HAIL CREEK MINE

Environmental Authority Amendment
Noise and Vibration Impact Assessment

Prepared for:

Glencore
PO Box 107
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BASIS OF REPORT

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
626.30128-R01-v1.0	24 March 2023	Steve Henry	Roger Hawkins	Roger Hawkins

EXECUTIVE SUMMARY

This Noise and Vibration Impact Assessment Technical Report has been prepared by SLR Consulting Australia Pty Ltd (SLR) on behalf of Hail Creek Holdings Pty Ltd (HCC) to provide supporting information to the EA Amendment Application under *Section 226* of the EP Act for the Hail Creek Open Cut (HCOC) Extension Project (the Project).

The potential for adverse noise impacts as a result of the Project was assessed against the criteria summarised in the following table.

Sensitive Place						
Noise Level (dBA) measured as:	Monday to Saturday			Sundays and Public Holidays		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am	Day 9am to 6pm	Evening 6pm to 10pm	Night 10pm to 9am
Environmental authority (EA) EPML00661913 on mining leases (MLs) 4738 and 700026						
$L_{Aeq, adj,15mins}$ Fort Cooper Homestead	35	31	30	33	34	30
$L_{Aeq, adj,15mins}$ Carrinyah Station and all other locations	46	40	27	45	40	25
$L_{A1, adj, 15mins}$ Fort Cooper Homestead	40	36	30	38	39	30
$L_{A1, adj, 15mins}$ Carrinyah Station and all other locations	51	45	32	50	37	30
Environmental Protection (Noise) Policy 2019 (EPP(Noise))						
EPP(Noise) – $L_{Aeq,15min}$ [1]	42	42	37	42	42	37
EPP(Noise) – $L_{A1,15min}$ [1]	52	52	47	52	52	47
Department of Environment and Science's (DES) Model Mining Conditions (MMC)						
MMC – $L_{Aeq,15min}$	35	35	30	35	35	30
MMC – $L_{A1,15min}$	40	40	35	40	40	35

Note 1: Internal criteria adopted from EPP(Noise) with a conservative 7 dB façade reduction to derive an externally assessable criterion. The derived daytime and evening criteria are lower than the reported 'outdoor' noise criteria (refer to Table 5) for a residential receptor (by 10 dBA).

Airblast overpressure and ground vibration predicted from the Project was assessed against the limits prescribed in the existing EA, noting these limits are also consistent with the MMC blasting criteria.

The assessment has modelled total HCOC noise with the proposed Carrinyah Pit and Exevale Pit extensions from two (2) representative operational mining scenarios based on mine plans for the Year 2033 and Year 2036 (summarised in the table below). Through a review of information supplied by HCC, these two (2) modelled scenarios approximately span the life of the Project.

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ID	Receptor	Predicted HCOC Noise Level (L_{Aeq} dBA)			
		Year 2033		Year 2036	
		Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather
R1	Fort Cooper Homestead	25	30	25	30
R2	Carrinyah Station	18	22	16	20
R3	Kemmis Creek Station	17	21	16	20

Assessment of predicted HCOC L_{Aeq} noise levels noted the following:

- HCOC noise levels at Fort Cooper Homestead are predicted to be compliant with the most stringent EA noise limit and MMC limit of 30 dBA L_{Aeq}. The EPP(Noise) Acoustic Quality Objective derived external noise limit of 37 dBA L_{Aeq} is also predicted to be complied with.
- HCOC noise levels at Carrinyah Station and Kemmis Creek Station are predicted to be compliant with the most stringent EA limit of 25 dBA L_{Aeq}, as well as the more relaxed MMC and EPP(Noise) noise limits.

Regarding assessment of L_{A1} noise levels, the highest predicted L_{A1} noise level was 33 dBA at sensitive receptor R1 (Fort Cooper Homestead) for both the Year 2033 and Year 2036 scenarios under adverse weather conditions (i.e., with a temperature inversion). This highest predicted L_{A1} noise level represents a 3 dBA exceedance of the existing EA noise limit of 30 dBA, however, it is considered that the 30 dBA L_{A1} limit should be 35 dBA to be consistent with the MMC. A limit of 35 dBA L_{A1} would be complied with at Fort Cooper Homestead together with the EPP(noise) derived external 47 dBA L_{A1} criterion.

In light of this potential discrepancy, it is recommended that the existing EA noise limits are replaced with the MMC noise criteria.

The assessment has considered cumulative mine noise impacts for sensitive receptors exposed to noise emission from both HCOC and South Walker Creek Mine (SWC). The cumulative noise impact assessment completed for the Project identified that the predicted contribution of mine noise from SWC will have no material effect on the received mine noise levels at the Fort Cooper Homestead (i.e., will not result in an overall increase to the predicted HCOC noise levels). A marginal 1 dB increase is predicted at Kemmis Creek Station, however, the predicted cumulative noise level complies with all forms of noise assessment criteria and therefore cumulative noise impacts are not anticipated as a result of this Project.

SLR understands that actual blast design parameters, predictive modelling and monitoring of impacts are regularly reviewed and completed for existing blasting activities at HCOC and that these practises would ultimately inform the blasting requirements for the Project. Notwithstanding this, a conservative assessment of the potential for airblast overpressure and ground vibration impact has been completed for the Project. The assessment has indicated that:

- Predicted airblast overpressure levels indicate that both the 115 dBL (20% exceedance case) and 120 dBL (maximum) blasting criteria can be achieved during blasting within the Carrinyah Pit extension areas of the Project.

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- Predicted peak particle velocity ground vibration levels indicate compliance with the 5 mm/s (10% exceedance) and 10 mm/s (maximum) ground vibration criteria based on MICs in the order of 4,000 kg to 5,000 kg.

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1 Introduction

1.1 Overview

Hail Creek Open Cut (HCOC) is an open cut coal mine located in the Bowen Basin in Central Queensland. It is situated 85km west of Mackay (150 km by road) and approximately 35 km northwest (50 km by road) of the township of Nebo. HCOC is a joint venture, predominantly owned by Hail Creek Coal Holdings Pty Ltd (HCC), a subsidiary of Glencore Coal Assets Australia. Glencore began operational management of the mine in August 2018, after Glencore acquired Rio Tinto's 82% interest in the mine.

HCOC is authorised through Environmental Authority (EA) EPML00661913 and Mining Leases (MLs) 4738 and 700026. Construction of HCOC commenced in December 2001 with infrastructure completed in April 2003. Mining of overburden began in April 2003, with the first coal produced in August 2003. Coal is mined using conventional open-cut strip-mining methods and has approval to produce up to 20 million tonnes of product coal per annum. The mine has an expected life of mine to 2043.

The four key mining activities undertaken at HCOC are:

1. Pre-production and exploration drilling;
2. Open cut mining;
3. Coal handling and preparation; and
4. Maintenance and services.

Due to changes in mine sequencing, improvements in mining efficiency and further resource definition, an extension to the approved mining footprint of the Carrinyah and Exevale Pits is required to continue mining at HCOC (the Project).

1.2 Report Purpose and Structure

This Noise and Vibration Impact Assessment Technical Report has been prepared by SLR Consulting Australia Pty Ltd (SLR) on behalf of HCC 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.

Table 1 Report Structure

Section	Description
1: Introduction	Provides an overview of the purpose of the Report and outlines the structure and supporting documentation.
2: Existing Environment	Provides an overview of the assessed sensitive receptors (noise and vibration), and a summary of the baseline noise survey completed to support the Report.
3: Assessment Criteria	Provides an overview of the noise and vibration assessment criteria that have been prepared for the Report based primarily on reference to the existing EA, the EP Act, EPP(Noise) and the Model Mining Conditions (MMC) guideline (Department of Environment and Science (DES) 2017).
4: 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.

Section	Description
5: 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 (1) or more of the assessment scenarios.
6: Recommendation	Provides noise and vibration management recommendations for the Project based on the outcomes of the noise and vibration impact assessment.
7: Conclusion	Summarises the key findings of the Report.

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

1.3 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 summarised 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 material
- Pre-stripping/excavation of overburden material using excavators/shovels and trucks
- Removal of overburden and placement in either the in pit or out of pit dumps
- Loading and hauling of ROM coal using a combination of excavators, loaders and trucks, and
- Progressive rehabilitation by backfilling the mined-out pit, reshaping dumps, topsoiling and revegetation.

There is only one activity, namely blasting, that is capable of producing measurable or perceptible vibration levels at assessed sensitive receptors due to the offset distances between the Project operations and sensitive receptors. Section 5.3 includes assessment of blasting ground vibration impacts from the Project.

Potential impacts associated with cumulative mine noise emissions have also been considered in the assessment (in Section 5.2).

2 Existing Environment

2.1 Existing Sensitive Receptors

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

A sensitive place means any of the following:

a. *a dwelling, residential allotment, mobile home or caravan park, residential marine or other residential premises; or*

b. *a motel, hotel or hostel; or*

c. *an educational institution; or*

d. *a medical centre or hospital; or*

e. *a protected area under the Nature Conservation Act 1992, the Marine Parks Act 1992 or a World Heritage Area; or*

f. *a public park or gardens.*

Note: The definition of 'sensitive place' and 'commercial place' is based on Schedule 1 of Environmental Protection (Noise) Policy 2008. That is, a sensitive place is inside or outside on a dwelling, library and educational institution, childcare or kindergarten, school or playground, hospital, surgery or other medical institution, commercial & retail activity, protected area or an area identified under a conservation plan under Nature Conservation Act 1992 as a critical habitat or an area of major interest, marine park under Marine Parks Act 2004, park or garden that is outside of the mining lease and open to the public for the use other than for sport or organised entertainment. A commercial place is inside or outside a commercial or retail activity.

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) is not a sensitive place for that mine or mining project, 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 holders of the environmental authority for the mining project, or a related company. Accommodation for mine employees or contractors is a sensitive place if the land is held by a mining company or related company, and if occupation is restricted to the employees, contractors and their families for the particular mine or mines which are held by the same company or a related company.

For example, a township (occupied by the mine employees, contractors and their families for multiple mines that are held by different companies) would be a sensitive, even if part or all of the township is constructed on land owned by one or more of the companies.

Based on the above definition, noise and vibration receptors surrounding and potentially impacted by the Project are listed in Table 2 and identified on Figure 1.

Table 2 Noise and Vibration Sensitive Receptors

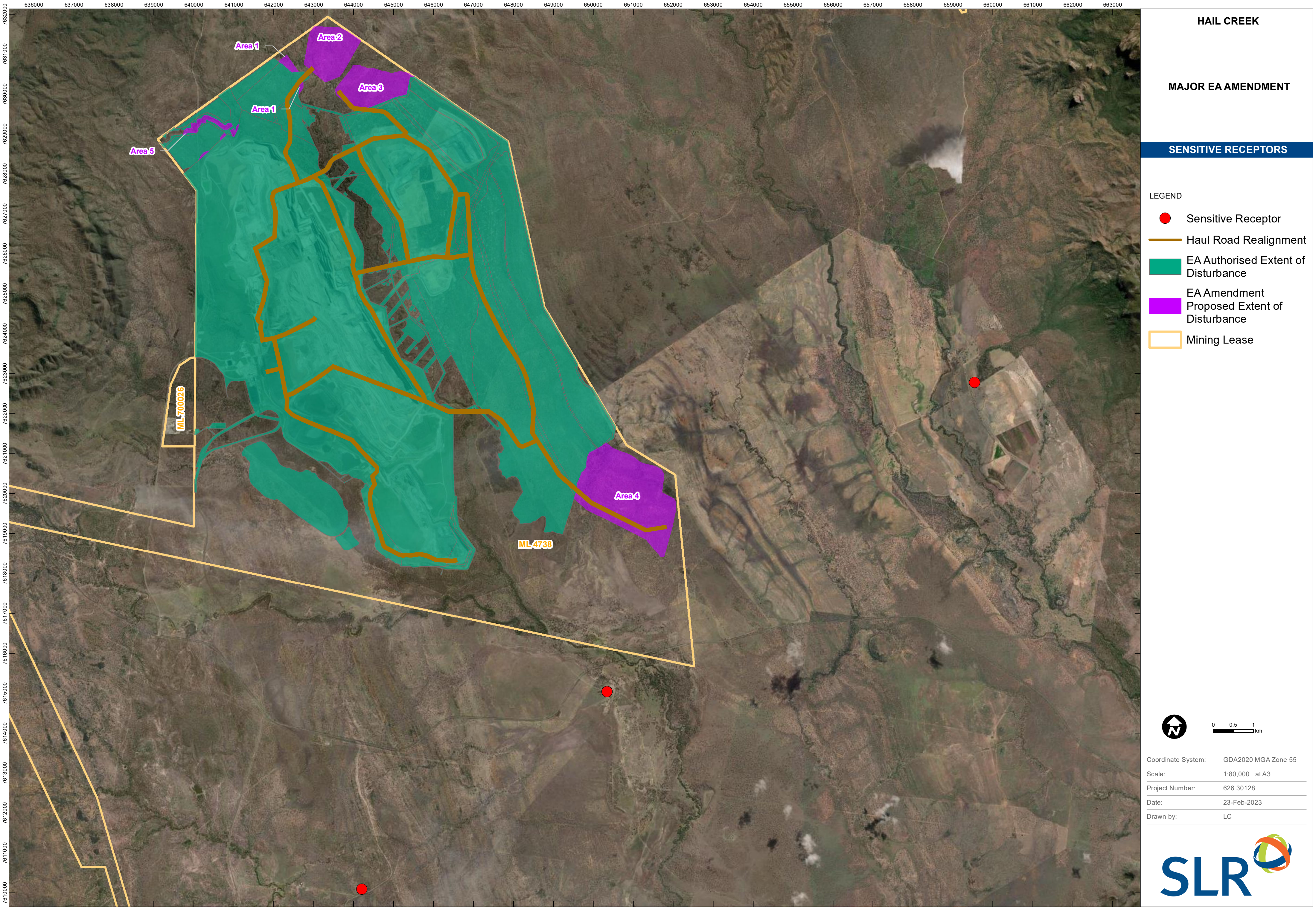
ID	Receptor	Easting (m) A	Northing (m) A	Ownership Status	Distance to ML 4738
R1	Fort Cooper Homestead	650,348	7,615,031	Privately owned	1.1 km
R2	Carrinyah Station	659,547	7,622,776	Privately owned	7.7 km
R3	Kemmis Creek Station	644,206	7,610,085	Privately owned	7.2 km

2.2 Existing Noise Levels

Noise monitoring results obtained from measurements completed by SLR at the Fort Cooper Homestead (SLR Report 626.10094-R1 dated 17 October 2014) are summarised in Table 3. As a result of the low background noise levels (measured in 2014) and absence of any subsequent, significant development in the vicinity of the Fort Cooper Homestead, baseline noise monitoring has not been carried out for the present Assessment.

Table 3 Fort Cooper Homestead Noise Monitoring Results Summary

Noise Descriptor	Monday to Saturday			Sunday and Public Holidays		
	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
L_{A90} (dBA)	30	26	<25	28	29	<25
L_{Aeq} (dBA)	56	43	36	55	42	40



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3 Assessment Criteria

3.1 Noise

3.1.1 HCOC EA Noise Criteria

Under the current EA, HCOC is required to operate in accordance with Schedule D Noise Conditions D1 to D3. Numerical noise limits are prescribed in Table D1 (Noise Limits) of the EA and are reproduced below in Table 4.

Table 4 HCOC EA Schedule D Table D1 (Noise Limits)

Sensitive Place						
Noise Level (dBA) measured as:	Monday to Saturday			Sundays and Public Holidays		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am	Day 9am to 6pm	Evening 6pm to 10pm	Night 10pm to 9am
$L_{Aeq, adj,15mins}$ Fort Cooper Homestead	35	31	30	33	34	30
$L_{Aeq, adj,15mins}$ Carrinyah Station and all other locations	46	40	27	45	40	25
$L_{A1, adj, 15mins}$ Fort Cooper Homestead	40	36	30	38	39	30
$L_{A1, adj, 15mins}$ Carrinyah Station and all other locations	51	45	32	50	37	30
Commercial Place						
$L_{Aeq, adj,15mins}$ Fort Cooper Homestead	40	36	30	33	39	30
$L_{Aeq, adj,15mins}$ Carrinyah Station and all other locations	51	45	32	44	37	30

With regard to the noise limits prescribed in Table D1 of the existing HCOC EA (as presented in Table 4), we note the following inconsistencies:

- The night-time L_{A1} noise limit at Fort Cooper Homestead (ie 30 dBA) should not be identical to the night-time L_{Aeq} noise limit particularly with noise from HCOC unlikely to be steady state in nature.
- The Fort Cooper Homestead "Commercial Place" night-time period noise limit should not be identical to the "Sensitive Place" noise limit.
- The Fort Cooper Homestead Sundays and Public Holidays evening period noise limit should not be higher than the weekday evening period noise limit.
- The Sundays and Public Holidays night-time period L_{Aeq} noise limit of 25 dBA at Carrinyah Station (and all other locations) is significantly more stringent than the Department of Environment and Science's (DES) Model Mining Conditions (MMC) threshold limit of 30 dBA L_{Aeq}.

In light of the above, a review of contemporary noise criteria for mines has been completed as part of this assessment with the findings and recommended alternative noise criteria summarised in Section 3.1.2.

3.1.2 Alternative Noise Assessment Criteria

To provide HCC with alternative noise criteria to negotiate more appropriate noise limits than those currently prescribed in the HCOC EA, this report considers and develops revised noise criteria, aligned with current legislation and/or best practice guidelines. This is discussed further in the following sub-sections.

3.1.2.1 Environmental Protection Policy (Noise)

The *Environmental Protection (Noise) Policy 2019* (EPP(Noise)) is subordinate legislation under the EP Act and the environmental values to be enhanced or protected under the EPP(Noise) are:

- The qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems.
- The qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following: sleep, study or learn or be involved in recreation, including relaxation and conversation.
- The qualities of the acoustic environment which are conducive to protecting the amenity of the community.

The EPP(Noise) contains Acoustic Quality Objectives (AQO) for receptors potentially sensitive to noise. Where the overall level of noise at the receptors, from all sources but excluding road and rail transport noise, are within the AQO, the environmental values are considered to be achieved. The AQO for the noise sensitive receptors and land use surrounding HCOC are presented in Table 5. HCOC operations require continuous operation of plant and equipment, as such this assessment has referenced the 1-hour L_{Aeq} and L_{A1} AQO to assess the noise emissions from HCOC noise sources.

Table 5 EPP(Noise) Acoustic Quality Objectives

Receptor Type	Time of Day	Acoustic Quality Objective (dBA)	
		$L_{Aeq,adj,1hr}$	$L_{A1,adj,1hr}$
Residential dwelling (outdoors)	Day time and evening	50	65
Residential dwelling (indoors)	Daytime and evening	35	45
	Night-time	30	40

To assess noise levels to the internal (indoor) AQO at residential dwellings, the external noise levels predicted by the noise modelling are adjusted by an attenuation factor, which accounts for the reduction of noise achieved by the building facade (with windows open). For this assessment, a conservative 7 dB façade noise reduction has been applied in line with the DES guideline titled '*Noise and Vibration EIS Information Guideline*', where, at page 3, it states:

> *When assessing outdoor to indoor noise attenuation at sensitive receptors … use an outdoor to indoor attenuation value of 7dB, which is appropriate for typical Queensland buildings with open windows.*

Accordingly, internal residential noise levels would be expected to be within the indoor AQO where external noise levels are not more than:

- $L_{Aeq,adj,1hr}$ 42 dB during the daytime and evening.
- $L_{Aeq,adj,1hr}$ 37 dB during the night-time.
- $L_{A1,adj,1hr}$ 52 dB during the daytime and evening.
- $L_{A1,adj,1hr}$ 47 dB during the night-time.

3.1.2.2 Model Mining Conditions

DES's MMC guideline provides a set of model conditions to form general environmental protection commitments for mining activities and environmental authority conditions for resource activities.

In accordance with Schedule D – Noise of MMC, it states that where the measured background noise level is less than 30 dBA, which has been shown to be the case at Fort Cooper Homestead (refer to Table 4), then 30 dBA can be substituted for the measured background level. Noise assessment criteria in accordance with MMC, are detailed in Table 6.

Table 6 Noise Assessment Criteria (external) – MMC

Sensitive Receptor	MMC External Noise Limits (dBA)		
	Daytime	Evening	Night-time
Residential - $L_{Aeq,15min}$	35	35	30
Residential – $L_{A1,15min}$	40	40	35

The noise assessment criteria from the MMC are between 5 dBA and 10 dBA more stringent than the external noise assessment criteria adapted from the EPP(Noise).

3.1.3 Summary of Operational Mining Noise Criteria

While all criteria sources reference an L_{Aeq} assessment parameter, it is important to note that the AQO's within the EPP(Noise) are relevant to a 1-hour assessment period while the existing EA and MMC are both based on a 15-minute assessment period. From a practical viewpoint, with appropriate noise management technology and processes in place, a 1-hour assessment period allows the potential for a mine to identify and accordingly manage an emerging noise issue within the 1-hour assessment period. Conversely, a 15-minute assessment period limits such an opportunity.

This assessment considers both fixed plant and mobile mining equipment and consequently it has been assumed that mining operations are quasi-steady and therefore noise emission levels would be consistent, whether the assessment period is over 15-minute or 1-hour duration. Table 7 outlines the operational mining noise criteria referenced in this assessment.

Table 7 Summary of Operational Mining Noise Criteria – Sensitive Receptors

Sensitive Place						
Noise Level (dBA) measured as:	Monday to Saturday			Sundays and Public Holidays		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am	Day 9am to 6pm	Evening 6pm to 10pm	Night 10pm to 9am
$L_{Aeq, adj,15mins}$ Fort Cooper Homestead	35	31	30	33	34	30
$L_{Aeq, adj,15mins}$ Carrinyah Station and all other locations	46	40	27	45	40	25
$L_{A1, adj, 15mins}$ Fort Cooper Homestead	40	36	30	38	39	30
$L_{A1, adj, 15mins}$ Carrinyah Station and all other locations	51	45	32	50	37	30
EPP(Noise) – $L_{Aeq,15min}$ [1]	42	42	37	42	42	37
EPP(Noise) – $L_{A1,15min}$ [1]	52	52	47	52	52	47
MMC – $L_{Aeq,15min}$	35	35	30	35	35	30
MMC – $L_{A1,15min}$	40	40	35	40	40	35

Note 1: Internal criteria are adopted from EPP(Noise) with a conservative 7 dB façade attenuation reduction to derive externally assessable criteria. The derived daytime and evening criteria are lower than the reported 'outdoor' noise criteria (refer to Table 5) for a residential receptor (by 10 dBA).

3.2 Blasting

3.2.1 HCOC EA Airblast Overpressure and Ground Vibration Criteria

The HCOC EA prescribes airblast overpressure and ground vibration criteria in Table D2, which are reproduced below in Table 8.

Table 8 EA Table D2 - Airblast Overpressure and Ground Vibration Criteria

Blasting Parameter	Sensitive or commercial place blasting limits observed during daylight hours	Sensitive or commercial place blasting limits observed during non-daylight hours
Airblast overpressure	115 dB (Linear) peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) peak at any time.	No blasting
Ground vibration peak particle velocity	5 mm/s peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/s peak particle velocity at any time.	No blasting

3.2.2 Alternative Blasting Criteria Review

Similar to the review of operational mining noise criteria in Section 3.1.2, this assessment involved a review of the current EA blasting limits within the EP Act and MMC.

3.2.2.1 EP Act Blasting Criteria

Section 440ZB of the EP Act, states the following blasting criteria:

> *A person must not conduct blasting if—*
>
> *(a) the airblast overpressure is more than 115dB Z Peak for 4 out of any 5 consecutive blasts; or*
>
> *(b) the airblast overpressure is more than 120dB Z Peak for any blast; or*
>
> *(c) the ground vibration is—*
>
> > *(i) for vibrations of more than 35Hz—more than 25mm a second ground vibration, peak particle velocity; or*
> >
> > *(ii) for vibrations of no more than 35Hz—more than 10mm a second ground vibration, peak particle velocity.*

No specific time intervals for blasting activities are stated under Section 440ZB of the EP Act.

The EPP(Noise) does not state any blasting criteria.

3.2.2.2 MMC Blasting Criteria

The MMC airblast overpressure and ground vibration criteria is identical to the current HCOC EA.

3.2.3 Summary of Blasting Criteria

In line with Section 3.1.3, for this summary of blasting criteria, it needs to be noted that the EP Act is legislation in Queensland while the MMC is a guideline. In stating this, the primary difference with respect to the airblast overpressure is that the EP Act is comparatively less stringent with 20% exceedance allowance of the 115 dB (Linear) peak (four (4) out of five (5) blasts), while the existing EA and MMC nominate a 10% exceedance allowance of the 115 dB (Linear) peak (nine (9) out of ten (10) blasts) together with an absolute limit of 120 dB (Linear) peak.

With respect to the ground vibration criteria, the primary differences are not directly comparable, as EP Act nominates a two stepped (frequency dependent) absolute criteria, while the MMC nominates a 10% exceedance allowance of the 5 mm/s peak particle velocity (nine (9) out of ten (10) blasts) together with an absolute limit of 10 mm/s.

Table 9 summarises the blasting criteria adopted for this assessment.

Table 9 Summary of Blast Criteria

Blasting Parameter	Time period	Criteria at a Sensitive or Commercial Blasting Place
Airblast overpressure (HCOC EA)	Daylight hours	115 dB (Linear) peak for 9 out of 10 consecutive blasts initiated; and not greater than 120 dB (Linear) peak at any time.
Airblast overpressure (MMC)	7.00 am to 6.00 pm	115 dB (Linear) peak for 9 out of 10 consecutive blasts initiated; and not greater than 120 dB (Linear) peak at any time.
Airblast overpressure (EP Act)	No specified time periods stated	115 dB (Linear) peak for 4 out of 5 consecutive blasts initiated; and not greater than 120 dB (Linear) peak at any time.
Ground vibration peak particle velocity (HCOC EA)	Daylight hours	5 mm/s peak particle velocity for 9 out of 10 consecutive blasts initiated; and not greater than 10 mm/s peak particle velocity at any time.
Ground vibration peak particle velocity (MMC)	7.00 am to 6.00 pm	5 mm/s peak particle velocity for 9 out of 10 consecutive blasts initiated; and not greater than 10 mm/s peak particle velocity at any time.
Ground vibration peak particle velocity (EP Act)	No specified time periods stated	For vibrations of more than 35 Hz - Not greater than 25 m/s peak particle velocity at any time. For vibrations of no more than 35 Hz - Not greater than 10 m/s peak particle velocity at any time.

4 Assessment Methodology

4.1 Assessed Mining Activities and Assumptions

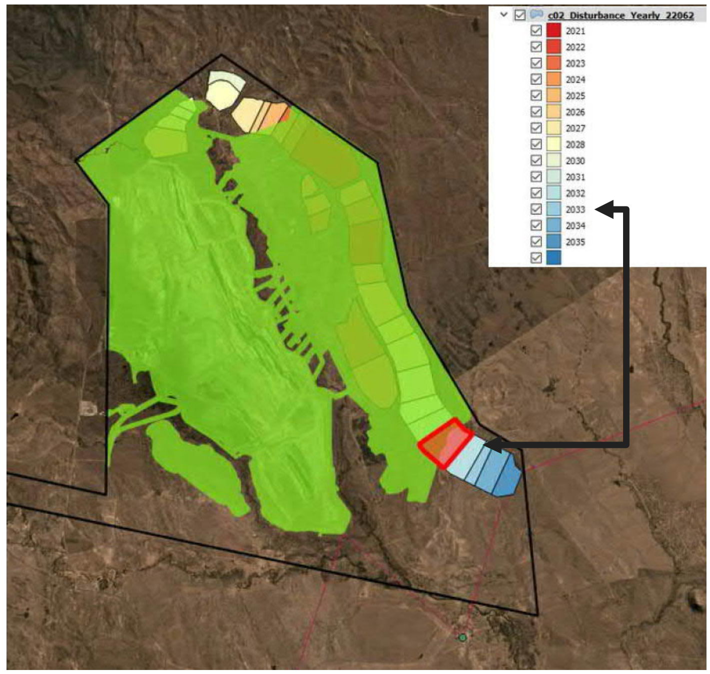
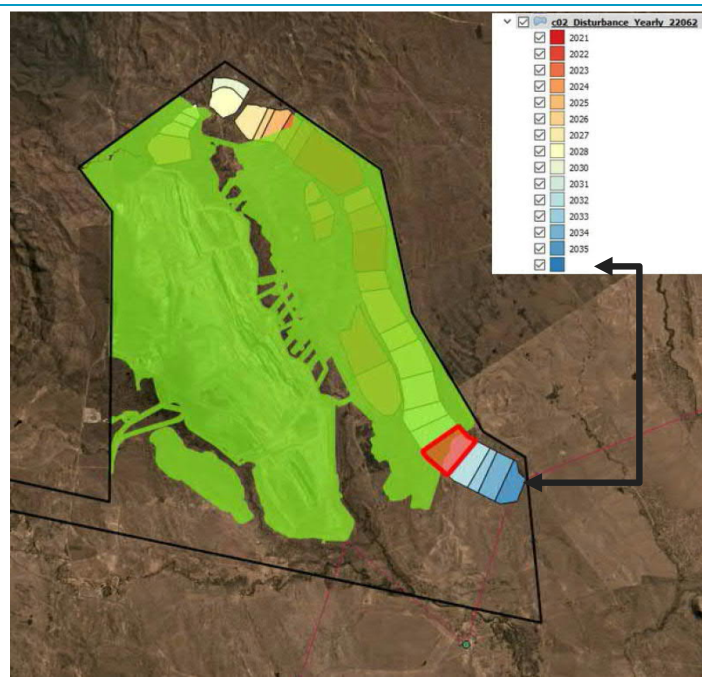
The selection of noise modelling/assessment scenarios for the Project was based on activities with the greatest potential to result in noise at the identified sensitive receptors. This included when plant and equipment (noise sources) would be at the closest proximity to receptors (i.e. due to active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

The assessment scenarios in Table 10 were developed to assess potential 'typical worse-case' noise levels with consideration of the following:

- Progressive mining within the Project areas with modelling of mining equipment biased towards the south-eastern extension area of the Carrinyah Pit and adjacent waste dump due to the sensitive receptors being located closer to this pit than the Exevale Pit to the north.
- HCC advised ROM and product coal output estimated over the life of the Project.

The Project is expected to require only minor "construction-type" activities (i.e. in comparison to the Project operational activities) and therefore the assessment has not included a construction phase scenario.

Table 10 Assessed Operational Scenarios and Associated Mining Activities

Scenario/Year of Operation	Scenario Justification	Mine Plan Diagram
Year 2033	Scenario modelled to assess the initial progression into the Project extension area of the Carrinyah Pit as well as coinciding with the peak mining equipment numbers during the life of the Project.	
Year 2036	Scenario modelled to assess the final stages of mining in the south-eastern tip of the Project area in Carrinyah Pit. The Year 2036 scenario also represents a reduction in operational mining equipment (discussed in further detail in Section 4.2.3)	

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

- The noise assessment involved the modelling of mine noise sources located within both the Project area as well as all remaining HCOC noise sources including equipment operating on existing haul roads, waste dumps, rehabilitation areas and the HCOC industrial area including CHPP and loadout.
- A 3-D mine plan of the entire HCOC, inclusive of the Project areas, was provided by HCC for the purpose of developing the noise model.
- With regard to mobile mining equipment, HCC advised the type and quantity of equipment proposed to be operated for future HCOC operations including the approximate allocations of equipment in both pits.
- Modelling of HCOC haul trucks (waste or coal) was completed via line sources calculating a noise emission level for a typical path travelled over a 15-minue period (accounting for different speeds in/out of pits and on flat haul roads). To account for the total number of trucks proposed for each pit/activity, an assumption has been made that one (1) stationary haul truck would be located next to the active excavator and the remaining number of trucks are considered in calculating a total line source to simulate the haulage circuit.
- All remaining equipment 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 (+8 dB) relationship is considered conservative in that it works off 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.
- Noting that the Project would not require any material change to existing fixed plant operating at HCOC, modelling of these sources was based on modelling of the CHPP completed by Renzo Tonin Ron Rumble for the *Hail Creek Transition Project Noise and Vibration Assessment* in 2015.
- Rail noise has been excluded from this assessment as rail operations are not proposed to change as a result of the Project. Further, given its an existing noise source, sensitive receptors are unlikely to associate future rail noise as part of the Project particularly given the large separation distance (i.e. at least 10 km from ML 4738) between the HCOC rail line and the sensitive receptors.
- 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. This would be minor in comparison to predicted noise levels from coal mining operations given a significant reduction in operational mining equipment.

4.2 Noise Prediction Modelling

4.2.1 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.

4.2.2 Modelled Weather Parameters

The default weather parameters applied to this study are summarised in Table 11.

Table 11 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	2 m/s

4.2.3 Noise Sources, Sound Power Levels and Location Allocation

With reference to the modelled mine scenarios (listed in Table 10), Table 12 and Table 13 summarise the following model inputs:

- Mine equipment make, model and numbers relevant to the assessed operational scenarios.
- Assumed overall sound power level (SWL) data and source emission heights for each equipment item sourced from SLR's mining equipment noise source database.
- Assumed overall SWL data and source emission heights for each fixed plant item (i.e., CHPP and conveyor drives) sourced from the Renzo Tonin Ron Rumble report.

Appendix C contains figures identifying the assigned mobile mining equipment locations for each modelled scenario.

Table 12 Modelled Noise Sources and Sound Power Levels

Equipment type	Make and Model	SWL (dBA, LAeq)	Source Height [1] (m)	Quantity of Plant per Modelled Year	
				2033	2036
Haul trucks	Komatsu 930	124	3	18	12
	CAT 793D	120	3	17	15
	CAT789	118	3	12	8
Dozers	D10	116	3	7	4
	D11	119	3	5	5
	D11R (CHPP)	119	3	4	2
	Wheeled dozer	118	3	2	1
Ancillary	Graders	113	3	6	4
	Water trucks	118	3	5	4
	Service trucks	108	3	2	2
	Scrapers	111	3	2	2
	Small LD/Cable reeler	113	3	4	3
	Drills	118	3	4	3
Excavators	Komatsu 4100 XPC	123	10	2	1
	Terex RH340	123	4	2	1
	Hitachi EX5600	119	4	1	1
	CAT 6040	118	4	3	1
	CAT 6015	117	3	3	2
	CAT 994K	113	3	2	1
Fixed Plant	Conveyor drive	105	2	4	4
	CHPP (per module)	115	15	2	2
	Stacker Reclaimer	115	10	1	1

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

Table 13 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
Komatsu 930	124	79	103	113	115	118	118	118	112	103
CAT 793D	120	77	98	100	110	114	114	114	108	97
CAT789	118	76	97	99	107	112	112	112	106	96
D10	116	78	89	104	106	110	113	107	101	94
D11	119	84	98	99	109	114	112	111	109	103
Wheeled dozer	118	84	98	99	109	114	112	111	105	97

Source	SWL, dBA LAeq									
	Overall	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Graders	113	71	94	100	106	103	109	106	102	84
Water trucks	118	76	97	99	107	112	112	112	106	96
Service trucks	108	80	89	86	100	101	102	100	101	91
Scrapers	111	58	63	88	92	99	106	108	102	94
Small LD/cable reeler	113	74	82	101	105	107	107	105	100	93
Drills	118	83	97	102	110	113	113	110	105	94
Komatsu 4100 XPC	123	86	94	112	116	117	117	115	111	99
Terex RH340	123	81	89	110	113	118	119	115	109	102
Hitachi EX5600	119	81	89	108	111	113	113	112	107	100
CAT 6040	118	78	86	106	109	112	111	111	105	97
CAT 6015	117	77	85	105	108	111	110	110	104	96
CAT 994K	113	74	82	101	105	107	107	105	100	93
Conveyor drive	105	-	70	80	88	100	98	99	96	87
CHPP (per module)	115	-	78	94	104	106	109	109	108	103
Stacker Reclaimer	115	78	94	105	108	108	108	108	102	92

4.3 Cumulative Noise Impact Assessment

The assessment has also considered cumulative mine noise impacts for sensitive receptors exposed to noise emission from HCOC and South Walker Creek Mine (SWC) on ML 4750. Other existing mines in the region are considered too far from the sensitive receptors near HCOC to be audible.

Predicted noise levels from SWC have been sourced from noise modelling completed by SLR in 2021 based on a Year 2036 operational scenario which correlates well with the mine plan scenarios assessed for the Project.

4.4 Blasting

Blasting parameters for the Project will generally be consistent with existing blast practises employed at HCOC, with Maximum Instantaneous Charges (MIC) in the order of 4,000 to 5,000 kg. Based on existing HCOC blast practises and previous blasting assessments completed by SLR, the assessment of airblast overpressure and ground vibration proposed for the Project has been conservatively based on:

- the attenuation formula in Australian Standard AS 2187.2 – 2006 *Explosives- Storage, Transport and Use – Part 2 Use of Explosives* (AS 2187) and ICI Explosives (now Orica) Blasting Guide 1995, and
- an MIC range of 4,000 to 5,000 kg which is typical for a mine of this size and deposit type.

Section 5.3 includes assessment of airblast overpressure and ground vibration impacts from the Project.

5 Noise and Vibration Impact Assessment

5.1 Mine Operational Noise Emission

5.1.1 Predicted Operational Noise Levels

The predicted noise levels from the modelled operational scenarios (ie Year 2033 and Year 2036) are summarised in Table 14 for neutral and adverse weather conditions, with corresponding noise level contours presented in Appendix B.

Table 14 Predicted Project and HCOC Operational Noise Levels

ID	Receptor	Predicted Noise Level (L_{Aeq} dBA)			
		Year 2033		Year 2036	
		Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather
R1	Fort Cooper Homestead	25	30	25	30
R2	Carrinyah Station	18	22	16	20
R3	Kemmis Creek Station	17	21	16	20

From the noise prediction modelling results presented in Table 14, the following is noted:

- HCOC noise levels at Fort Cooper Homestead are predicted to be compliant with the most stringent EA limit and MMC limit of 30 dBA L_{Aeq}. The EPP(Noise) Acoustic Quality Objective derived external noise limit of 37 dBA L_{Aeq} is also predicted to be complied with.
- HCOC noise levels at Carrinyah Station and Kemmis Creek Station are predicted to be compliant with the most stringent EA limit of 25 dBA L_{Aeq}, as well as the more relaxed MMC and EPP(Noise) noise limits.

Regarding assessment of L_{A1} noise levels, as noted in Section 4.1, a +8 dB relationship between the L_{Aeq} and L_{A1} noise level descriptor has been used where the noise modelling indicated mobile mining equipment to be the dominant noise source. Accordingly, the highest predicted L_{A1} noise level was 33 dBA at sensitive receptor R1 (Fort Cooper Homestead) for both the Year 2033 and Year 2036 scenarios under adverse weather conditions (i.e., with a temperature inversion). This highest predicted L_{A1} noise level represents a 3 dBA exceedance of the existing EA noise limit of 30 dBA, however, as discussed in Section 3.1.1, it is considered that the 30 dBA L_{A1} limit should be 35 dBA to be consistent with the MMC. A noise limit of 35 dBA L_{A1} would be complied with at Fort Cooper Homestead together with the EPP(noise) derived external 47 dBA L_{A1} criterion.

In light of this potential discrepancy, it is recommended that the existing EA noise limits are replaced with the MMC noise criteria.

Consideration of cumulative noise levels is discussed in Section 5.2.

5.1.2 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 13, 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 with 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 HCOC such as on top of out of pit waste dumps.

EPP(Noise) does not contain specific criteria for assessing low frequency noise (which can be defined as noise from the 10 Hz to 200 Hz frequency range[1]). In the absence of specific low frequency noise assessment requirements with regard to mining impact assessments, the following two (2) documents and associated criteria are referenced to provide consideration to potential low frequency noise impact from the Project onto the assessed noise sensitive receptors:

- The 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 Leq (internal) and the difference between the overall dBL and dBA Leq (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 Leq external) given that building facades generally do not attenuate low frequency noise as well as broader spectrum noise.
- The DES *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 (Leq 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; or
    - 50 dBL measured inside the sensitive receptor; and
    - the difference between the internal A-weighted and Linear (unweighted) (Max $L_{pZ, 15 min}$) noise levels is no greater than 15 dB.

Consistent with the overall A-weighted predicted noise levels (i.e. Table 14), the highest predicted dBC and dBL external noise levels at a sensitive receptor are predicted to occur at R1 (Fort Cooper Homestead) for the Year 2033 scenario under adverse conditions. Predicted levels are 44 dBC and 44 dBL Leq, which are higher than the predicted 30 dBA LAeq due to the A-weighting scale. Neither the dBC or dBL predicted noise levels exceed the respective overall 60 dBC or 55 dBL Leq external criteria. Accordingly, low frequency noise is not predicted to be an issue for 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 6.1. If these mitigation measures are implemented effectively, impulsive noise characteristics can be managed such that impulsive noise penalties may not apply.

[1] With reference to DES Noise Measurement Manual and the former Ecoaccess *Assessment of Low Frequency Noise* Guideline.

5.1.3 Potential for Sleep Disturbance

The World Health Organisation's (WHO) *Night Noise Guidelines for Europe* 2009 recommends that noise levels within bedrooms do not exceed a 30 dBA L_{Aeq} and a maximum (L_{Amax}) noise level of 42 dBA to minimise the risk of sleep disturbance.

SLR's experience in monitoring and assessing noise from mine operations has determined that the L_{A1}/L_{Amax} noise levels are conservatively 8 dB greater than the overall L_{Aeq} noise levels for mine operations. It is to be noted that the maximum noise level is the singular highest noise event and is not a cumulative noise level from all sources of mine noise.

Referencing the highest predicted external noise level of 30 dBA L_{Aeq} at a sensitive receptor, this predicted noise level complies with the conservatively derived external sleep disturbance noise limit of 37 dBA L_{Aeq}. Further, referencing the highest predicted noise level of 30 dBA L_{Aeq} which is based on cumulative HCOC mine noise and not a singular source (i.e., this assessment is highly conservative), the corresponding predicted external noise level would be 38 dBA L_{Amax} at sensitive receptor R1. In this case, the internal 42 dBA L_{Amax} criterion is achieved regardless of the noise attenuation provided by the façade of the homestead at sensitive receptor R1.

Therefore, the above sleep disturbance assessment indicates compliance with the L_{Aeq} 30 dBA and L_{Amax} 42 dB internal noise objectives at the closest sensitive receptor.

5.2 Cumulative Noise

The cumulative noise impact assessment completed as part of this assessment, in line with the methodology outlined in Section 4.3, is detailed in Table 15. The assessment has considered cumulative mine noise emissions at sensitive receptors R1 (Fort Cooper Homestead) and R3 (Kemmis Creek Station) conservatively based on the highest predicted modelling results for HCOC (i.e., Year 2033 adverse weather scenario).

Table 15 Cumulative Mine Noise Under Adverse Weather Conditions

Receptor	Highest Predicted L_{Aeq} (dBA) Noise Level from:		Cumulative L_{Aeq} (dBA) Noise Level
	HCOC	SWC	
R1 – Fort Cooper Homestead	30	<10 [1]	30
R3 – Kemmis Creek Station	21	14 [1]	22

Note 1: From SLR predictive modelling of future (i.e., Year 2036) SWC operations.

Based on the cumulative noise impact assessment detailed in Table 15, it is noted that the predicted contribution of mine noise from SWC will have no material effect on the received mine noise levels at the Fort Cooper Homestead (i.e., will not result in an overall increase to the predicted HCOC noise levels). A marginal 1 dB increase is predicted at Kemmis Creek Station, however, the predicted cumulative noise level complies with all forms of noise assessment criteria and therefore cumulative noise impacts are not anticipated as a result of this Project.

5.3 Blasting

5.3.1 Airblast Overpressure

As noted in Section 3.2, the airblast overpressure limits prescribed in the HCOC 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 generated for the airblast site law.

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

$$SPL = K_a - 24(\log10\ R - 0.33\ \log10\ Q)$$

Where,

SPL = Peak airblast level (dBLinear)

K_a = Site constant (discussed below)

R = Distance between charge and receiver (m)

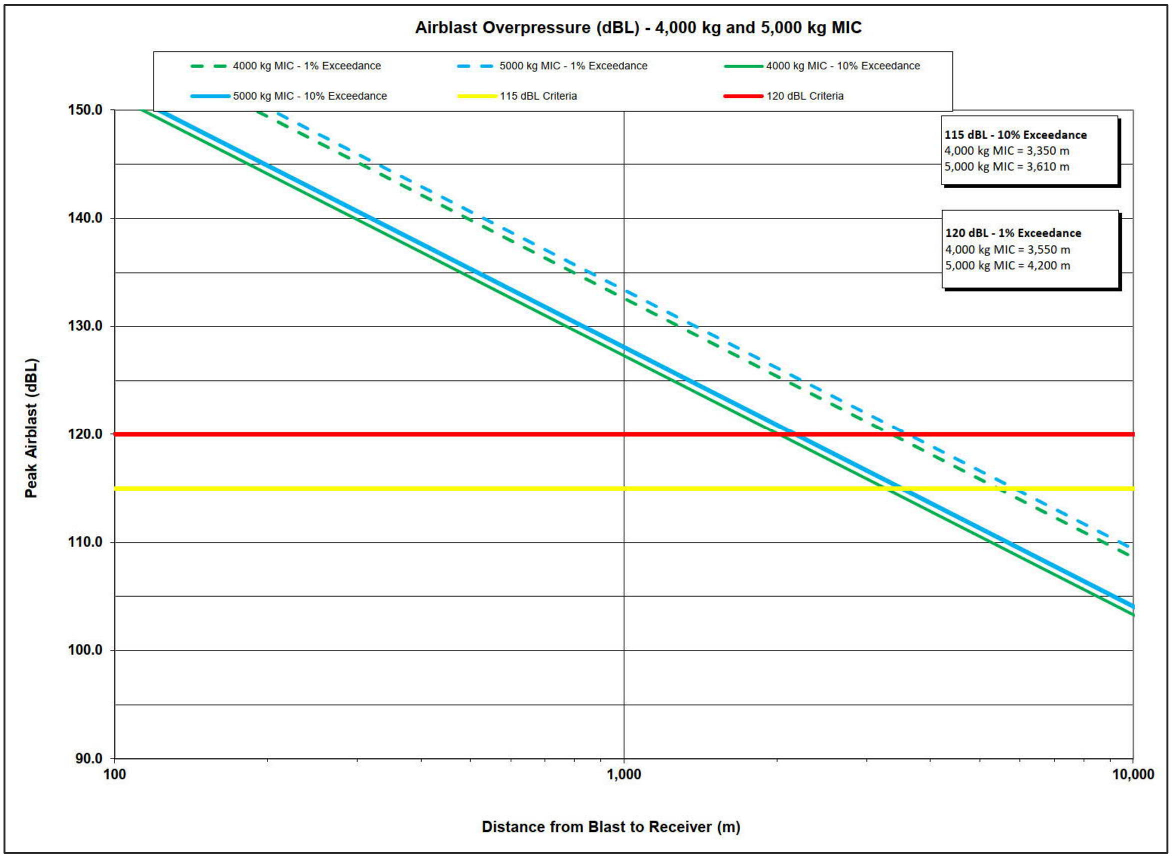
Q = Charge mass per delay (kg)

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 to free-face blasting in rock conditions typical of HCOC:

- 170.5 – for assessment against the 115 dBL criterion for nine (9) out of ten (10) consecutive blasts 10% exceedance, and
- 175.8 – for assessment against the maximum limit of 120 dBL at any time.

The relationship between distance and peak airblast overpressure (1% or 10% exceedances) from the proposed blasting site are presented in Figure 2 for MICs of 4,000 kg and 5,000 kg.

Figure 2 Peak Airblast Overpressure Versus Distance Relationship for MICs of 4,000 kg and 5,000 kg



Based on the relationship in Figure 2, Table 16 summarises the predicted airblast overpressure levels at all sensitive receptors based on the calculated offset distance from the nearest anticipated blast area (of the Project) to each receptor.

Table 16 Predicted Airblast Overpressure Levels at the Sensitive Receptors

Sensitive Receptor	Estimated Distance to Receptor (m)	Assessed MIC (kg)	Airblast Overpressure (dBL)	
			115 dBL Criterion 10% Exceedance Allowance	120 dBL Criterion 1% Exceedance Allowance
Fort Cooper Homestead	4,300	4,000-5,000	112-113	117-118
Carrinyah Station	8,100	4,000-5,000	106-107	111-112
Kemmis Creek Station	11,300	4,000-5,000	102-103	107-108

The range in prediction represent the average and upper 10th percentile of MIC's for the Project.

The predicted airblast overpressure levels presented in Table 16 show that both the 115 dBL (20% exceedance case) and 120 dBL (maximum) blasting criteria can be achieved during blasting within the Carrinyah Pit extension areas of the Project.

5.3.2 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 site and rock properties for estimation purposes

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

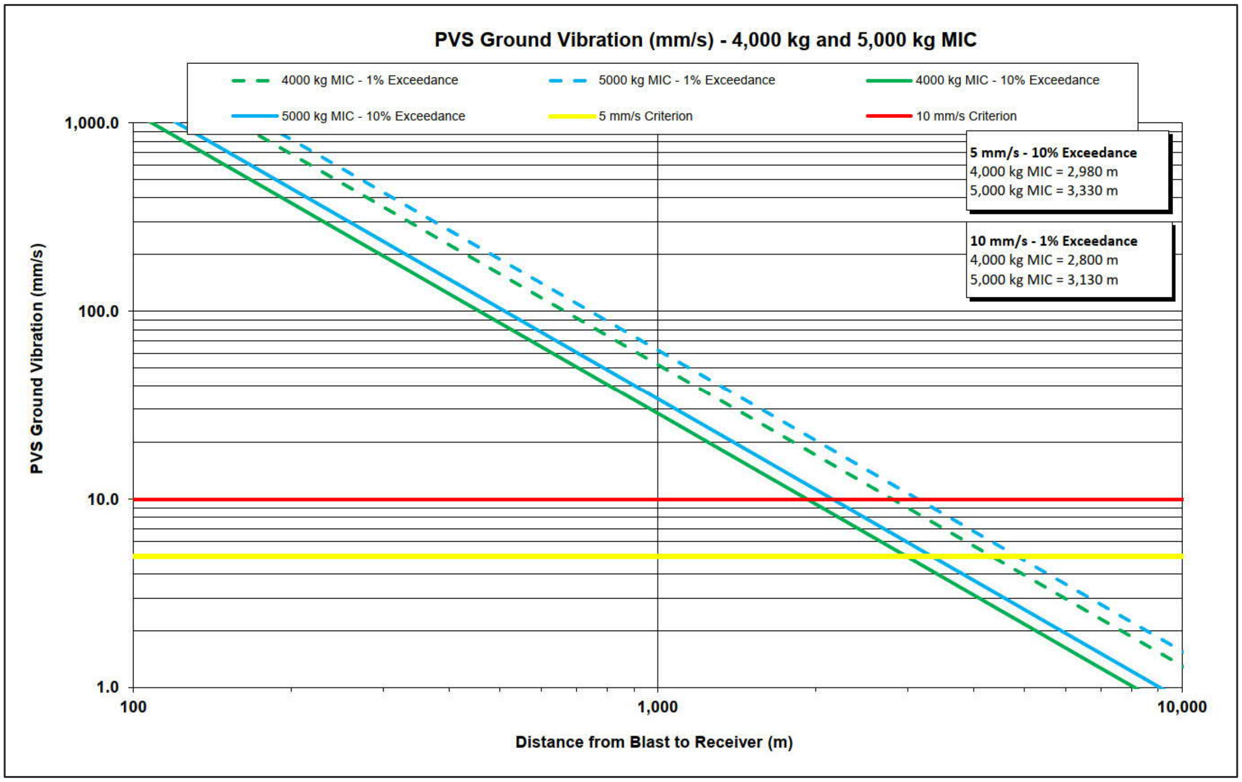
$$V = 1140 \left(\frac{R}{Q^{1/2}}\right)^{-1.6}$$

The ‘1,140’ ground response factor has been scaled up to the following constants:

- ‘2,368’ for assessment against the 5 mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts, and
- ‘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 3 for MICs of 4,000 kg and 5,000 kg.

Figure 3 Ground Vibration Versus Distance Relationship for MICs of 4,000 kg and 5,000 kg



Based on the relationship in Figure 3, Table 17 summarises the predicted ground vibration levels at sensitive receptor R2 based on the calculated offset distance from the nearest anticipated blast point for the Project.

Table 17 Predicted Ground Vibration Levels at Sensitive Receptors

Sensitive Receptor	Estimated Distance to Receptor (m)	Assessed MIC (kg)	Ground Vibration (dBL)	
			5 mm/s Criterion 10% Exceedance Allowance	10 mm/s Criterion 1% Exceedance Allowance
Fort Cooper Homestead	4,300	4,000-5,000	2.8-3.3	5.0-6.0
Carrinyah Station	8,100	4,000-5,000	1.0-1.2	1.8-2.2
Kemmis Creek Station	11,300	4,000-5,000	0.6-0.7	1.1-1.3

The predicted peak particle velocity ground vibration levels presented in Table 17 indicates compliance with the 5 mm/s (10% exceedance) and 10 mm/s (maximum) ground vibration criteria based on MICs in the order of 4,000 kg to 5,000 kg.

While no specific mitigation measures are required to mitigate ground vibration from blasting within the Project extension areas, leading practice mitigation measurements are detailed in Section 6.3 for consideration.

6 Recommendations

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

6.1 Operational Mine Noise

As noted in Section 5.1 no specific noise mitigation measures are required as a result of the predicted compliance with the assessment criteria. Nonetheless, in-principle noise mitigation measures are provided below for consideration. These mitigation measures primarily relate to mobile mining equipment proposed to operate in and out of the extension area of Carrinyah Pit.

- Where practicable, haul roads in and out of Carrinyah Pit should be designed so as to maximise the shielding provided by the high wall and/or OOPDs, in the direction towards the sensitive receptors.
- Avoid dozers operating in exposed and elevated areas during adverse (ie temperature inversion) weather conditions.

In addition to the above in-principle noise mitigation options, the following proven noise management advice is outlined for consideration during mine planning and operations over the life of the Project to minimise off-site noise emission levels:

- All equipment should be operated in accordance with the manufacturer's instruction and regularly maintained in order to minimise noise emission levels.
- Avoid clustering of mobile equipment on haul roads, ROM areas 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.
- Broadband "buzzer", not tonal "beeper", reversing alarms should be utilised on all mobile plant.
- To eliminate potentially impulsive noise, dozer track slap can be minimised through idle wheel modification, use of track slides and grousers, and management controls such as gear limitation.

It should be noted that the noise mitigation options discussed above are preliminary in nature. Any actual noise mitigation measures implemented on site, if required based on actual mine noise emissions, will be subject to further detailed analysis in the future in accordance with the HCOC Noise and Vibration Management Plan.

6.2 Cumulative Noise

No specific noise mitigation measures with respect to cumulative noise are warranted for the Project for the reasons noted in Section 5.2. In stating this, implementation of the Project should consider recommendations made in Section 6.1 to ensure noise level contributions to cumulative noise are minimised.

6.3 Blasting

No specific noise and/or vibration mitigation measures with respect to proposed blasting operations for the Project are warranted for the reasons outlined in Section 5.3. SLR understands that the blasting contractor will continue to:

- Using the computer simulation software, complete predictive modelling in advance of each blast event.
- Conduct monitoring at the fixed blast overpressure and ground vibration monitoring stations.

Regularly review the modelling and monitoring results to further develop/refine the HCOC blasting site law and inform future blasts for the Project.

7 Conclusion

7.1 Mine Operations

The assessment has modelled total HCOC mine noise with the proposed Carrinyah Pit and Exevale Pit extensions from two (2) representative operational mining scenarios based on mine plans for the Year 2033 and Year 2036. Through a review of information supplied by HCC, these two (2) modelled scenarios approximately span the life of the Project.

Assessment of predicted HCOC L_{Aeq} noise levels noted the following:

- HCOC noise levels at Fort Cooper Homestead are predicted to be compliant with the most stringent EA noise limit and MMC limit of 30 dBA L_{Aeq}. The EPP(Noise) Acoustic Quality Objective derived external noise limit of 37 dBA L_{Aeq} is also predicted to be complied with.
- HCOC noise levels at Carrinyah Station and Kemmis Creek Station are predicted to be compliant with the most stringent EA limit of 25 dBA L_{Aeq}, as well as the more relaxed MMC and EPP(Noise) noise limits.

Regarding assessment of L_{A1} noise levels, the highest predicted L_{A1} noise level was 33 dBA at sensitive receptor R1 (Fort Cooper Homestead) for both the Year 2033 and Year 2036 scenarios under adverse weather conditions (i.e., with a temperature inversion). This highest predicted L_{A1} noise level represents a 3 dBA exceedance of the existing EA noise limit of 30 dBA, however, it is considered that the 30 dBA L_{A1} limit should be 35 dBA to be consistent with the MMC. A limit of 35 dBA L_{A1} would be complied with at Fort Cooper Homestead together with the EPP(noise) derived external 47 dBA L_{A1} criterion.

In light of this potential discrepancy, it is recommended that the existing EA noise limits are replaced with the MMC noise criteria.

7.2 Cumulative Noise

The assessment has considered cumulative mine noise impacts for sensitive receptors exposed to noise emission from both HCOC and SWC.

The cumulative noise impact assessment completed for the Project identified that the predicted contribution of mine noise from SWC will have no material effect on the received mine noise levels at the Fort Cooper Homestead (i.e., will not result in an overall increase to the predicted HCOC noise levels). A marginal 1 dB increase is predicted at Kemmis Creek Station, however, the predicted cumulative noise level complies with all forms of noise assessment criteria and therefore cumulative noise impacts are not anticipated as a result of this Project.

7.3 Blasting

SLR understands that actual blast design parameters, predictive modelling and monitoring of impacts are regularly reviewed and completed for existing blasting activities at HCOC and that these practises would ultimately inform the blasting requirements for the Project. Notwithstanding this, a conservative assessment of the potential for airblast overpressure and ground vibration impact has been completed for the Project. The assessment has indicated that:

- Predicted airblast overpressure levels indicate that both the 115 dBL (20% exceedance case) and 120 dBL (maximum) blasting criteria can be achieved during blasting within the Carrinyah Pit extension areas of the Project.
- Predicted peak particle velocity ground vibration levels indicate compliance with the 5 mm/s (10% exceedance) and 10 mm/s (maximum) ground vibration criteria based on MICs in the order of 4,000 kg to 5,000 kg.

8 References

Legislation (Queensland)

Queensland Environmental Protection Act 1994

Queensland Environmental Protection (Noise) Policy 2019

Guidelines, Standards, EAs etc

Queensland Department of Environment and Science’s Environmental Authority EPML00661913 date 9 March 2022

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 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

World Health Organisation’s Night Noise Guidelines for Europe 2009

9 Feedback

At SLR, we are committed to delivering professional quality service to our clients. We are constantly looking for ways to improve the quality of our deliverables and our service to our clients. Client feedback is a valuable tool in helping us prioritise services and resources according to our client needs.

To achieve this, your feedback on the team's performance, deliverables and service are valuable and SLR welcome all feedback via https://www.slrconsulting.com/en/feedback. We recognise the value of your time and we will make a $10 donation to our 2023 Charity Partner for every completed form.

Appendix A:

Acoustic Terminology

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	
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.

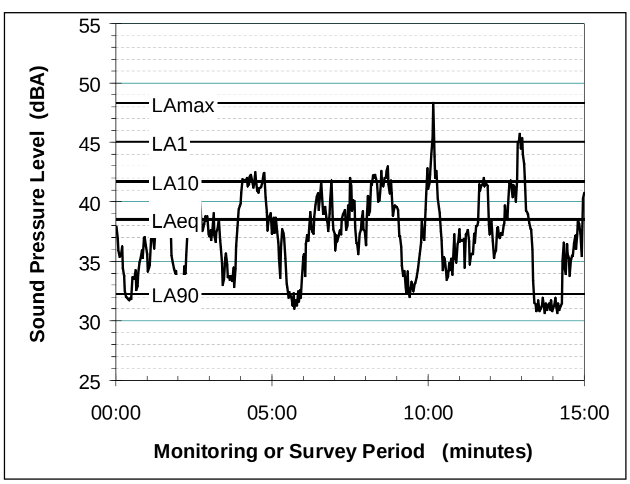


Figure A-1 Hypothetical 15-minute noise measurement

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, and
- 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.

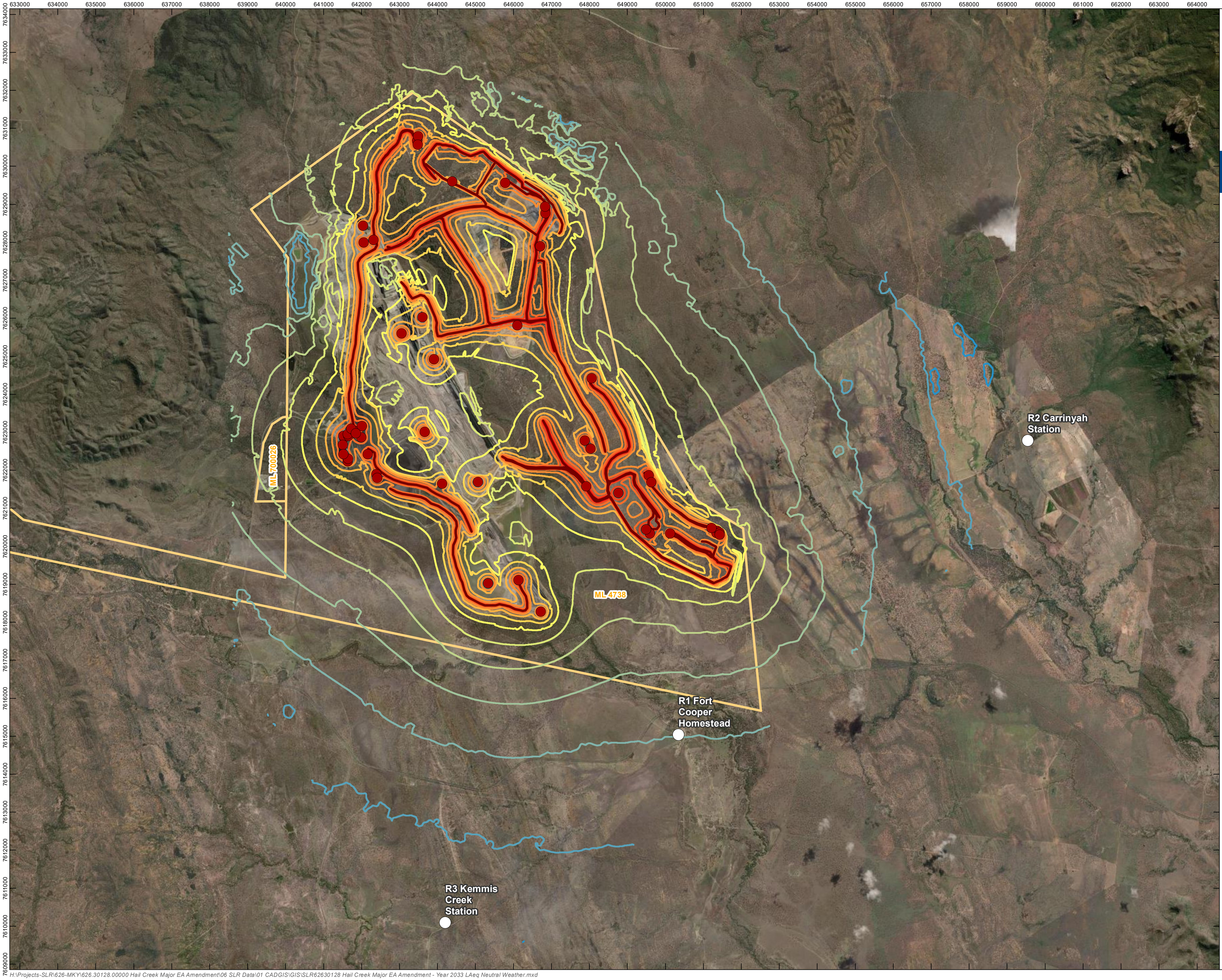
The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (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:

Noise Contour Maps



HAIL CREEK

MAJOR EA AMENDMENT

NOISE CONTOURS - SCENARIO 1
YEAR 2033 LAEQ
NEUTRAL WEATHER

LEGEND

- Receptor
- Noise Source (point)
- Noise Source (line)
- Mining Lease

Noise Contours (LAeq)

- 15
- 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75

0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A3
Project Number:	626.30128
Date:	13-Mar-2023
Drawn by:	LC

SLR

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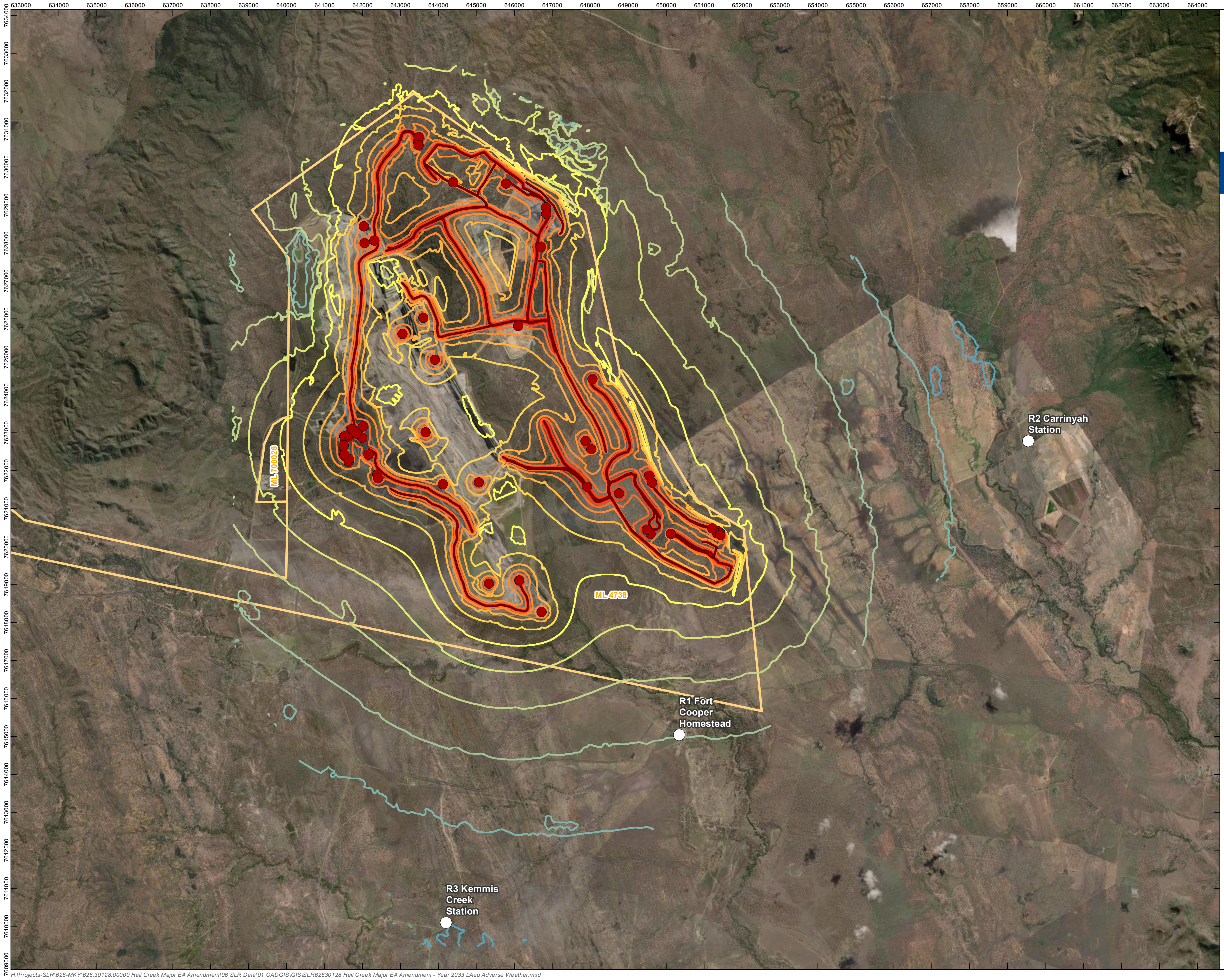

HAIL CREEK

MAJOR EA AMENDMENT

NOISE CONTOURS - SCENARIO 1 YEAR 2033 LAEQ ADVERSE WEATHER

LEGEND

- Receptor
- Noise Source (point)
- Noise Source (line)
- Mining Lease

Noise Contours (LAeq)

- 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75

0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A3
Project Number:	626.30128
Date:	13-Mar-2023
Drawn by:	LC

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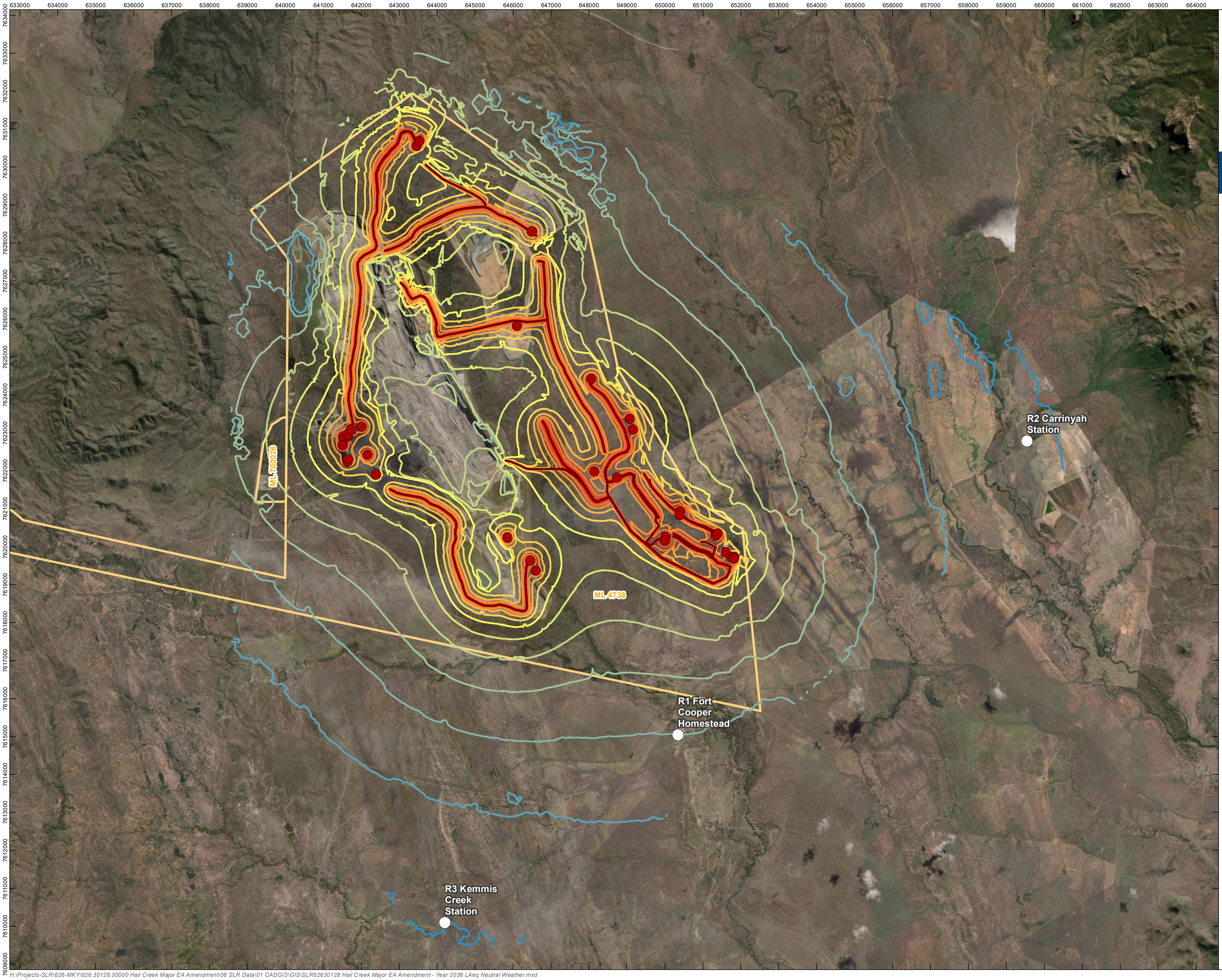

HAIL CREEK

MAJOR EA AMENDMENT

NOISE CONTOURS - SCENARIO 2
YEAR 2036 LAEQ
NEUTRAL WEATHER

LEGEND

- Receptor
- Noise Source (point)
- Noise Source (line)
- Mining Lease

Noise Contours (LAeq)

- 15
- 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75

0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A3
Project Number:	626.30128
Date:	13-Mar-2023
Drawn by:	LC

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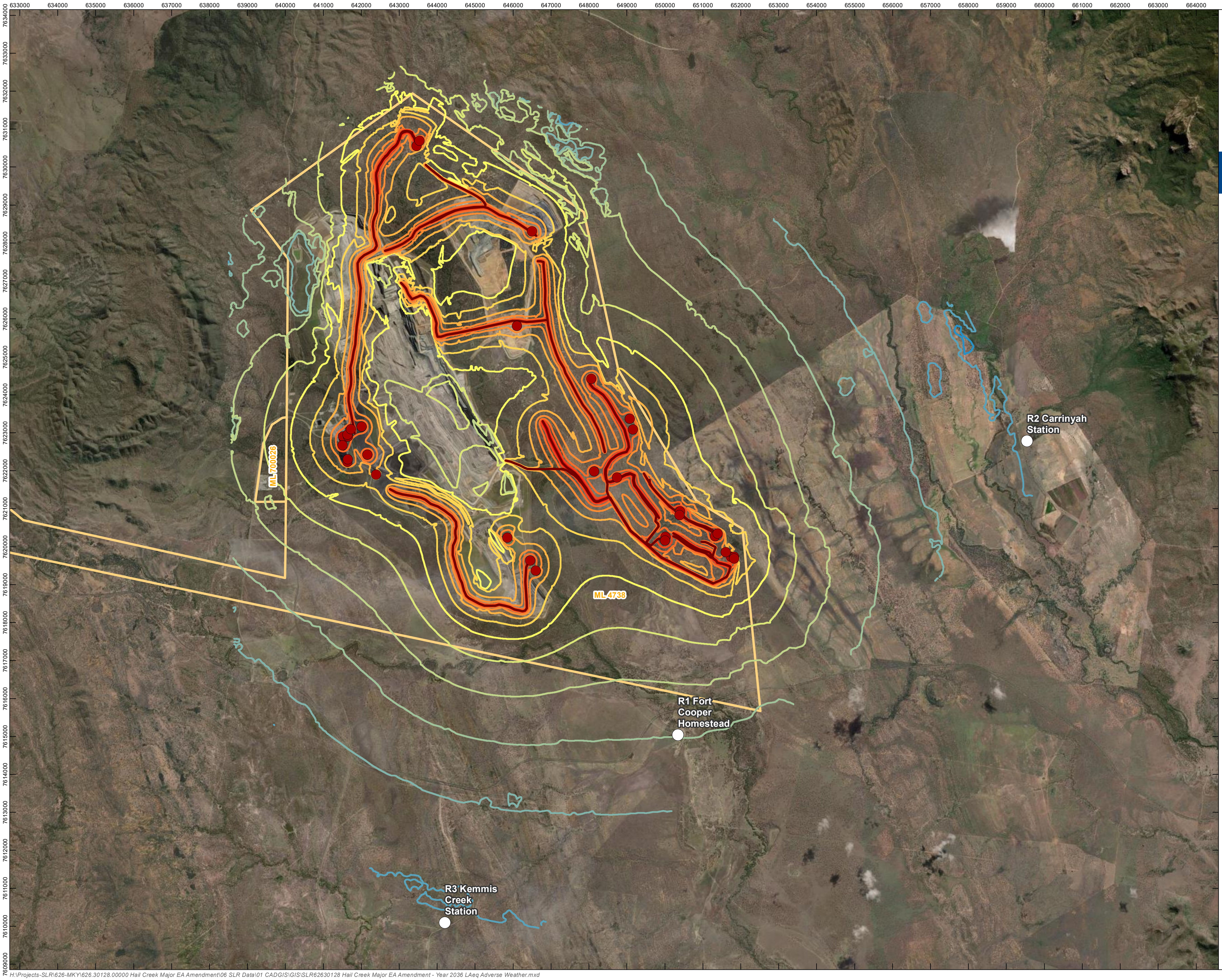

HAIL CREEK

MAJOR EA AMENDMENT

NOISE CONTOURS - SCENARIO 2
YEAR 2036 LAEQ
ADVERSE WEATHER

LEGEND

- Receptor
- Noise Source (point)
- Noise Source (line)
- Mining Lease

Noise Contours (LAeq)

- 15
- 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A3
Project Number:	626.30128
Date:	13-Mar-2023
Drawn by:	LC

SLR

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