15min}$ <45 dBA $L_{A1,adj,15min}$
R3 (measures also applicable to R4)	41 dBA $L_{Aeq,adj,15min}$	Komatsu 930 haul trucks on R16S: up to 34 dBA L_{Aeq} (7 trucks) Komatsu 930 haul trucks on R16N: up to 32 dBA (5 trucks)	• Given the location of R3 relative to R5 and R6 and the exceedance being a marginal 1 dBA, applying the above mitigation measures for R5 and R6 would result in compliance with the noise limit at R3.	<40 dBA $L_{Aeq,adj,15min}$

Receptor	Predicted Noise Level	Reason for Predicted Exceedance	Potential Noise Mitigation Options	Mitigated Noise Level
	46-49 dBA $L_{A1,adj,15min}$ (FY2039 and FY2044 adverse weather with temperature inversion scenario)	Komatsu 830 coal haul trucks on haul road: up to 31 dBA (2 trucks)		<45 dBA $L_{A1,adj,15min}$ (with mitigation measures applied for R5)
R7	39 dBA $L_{Aeq,adj,15min}$ 47 dBA $L_{A1,adj,15min}$ (FY2044 adverse weather with temperature inversion scenario)	Komatsu 830 coal haul trucks on haul road: up to 35 dBA L_{Aeq} (2 trucks) Komatsu 930 haul trucks on R16N: up to 31 dBA (5 trucks)	• The haul truck mitigation measures noted above for R5 would result in compliance with the L_{A1} noise limit for R7.	<45 dBA $L_{A1,adj,15min}$ (with mitigation measures applied for R5)

In relation to the marginal 1 to 2 dBA noise limit exceedances in **Table 6-1** and **Table 6-2**, it is important to note that variations in sound pressure are easier to detect for steady-state sounds than time-varying sounds which have been averaged over a time period. Due to its nature, a time-varying sound (such as mine noise) will be momentarily perceived as quieter or louder at different times throughout the measurement period. However, these peaks and troughs in instantaneous sound pressure level are averaged over the measurement period to output a single L_{Aeq} value. Two different 15-minute intervals producing identical L_{Aeq} values may sound subjectively quieter or louder due to these effects. This makes it difficult to detect when there is a small change in the overall L_{Aeq} noise level.

The *Handbook of Environmental Acoustics*[4] (1994) and *Industrial Noise Control: Fundamentals and Applications*[5] (1994) both present the following thresholds for the perception of change in noise level from time-varying sources:

Less than 3dBA = No perceivable difference.

3 dBA = Barely perceptible difference.

5 dBA = Readily perceptible difference.

10 dBA = 'Doubling' (or 'halving') of performance.

These thresholds for the perception of change in loudness are widely accepted. For example, the Queensland Department of Transport and Main Roads makes use of the same thresholds in their *Transport Noise Management Code of Practice – Volume 1 – Road Traffic Noise* [6] (2013), defining an increase in noise level of less than 3 dBA to be "insignificant". The Queensland Department of Environment and Science's Noise Measurement Manual[7] (2013) also defines a change in noise level of 3 dB as "just perceptible" in Table 5 of Appendix 3.

Further to this, the New South Wales *Noise Policy for Industry*[8] (2017) offers guidance on the significance of residual noise impacts (i.e. noise levels above the applicable noise goal) and recommends that these impacts be considered on a case-by-case basis. In Section 4 of the *Noise Policy for Industry,* Table 4.1 defines a residual noise impact of < 2 dB as negligible. Table 4.2 goes on to state:

> *"The exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls."*

The predecessor to this current (Noise Policy for Industry) policy was NSW's Industrial Noise Policy[9] (2000). Section 11.1.3 of this policy stated:

> *"A development will be deemed to be in non-compliance with a noise consent or licence condition if the monitored noise level is more than 2 dB above the statutory noise limit specified in the consent or licence condition."*

[4] Cowan, James P 1994, Handbook of environmental acoustics, Van Nostrand Reinhold, New York

[5] Bell, LH & Bell, DH 1994, Industrial noise control: Fundamentals and applications, Marcel Dekker Inc, New York

[6] Queensland Department of Transport and Main Roads 2013, Transport Noise Management Code of Practice Volume 1 – Road Traffic Noise, Department of Transport and Main Roads, Queensland

[7] Queensland Department of Environment and Heritage Protection 2013, Noise Measurement Manual, Department of Environment and Heritage Protection, Queensland

[8] Environment Protection Authority 2017, Noise Policy for Industry, Environment Protection Authority, New South Wales

[9] Environment Protection Authority 2000, Industrial Noise Policy, Environment Protection Authority, New South Wales

Many other regulatory bodies also provide supporting documentation stating that a difference of less than 3 dB is insignificant or negligible, including:

- Australian Government (http://www.yourhome.gov.au/housing/noise-control)
- Victorian Department of Transport (https://transport.vic.gov.au/about/planning/passenger-rail-infrastructure-noise-policy)

Based on the above, it is reasonable to expect that a human would be unlikely to tell the difference between 40 dBA L_{Aeq} and 41 to 42 dBA L_{Aeq} in relation to BWM noise.

7.2 Cumulative Noise

The cumulative noise assessment presented in **Section 6.2** identified the potential for cumulative noise impacts at sensitive receptor R17 with combined BWM and Cook Colliery noise levels. In consideration of this predicted impact and noting the cumulative noise level of up to 45 dBA is primarily attributed to BWM (i.e. 44 dBA), the noise mitigation options detailed in **Table 7-1** have been designed to ensure that cumulative noise levels at R17 achieve compliance with the 40 dBA noise limit for BWM.

As noted in **Section 6.2**, it is anticipated that cumulative noise impacts for sensitive receptors located along the Capricorn Highway would be avoided if noise intensive Curragh Mine operations in the southern extent of ML700006 commence after BWM operations have ceased in Pit 8.

7.3 Blasting

As noted in **Section 5.4**, future site blasting practices occurring within the Project area would be controlled to acceptable airblast overpressure and ground vibration levels at all sensitive receptor locations using current BWM blasting practices including detailed computational modelling and limited charges where necessary.

8.0 Conclusion

8.1 Mine Operations

The technical assessment has modelled proposed Project noise emission levels from three operational mining scenarios/mine plans representing FY2027, FY2039 and FY2044. Through a review of Project information supplied by BMA as part of the assessment, these three modelled scenarios were selected to represent various stages of operational intensity (including worst-case equipment numbers) as well as targeting proximity of mining operations to noise sensitive receptors surrounding the Project.

The assessment for the Project identified the following potential noise impacts:

- Under neutral weather conditions, only noise sensitive receptors R5 and R17 are predicted to experience BWM noise levels that exceed the EA noise limits. For sensitive receptor R5, exceedances of the 40 dBA L_{Aeq} and 45 dBA L_{A1} limits are predicted for the FY2039 and FY2044 scenarios (i.e. up to 43 dBA L_{Aeq} and 46 dBA L_{A1} for the FY2044 scenario only). The predicted exceedances are primarily attributed to:
    - Coal haulage trucks operating along the main haul route from pits north of the R20N (i.e. up to 37 dBA L_{Aeq}) and waste haulage trucks operating between pit and waste dumps at ramps east of R5 including R16S, R16N, R20S and R20N (i.e. up to 38 dBA L_{Aeq}).
    - Noise levels at R5 associated with the plant and equipment operating at the TCP have been predicted in the order of 30 dBA, which is likely to be audible at R5 in the absence of significant ambient noise.

  For sensitive receptor R17, a marginal 1 dBA exceedance of the 45 dBA L_{A1} noise limit is predicted for the FY2039 scenario. The predicted exceedance is attributed to Komatsu 930 waste haul trucks operating in R46S, R46N and R42S.
- Under adverse weather conditions (i.e. temperature inversion), noise limit exceedances have been predicted for the following sensitive receptors:
    - R5 under all three modelled scenarios with exceedances predicted against both the 40 dBA L_{Aeq} and 45 dBA L_{A1} noise limits. The highest predicted exceedance was 48 dBA L_{Aeq} (i.e. 8 dBA above the noise limit) and 56 dBA L_{A1} (i.e. 11 dBA exceedance) for the FY2044 scenario.
    - R6 for the FY2027 scenario (i.e. 2 dBA exceedance of the 45 dBA L_{A1} limit) and for FY2039 and FY2044 scenarios exceedances were predicted against both the 40 dBA L_{Aeq} and 45 dBA L_{A1} noise limits (i.e. by up to 7 dBA). The highest predicted exceedance was 52 dBA L_{A1} for the FY2044 scenario. Consistent with R5, the exceedances are primarily attributed to coal and waste haulage from ramps to the east and north-east of R6.
    - R3 for the FY2044 modelled scenario by a marginal 1 dBA against the 40 dBA L_{Aeq} noise limit and 4 dBA against the 45 dBA L_{A1} noise limit. A marginal 1 dBA exceedance of the L_{A1} noise limit is also predicted for the FY2039 scenario. The predicted exceedances are primarily attributed to waste haulage from ramp R16N and R16S and coal haulage from ramp R14N (i.e. from Komatsu 830s travelling along the main haul road).
    - R17 under modelled scenario FY2039 by 4 dBA against the 40 dBA L_{Aeq} noise limit and 7 dBA against the 45 dBA L_{A1} noise limit, and by 3 dBA against the L_{A1} noise limit for the FY2044 scenario. As noted above with the neutral weather

predictions, the predicted adverse weather exceedances are primarily attributed to waste haulage from ramps R46N, R46S and R42N.

- For the FY2044 scenario, marginal 2 dBA exceedances of the 45 dBA L_{A1} noise limit has been predicted for R4 (Lot 13 on HT602) and R7 (Lot 10 on RP619501). The exceedances are primarily attributed to coal haulage from the main haul road and waste haulage from the closest ramps.
- For the FY2027 scenario, marginal 1 to 2 dBA exceedances have been predicted for sensitive receptors R20, R21, R22 and R23 (i.e. 46 to 47 dBA L_{A1}), which are all located on the northern side of the Capricorn Highway. However, impacts associated with the Project are not expected for these receptors given the existing high ambient noise levels from the Capricorn Highway.

Considering the above predicted noise limit exceedances, noise mitigation options have been investigated as part of this study. The key noise mitigation options include:

- Using pit and waste dump landform for shielding of waste dump trucks and dozers operating from Pits 16 and 20, when pits are concurrently operated under neutral or adverse weather conditions.
- Mitigation of noise from coal haulage activities near sensitive receptors R5 and R6 via either:
  - Option 1 - use of quieter coal haul trucks on the main haul road such as CAT793s or Kress haulers instead of the Komatsu 830 haul trucks.
  - Option 2 - construction of an acoustic bund/barrier adjacent the main haul road between the TCP and Pit 16 would be effective at reducing mine noise levels at R5, R6 and potentially at R3 and R4.
- Using the pit wall or intervening landform to shield waste dump trucks and dozers operating from Pit 46 and 42 during adverse weather conditions. Alternatively, limiting Komatsu 930 waste haul trucks operating simultaneously from Pits 46 and 42.

While the above noise mitigation measures represent the current leading options for sensitive receptors this doesn't prohibit the BWM from exploring and implementing further alternatives (modelled) that achieve the noise limits (i.e. haul road placement/incline, speed restrictions, landholder agreements and/or land acquisitions).

8.2 Cumulative Noise

The technical assessment has also considered the potential for cumulative mine noise impacts for the following:

- Sensitive receptors surrounding the Cook Colliery and potentially impacted by combined noise from the Cook Colliery and BWM.
- Sensitive receptors located between BWM and Curragh Mine.

The assessment has identified the potential for mine noise from BWM and Cook Colliery to result in a combined noise level of 45 dBA L_{Aeq} at sensitive receptor R17. The predicted cumulative noise level is clearly dominated by BWM (i.e. 44 dBA) with the contribution from Cook Colliery (i.e. 34 dBA) increasing the cumulative noise level by a marginal 1 dBA. The noise mitigation measures recommended in the assessment have been designed to ensure that cumulative noise levels at R17 achieve compliance with the 40 dBA noise limit for BWM.

Based on the predicted BWM noise levels at Blackwater township and the existing Curragh Mine EA noise limits, it is anticipated that cumulative noise would not impact the Blackwater township sensitive receptors.

For sensitive receptors located along the Capricorn Highway (west of the township), it is anticipated that cumulative noise impacts would be avoided if noise intensive Curragh Mine operations in the southern extent of ML700006 commence after BWM operations have ceased in Pit 8.

8.3 Blasting

SLR understands that actual blast design parameters, predictive modelling and monitoring of impacts are regularly reviewed and completed for existing blasting activities at BWM and is expected to continue as part of the Project. Based on the current and future site practices and the conservative blasting assessment, it is anticipated that airblast overpressure and ground vibration from the Project can be controlled to acceptable levels at the sensitive receptor locations using current BWM blasting practices.

9.0 References

Legislation (Queensland)

Queensland Environmental Protection Act 1994

Queensland Environmental Protection (Noise) Policy 2019

Queensland Environmental Protection Regulation 2019

Guidelines, Standards, EAs etc

Queensland Department of Environment and Science's Environmental Authority EPML00717813 dated 29 June 2023

Queensland Department of Environment and Science's Model Mining Conditions Guideline 2017

Queensland Department of Environment and Science's Noise guideline: assessment of low frequency noise 2005 (Draft). Unpublished.

Queensland Department of Environment and Science's Noise Measurement Manual 2020

Queensland Department of Environment and Science's Planning for Noise Control Guideline 2004 (under review by DES – not currently an approved DES guideline)

Queensland Department of Environment and Science's Streamlined Model Conditions for Petroleum Activities Guideline 2016

Standards Association of Australia, 2004. Electroacoustics-Sound level meters– Part 1: Specifications AS IEC 61672.1-2004.

Standards Association of Australia, 2018. Acoustics – Description and measurement of environmental noise AS 1055-2018.

Standards Association of Australia, 2006. Explosives – Storage and use Part 2: Use of explosives AS 2187.2-2006.

Queensland Department of Environment and Science's Environmental Authority EPML00643713 dated 1 August 2022

Reports

EMM B180329_R5_Northern baseline noise levels_v.01, 26 February 2021

Appendix A Acoustic Terminology

Blackwater Mine – North Extension Project

Noise and Vibration Impact Assessment

BM Alliance Coal Operations Pty Ltd

SLR Project No.: 620.014601.00000

16 November 2023

Sound Level (or Noise Level)

The terms sound and noise are almost interchangeable, except that in common usage noise is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear (and those of other species) responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (dB or dBL) scale reduces this ratio to a more manageable size by the use of logarithms.

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 human hearing.

Sound Power Level

The sound power of a source is the rate at which it emits acoustic energy. As with sound pressure, sound power levels (SWL) are expressed in dB units, but are identified by the symbols SWL.

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

Change in Sound Pressure Levels

For human perception, a change of 1 dBA or 2 dBA in the level of a sound is considered to be indiscernible, while a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness.

Typical Sound Pressure Levels

The table below lists examples of typical sound pressure levels.

Table A-1 Examples of Typical Sound Pressure Levels

Sound pressure level (dBA)	Typical example	Subjective (human) evaluation
130	Threshold of pain	Intolerable
120	Metal hammering	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 metres (m)	Very noisy
90	Dog bark at 1 m	
80	Cicadas at 1 m	Loud
70	Noise level directly adjacent to a busy main road	
60	Ambient noise level in urban area close to main roads	Moderate to quiet
50	Typical rural environment with high insect noise or close to a main road	

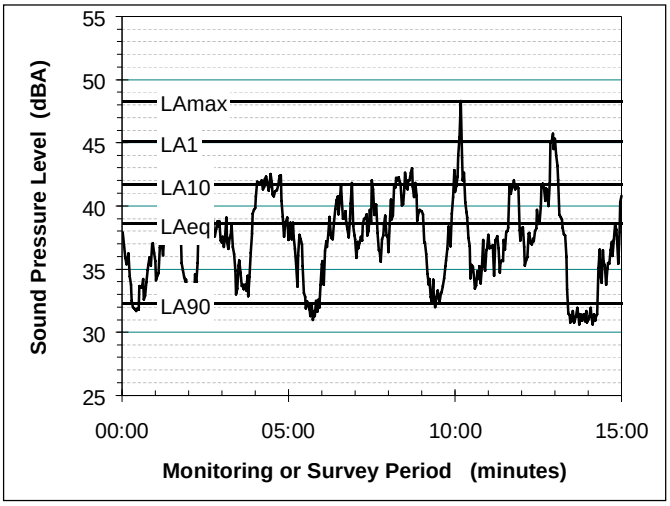
Sound pressure level (dBA)	Typical example	Subjective (human) evaluation
40	Ambient noise level in a rural environment with light breezes and some noise from insects, birds and distant traffic	Quiet to very quiet
30	Ambient noise level in a typical rural noise environment in the absence of insect noise and wind	
20	Ambient noise level in remote and quiet rural environment away from main roads with no wind and no insect noise	Almost silent

Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels (LAN), where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time and LA10 the noise exceeded for 10% of the time.

The Figure below presents a hypothetical 15-minute noise measurement, illustrating various common statistical indices of interest.

Figure A-1 Hypothetical 15 Minute Noise Measurement



Of particular relevance to this study, are:

- 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.
- L_{A1} - The A-weighted noise level exceeded for 1% during any given measurement period.

Noise Propagation

Provided the receptor is in the far-field of the noise source, noise levels will reduce as a receptor moves further away from the source. This is due to spreading of the noise source energy over distance. For a simple point source (for example, a motor) the theoretical reduction in noise levels is 6 dBA per doubling of distance. For a line source (for example, a busy road) the theoretical reduction is 3 dBA per doubling of distance. In reality however other factors affect noise propagation. These include ground absorption, air absorption, acoustic screening and meteorological effects.

Meteorological Effects

At distances over 500 m, meteorological affects (for example, local weather and atmospheric conditions) can substantially enhance or impair noise propagation. The most influential meteorological conditions on noise propagation are wind speed and direction and the occurrence of temperature inversions. Ambient air temperature and humidity and atmospheric pressure also affect noise propagation although to a lesser extent than wind and temperature inversions.

Wind Conditions

Wind conditions enhance noise propagation when the wind is blowing from a noise source towards a receptor and therefore noise levels at the receptor will be higher under these conditions. The wind can be thought to carry the noise in the direction it is heading. Where winds blow from the receptor towards the source, the propagation of noise is impaired and therefore lower noise levels will be experienced at the receptor.

It is important to consider the effect of prevailing wind conditions when assessing noise propagation over larger distances. Wind roses, which graph long term variations in wind speed and direction, are a useful tool for analysing prevailing wind conditions where available.

Temperature Inversions

Temperature inversions are a meteorological phenomenon where a layer of cold air is trapped at the ground surface under a layer of warmer air. Temperature inversions enhance noise propagation because sound travelling away from the ground is reflected back down from where the colder air meets the warmer air due to the change in pressure between the two layers.

Conditions that favour the development of a strong surface inversion are nights with calm winds and clear skies. Calm winds prevent warmer air above the surface from mixing down to the ground, and clear skies increase the rate of cooling at the Earth's surface. It is therefore important to consider the effect of temperature inversions when assessing noise propagation over larger distances and during night-time periods.

Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of “peak” velocity or “rms” velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as “peak particle velocity”, or PPV. The latter incorporates “root mean squared” averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organizations.

Over-Pressure

The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (i.e. unweighted), at frequencies both in and below the audible range.

Appendix B Wind Roses

Blackwater Mine – North Extension Project

Noise and Vibration Impact Assessment

BM Alliance Coal Operations Pty Ltd

SLR Project No.: 620.014601.00000

16 November 2023

Figure B-1 Wind Roses – Day Time

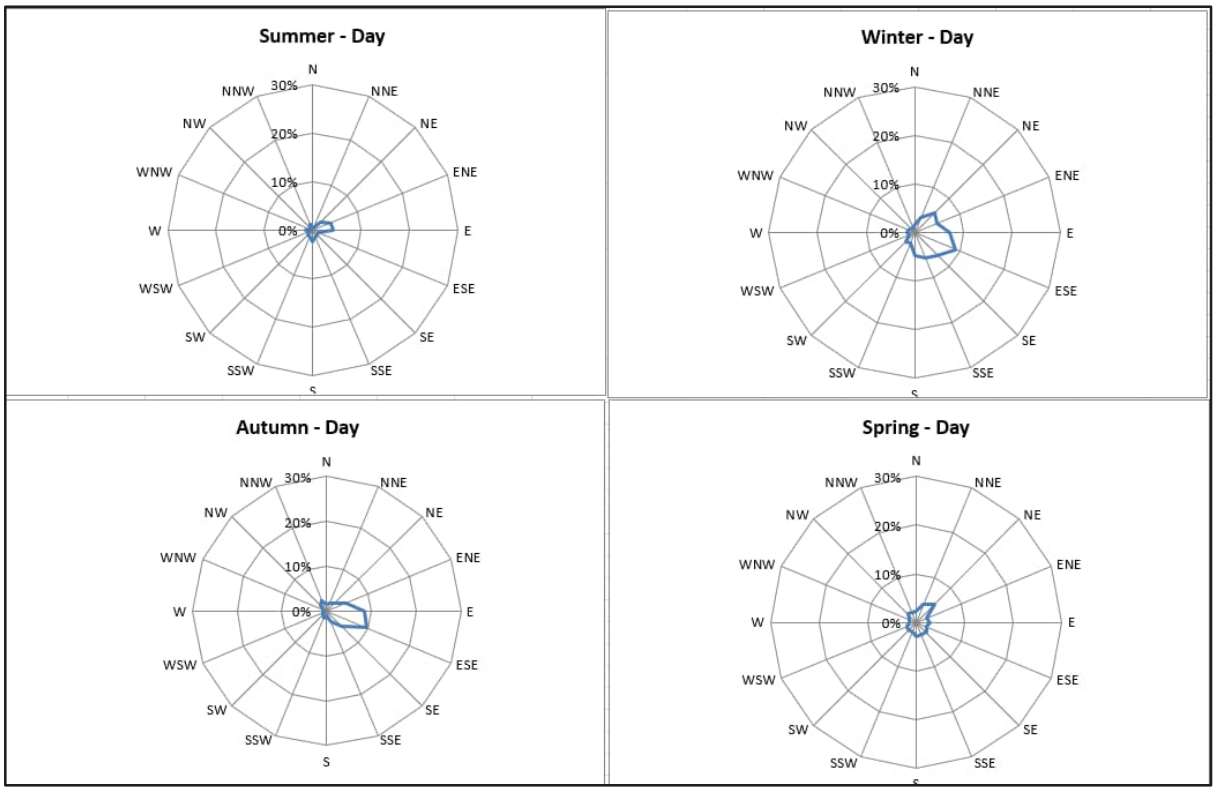


Figure B-2 Wind Roses – Evening

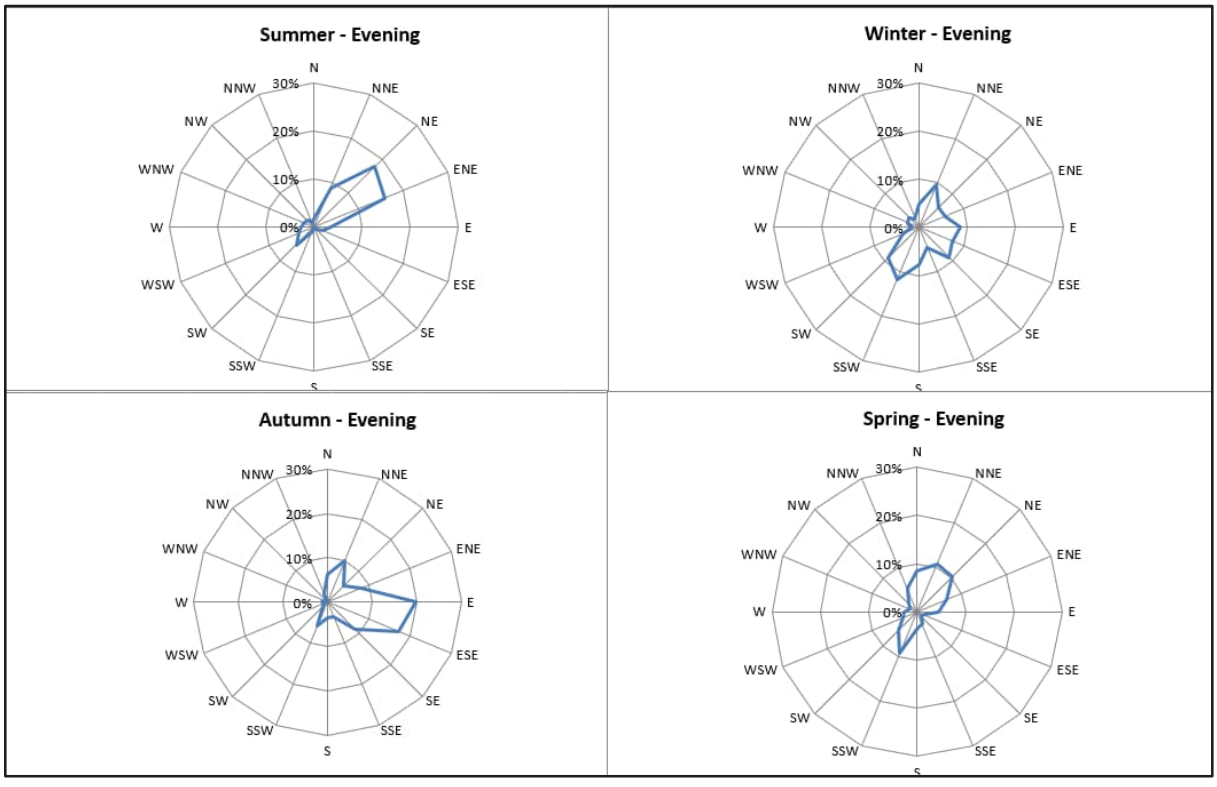
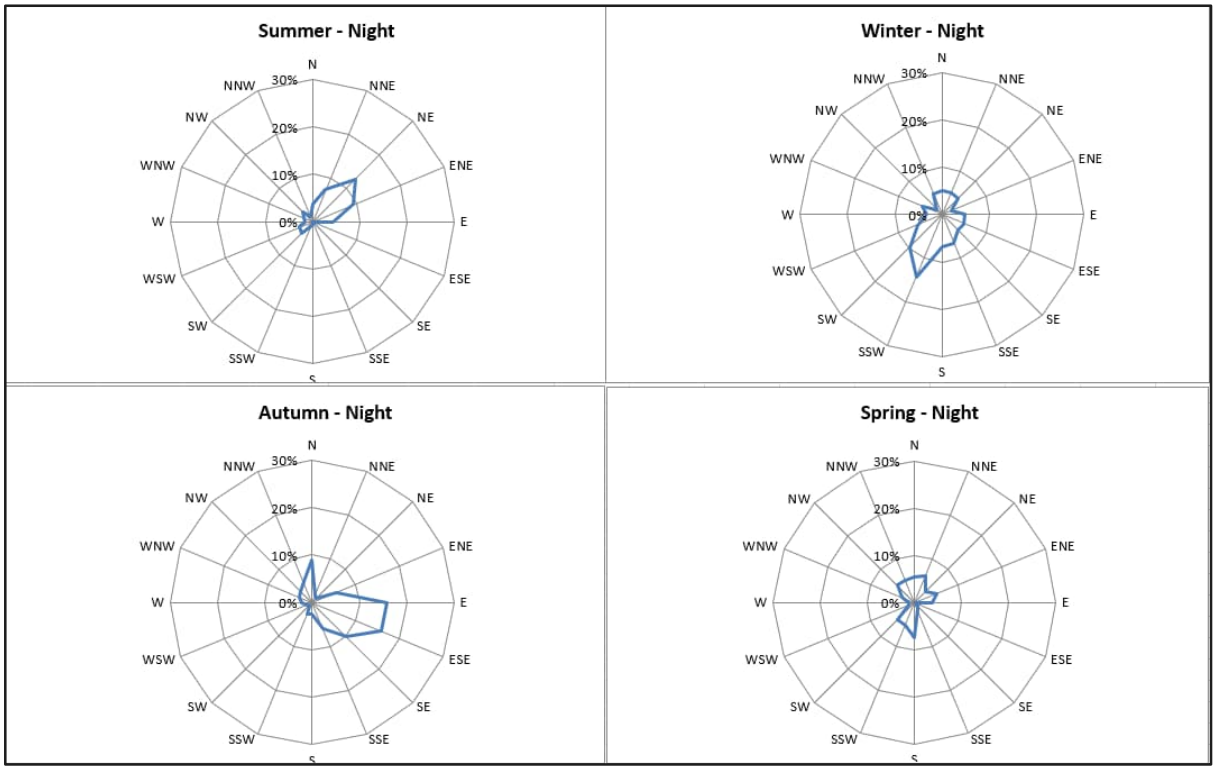


Figure B-3 Wind Roses – Night-time



Appendix C Predicted BWM Operational Noise Level Contour Maps

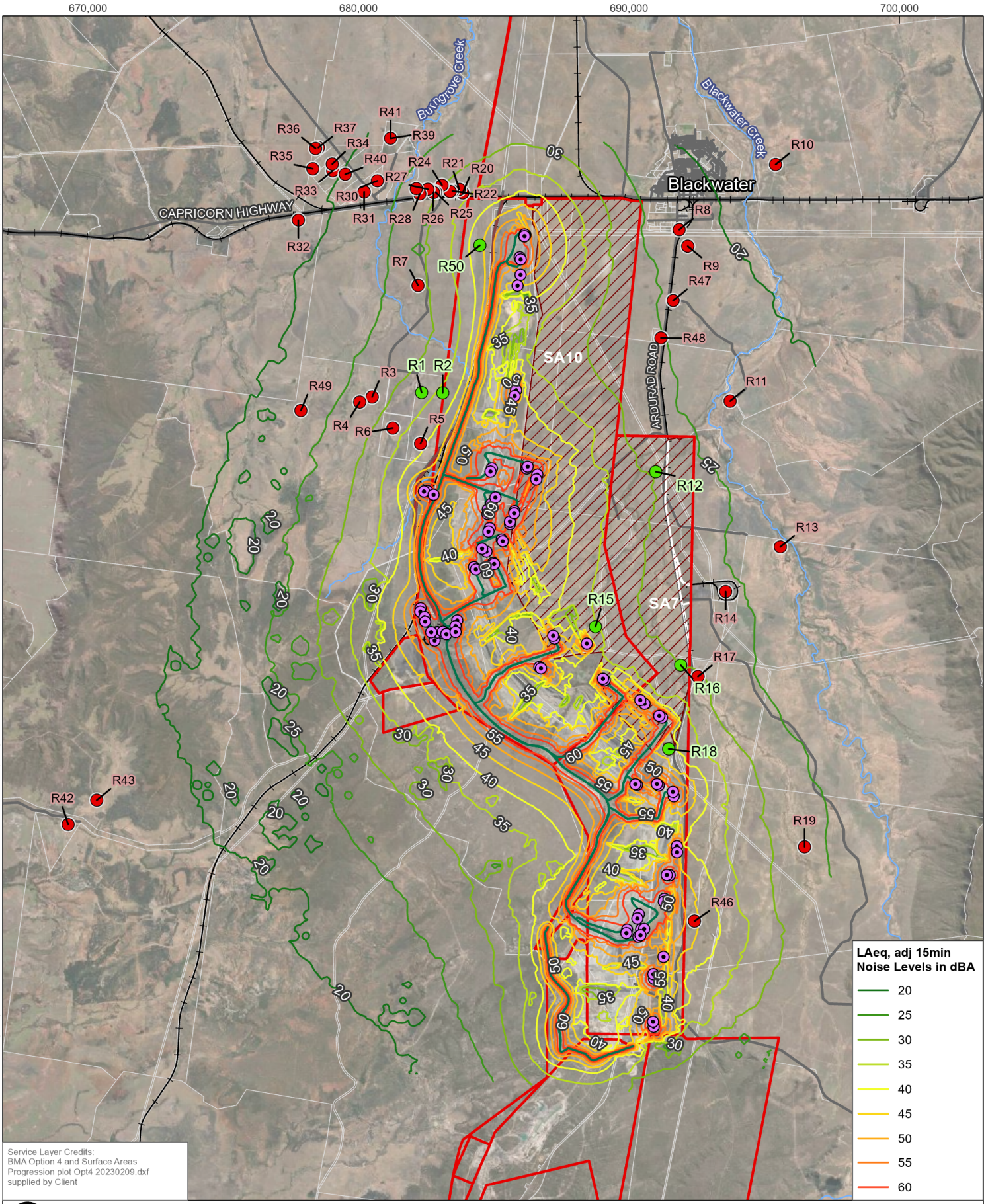
Blackwater Mine – North Extension Project

Noise and Vibration Impact Assessment

BM Alliance Coal Operations Pty Ltd

SLR Project No.: 620.014601.00000

16 November 2023



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Scale:	1:185,000 at A4
Project Number:	620.014601
Date Drawn:	07-Dec-2023
Drawn by:	NT

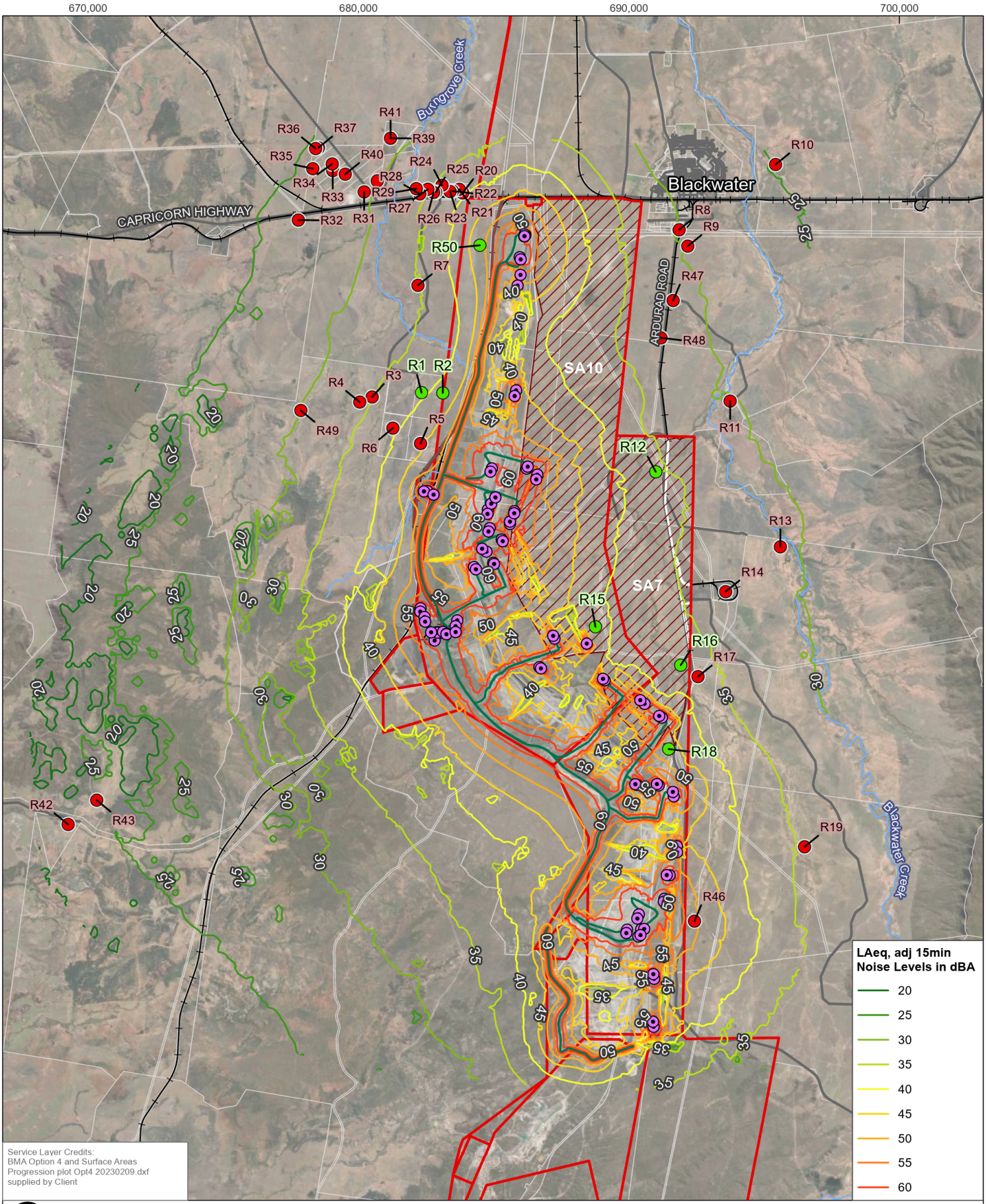
BLACKWATER MINE - NORTH EXTENSION PROJECT

FY2027 NEUTRAL CONTOUR MAP

SLR

FIGURE C-1

Path: H:\Projects-SLR\620-BNE\620-BNE\620.014601.00001 Blackwater NEP\08 GIS\BWM NEP Pro\BWM NEP Pro v1.aprx\620014601_NV_FC_1_FY2027 Neutral



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Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:185,000 at A4
Project Number:	620.014601
Date Drawn:	07-Dec-2023
Drawn by:	NT

LEGEND

- Railway
- Road
- Watercourse
- Mine Acces Road
- BWM Mining Lease
- BWM North Extension Project Area
- Cadastre
- Non-sensitive Receptor
- Sensitive Receptor
- FY2027 Point Source
- FY2027 Line Source

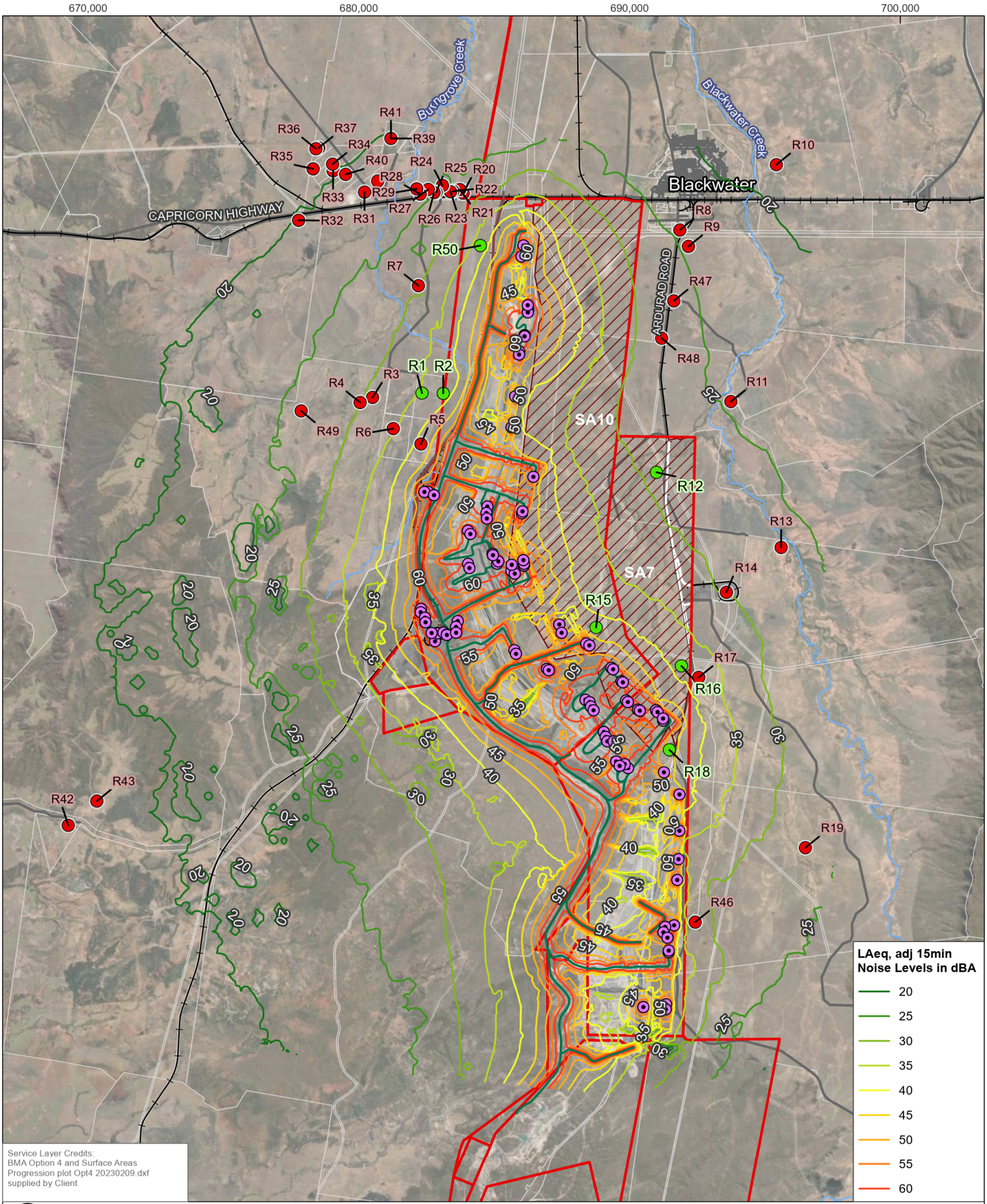
BLACKWATER MINE - NORTH EXTENSION PROJECT

FY2027 ADVERSE CONTOUR MAP

SLR

FIGURE C-2

Path: H:\Projects-SLR\620-BNE\620-BNE\620.014601.00001 Blackwater NEP\08 GIS\BWM NEP Pro\BWM NEP Pro v1.aprx\620014601_NV_FC_2_FY2027 Adverse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Blackwater Creek
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ARDURAD ROAD
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Railway
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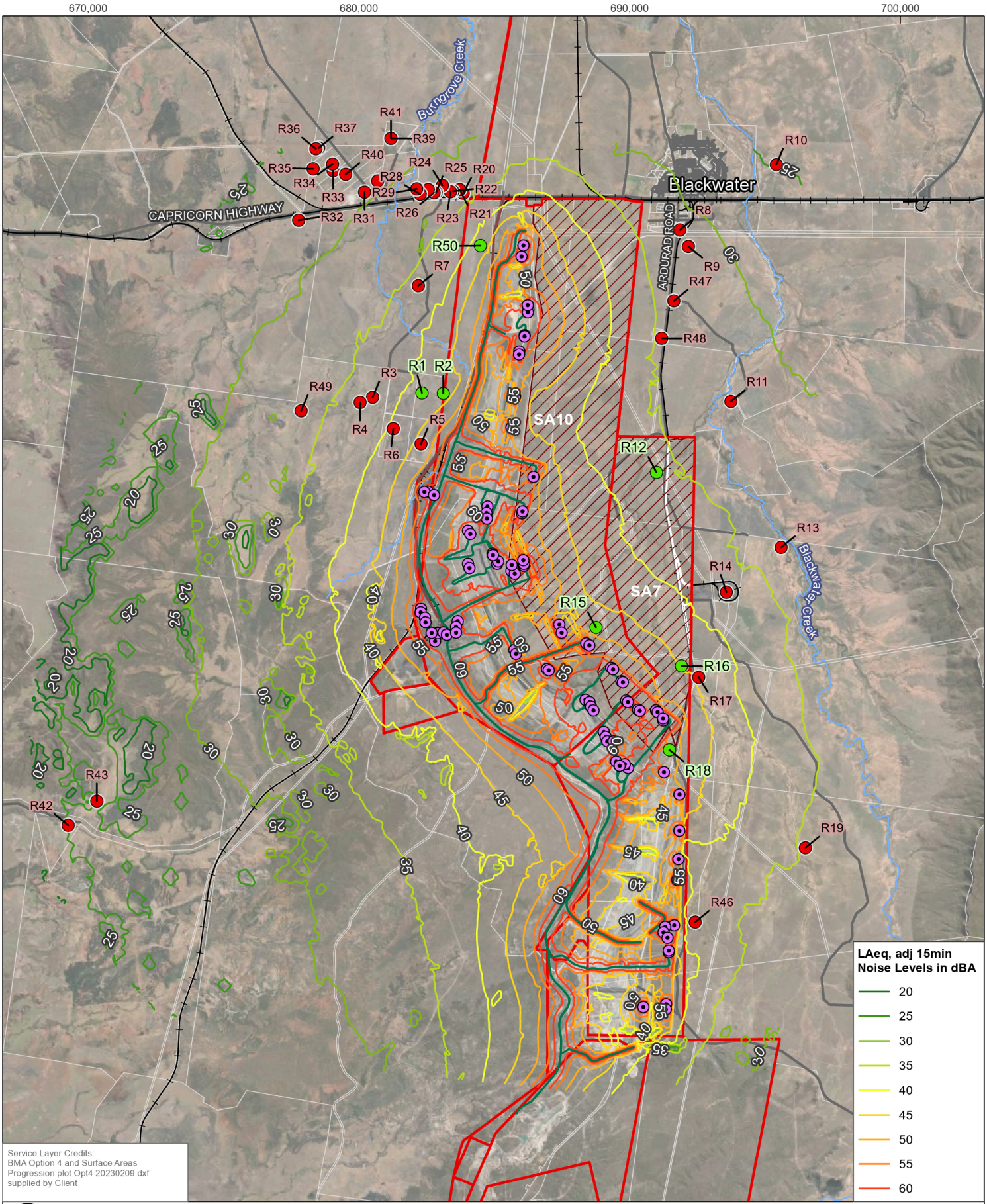
Mine Acces Road
BWM Mining Lease
BWM North Extension Project Area
Cadastre
Non-sensitive Receptor
Sensitive Receptor
FY2039 Point Source
FY2039 Line Source
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:185,000 at A4
Project Number: 620.014601
Date Drawn: 07-Dec-2023
Drawn by: NT
BLACKWATER MINE -
NORTH EXTENSION PROJECT
FY2039 NEUTRAL
CONTOUR MAP
SLR
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.
FIGURE C-3
Path: H:\Projects-SLR\620-BNE\620-BNE\620.014601.00001 Blackwater NEP\08 GIS\BWM NEP Pro\BWM NEP Pro v1.aprx\620014601_NV_FC_3_FY2039 Neutral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LEGEND
Railway
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Watercourse
Mine Acces Road
BWM Mining Lease
BWM North Extension Project Area
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Non-sensitive Receptor
Sensitive Receptor
FY2039 Point Source
FY2039 Line Source
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:185,000 at A4
Project Number: 620.014601
Date Drawn: 07-Dec-2023
Drawn by: NT
BLACKWATER MINE -
NORTH EXTENSION PROJECT
FY2039 ADVERSE
CONTOUR MAP
SLR
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FIGURE C-4
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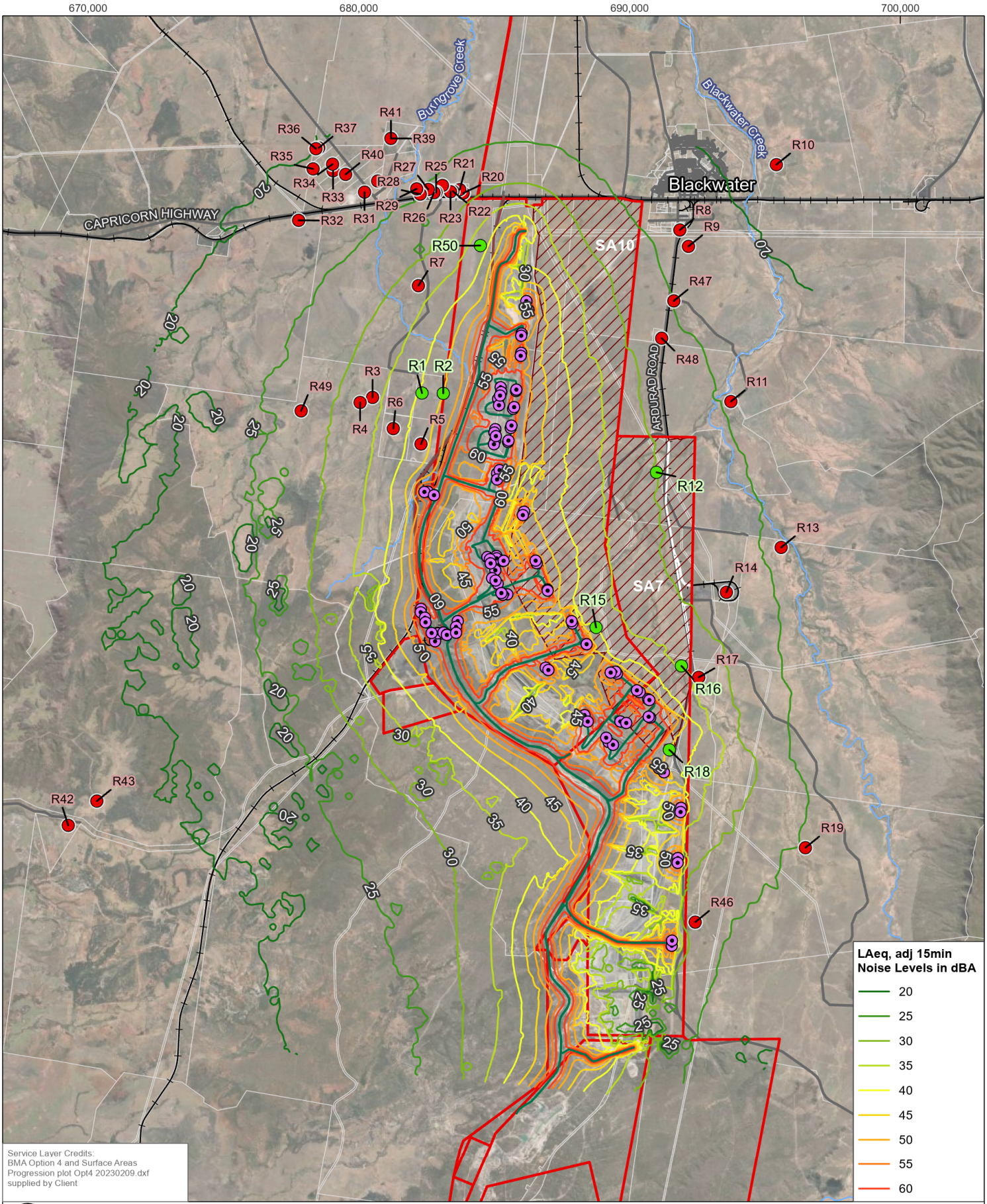
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Watercourse
Mine Acces Road
BWM Mining Lease
BWM North Extension Project Area
Cadastre
Non-sensitive Receptor
Sensitive Receptor
FY2044 Point Source
FY2044 Line Source
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:185,000 at A4
Project Number: 620.014601
Date Drawn: 07-Dec-2023
Drawn by: NT
BLACKWATER MINE -
NORTH EXTENSION PROJECT
FY2044 NEUTRAL
CONTOUR MAP
SLR
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FIGURE C-5
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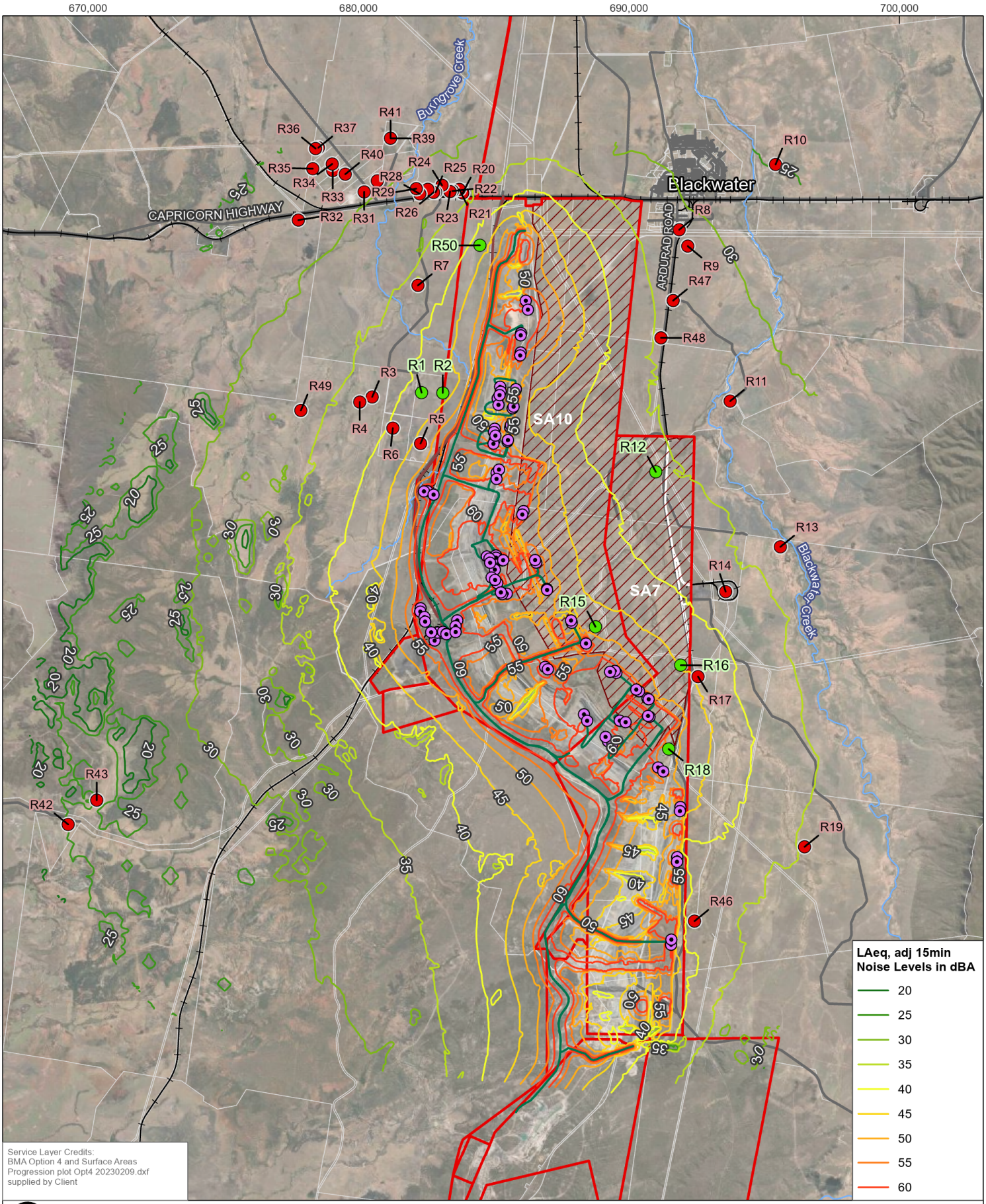
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BWM North Extension Project Area
Cadastre
Non-sensitive Receptor
Sensitive Receptor
FY2044 Point Source
FY2044 Line Source
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Date Drawn: 07-Dec-2023
Drawn by: NT
BLACKWATER MINE -
NORTH EXTENSION PROJECT
FY2044 ADVERSE
CONTOUR MAP
SLR
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.
FIGURE C-6
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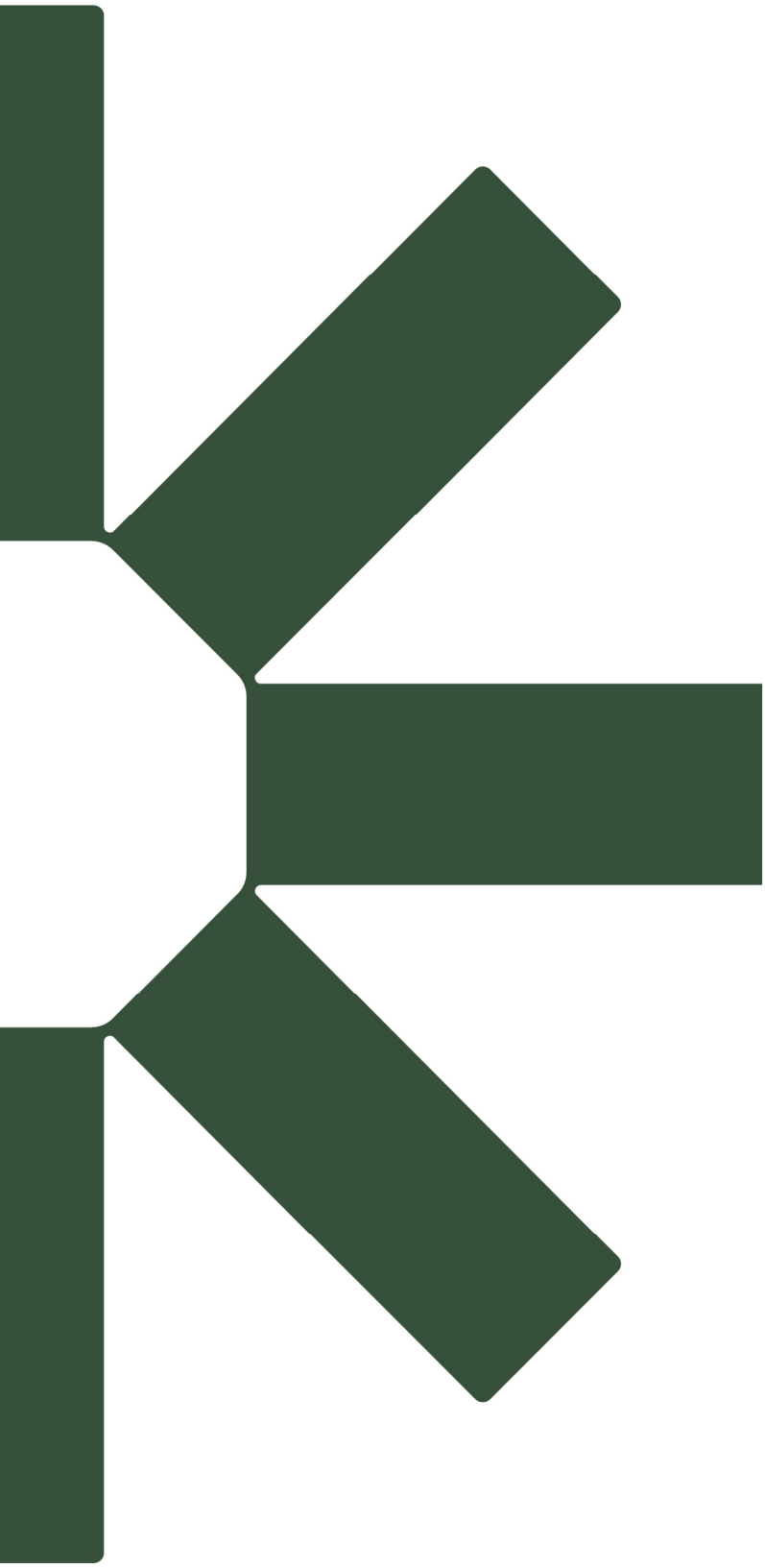

Making Sustainability Happen