2 Existing environment

2.1 Site description

The project area is approximately 100 km south-west of Sydney and 4.5 km west of the Moss Vale town centre in the Wingecarribee LGA (refer to Figure 1.1 and Figure 1.2). The nearest area of surface disturbance will be associated with the surface infrastructure area, which will be 7.2 km north-west of Moss Vale town centre. It is in the Southern Highlands region of NSW and the Sydney Basin Biogeographic Region.

The project area is in a semi-rural setting, with the wider region characterised by grazing properties, small-scale farm businesses, natural areas, forestry, scattered rural residences, villages and towns, industrial activities such as the Berrima Cement Works and Berrima Feed Mill, and some extractive industry and major transport infrastructure such as the Hume Highway.

Surface infrastructure is proposed to be developed on predominately cleared land owned by Hume Coal or affiliated entities, or for which there are appropriate access agreements in place with the landowner. Over half of the remainder of the project area (principally land above the underground mining area) comprises cleared land that is, and will continue to be, used for livestock grazing and small-scale farm businesses. Belanglo State Forest covers the north-western portion of the project area and contains introduced pine forest plantations, areas of native vegetation and several creeks that flow through deep sandstone gorges. Native vegetation within the project area is largely restricted to parts of Belanglo State Forest and riparian corridors along some watercourses.

The project area is traversed by several drainage lines including Oldbury Creek, Medway Rivulet, Wells Creek, Wells Creek Tributary, Belanglo Creek and Longacre Creek, all of which ultimately discharge to the Wingecarribee River, at least 5 km downstream of the project area (Figure 1.2). The Wingecarribee River's catchment forms part of the broader Warragamba Dam and Hawkesbury-Nepean catchments. Medway Dam is also adjacent to the northern portion of the project area (Figure 1.2).

Most of the central and eastern parts of the project area have very low rolling hills with occasional elevated ridge lines. However, there are steeper slopes and deep gorges in the west in Belanglo State Forest.

Existing built features across the project area include scattered rural residences and farm improvements such as outbuildings, dams, access tracks, fences, yards and gardens, as well as infrastructure and utilities including roads, electricity lines, communications cables and water and gas pipelines. Key roads that traverse the project area are the Hume Highway and Golden Vale Road. The Illawarra Highway borders the south-east section of the project area.

Industrial and manufacturing facilities adjacent to the project area include the Berrima Cement Works and Berrima Feed Mill on the fringe of New Berrima. Berrima Colliery's mining lease (CCL 748) also adjoins the project area's northern boundary. Berrima colliery is currently not operating with production having ceased in 2013 after almost 100 years of operation. The mine is currently undergoing closure.

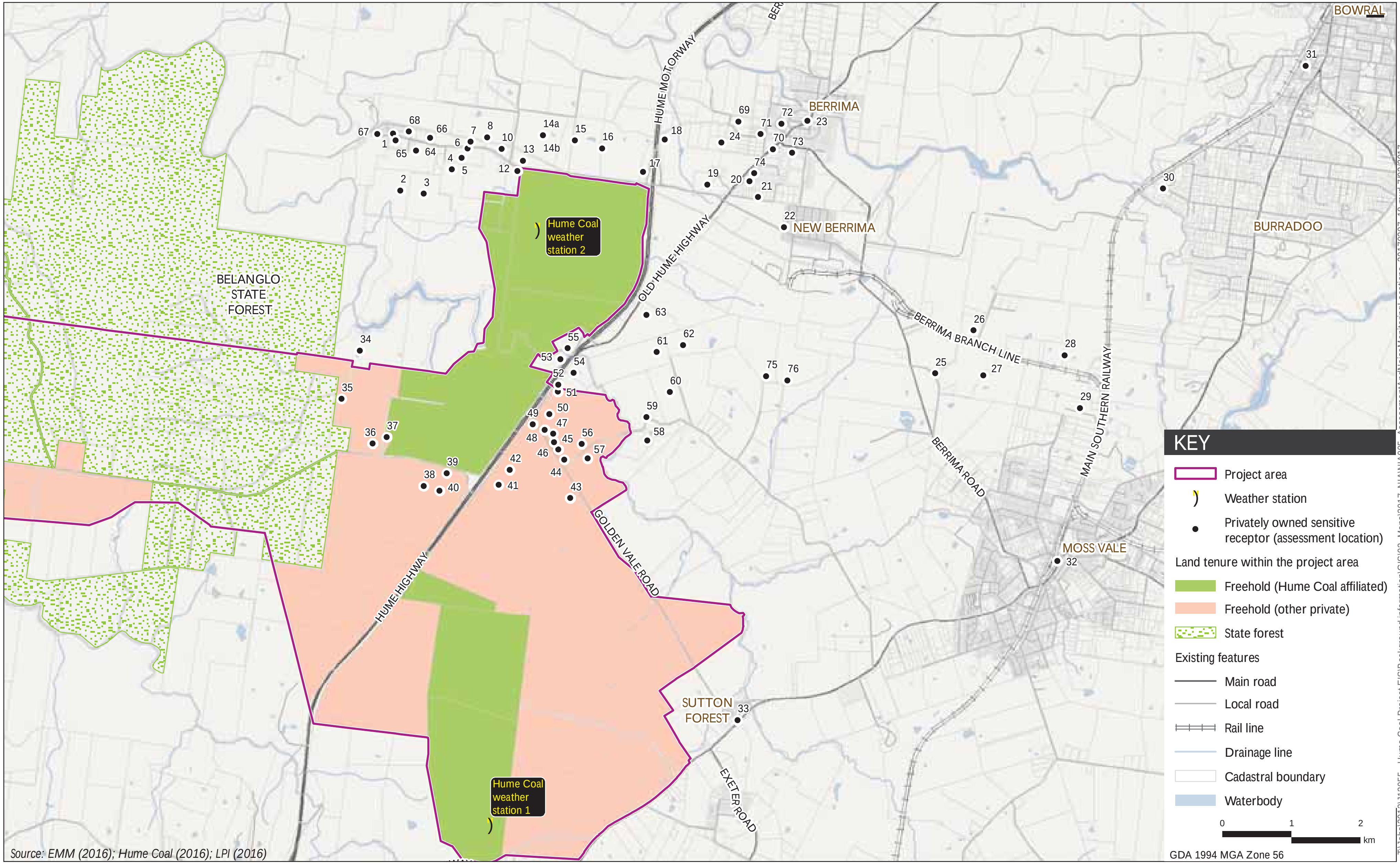
2.2 Properties surrounding the project

The noise and vibration assessment considered 74 potentially noise sensitive assessment locations (i.e. residential properties) or 75 dwellings (location 14 was identified as having two dwellings on the property) surrounding the Hume Coal Project, primarily focussed around the proposed surface infrastructure site. These are described herein as assessment locations and shown in Figure 2.1 with details listed in Appendix A.

Assessment locations were initially identified using land ownership registrations, aerial photography and verification in the field where locations were visible from public roads. The assessment locations identified are considered representative of all residential locations and catchments surrounding the site.

2.3 Background noise survey

For assessment of potential construction and industrial-type noise, the background noise of the area needs to be quantified. An extensive long term background noise survey commenced by Hume Coal in 2011 which comprised noise monitoring at 17 locations surrounding the project area. The assessment has adopted 12 of the 17 noise monitoring locations. The 12 selected locations are most representative of assessment locations near the proposed surface infrastructure. Where possible, long term background noise surveys were conducted on a quarterly basis to establish seasonal changes in noise levels. This approach provides a comprehensive sample of baseline noise levels in the area and demonstrates leading assessment practice given it exceeds the NSW INP seven day minimum requirement. The location of noise monitoring equipment was selected giving due consideration to extraneous noise sources atypical of overall ambient noise environment (e.g. storage dam pumps), the proximity of assessment locations, security issues for the noise monitoring devices and gaining permission for access from the residents or landowners. The background noise monitoring locations most relevant to the proposal are shown in Figure 2.1 and discussed in more detail in the following sections.



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Representative sensitive receptor locations

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Noise Impact Assessment

Figure 2.1

2.3.1 Unattended noise monitoring

Unattended noise surveys were conducted at the monitoring locations in general accordance with the procedures described in Australian Standard AS 1055-1997, "Acoustics - Description and Measurement of Environmental Noise".

Weather data for the survey period was obtained from the Hume Coal meteorology monitoring station (Met1) installed at the location shown in Figure 2.1. The wind speed and rainfall data from this station was used for the purpose of determining the validity of recorded noise data. In accordance with methodology provided in the INP, noise data recorded during periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18 km/h) was excluded from the calculations of background and ambient noise levels.

A summary of existing background and ambient noise levels is given in Table 2.1 for INP day, evening and night periods. Daily noise monitoring results adopted in this assessment are provided in Appendix B. Where more than one season of monitoring data is available the range in recorded noise levels has been provided, along with the adopted RBL. The minimum RBL recorded over all quarterly monitoring periods since 2011 has been adopted as the final RBL for each location. Where the final RBL is less than 30 dB, the INP background noise level threshold of 30 dB has been adopted. This method has been adopted to conform to INP methods, which generally do not allow RBLs for the purpose of defining industrial noise criteria to be set on a seasonable basis.

Table 2.1 Summary of existing background and ambient noise levels, dB

Monitoring location ID (Figure 2.1)	Period	Measured background noise level, RBL, dB[1]	Final background noise level, RBL, dB[2]	Measured existing L_{Aeq} ambient noise level, dB[1,3]	Estimated existing L_{Aeq} industrial noise contribution, dB
BG1	Day	26 - 34	30	43 - 57	None observed
	Evening	23 - 34	30	40 - 52	None observed
	Night	23 - 33	30	43 - 49	None observed
BG2	Day	32	32	44	None observed
	Evening	36	32	44	None observed
	Night	33	32	41	None observed
BG3	Day	35 - 39	35	46 - 68	None observed
	Evening	38 - 41	35	46 - 51	None observed
	Night	34 - 36	34	42 - 48	None observed
BG4	Day	29 - 45	30	46 - 51	None observed
	Evening	28 - 47	30	44 - 51	None observed
	Night	28 - 42	30	41 - 50	None observed
BG5	Day	35 - 40	35	47 - 50	45[4]
	Evening	34 - 41	34	45 - 60	45[4]
	Night	31 - 44	31	40 - 48	45[4]
BG6	Day	46	46	56	39[4]
	Evening	51	46	60	39[4]
	Night	45	45	54	39[4]

Table 2.1 Summary of existing background and ambient noise levels, dB

Monitoring location ID (Figure 2.1)	Period	Measured background noise level, RBL, dB[1]	Final background noise level, RBL, dB[2]	Measured existing L_{Aeq} ambient noise level, dB[1,3]	Estimated existing L_{Aeq} industrial noise contribution, dB
BG7	Day	35	35	45	39[4]
	Evening	39 - 40	35	49 - 50	39[4]
	Night	38	35	46	39[4]
BG8	Day	45 - 48	45	53 - 56	None observed
	Evening	46 - 48	45	54 - 61	None observed
	Night	39 - 44	39	52 - 54	None observed
BG9	Day	28	30	42	None observed
	Evening	32	30	40	None observed
	Night	29	30	42	None observed
BG10	Day	32 - 42	32	44 - 62	None observed
	Evening	29 - 41	30	39 - 53	None observed
	Night	26 - 35	30	40 - 47	None observed
BG11	Day	45	45	60	None observed
	Evening	48	45	60	None observed
	Night	38	38	58	None observed
BG12	Day	41 - 50	41	55 - 61	None observed
	Evening	44 - 52	41	55 - 62	None observed
	Night	35 - 39	35	54 - 59	None observed

Notes: *1. A range in noise levels has been provided where more than one season of valid noise monitoring data as defined in the INP is available.*

2. This is based on the noise level exceeded 90% of the time and representative of the underlying background noise level .The INP minimum background noise threshold of 30 dBA day, evening and night, has been adopted where applicable. In accordance with the INP Application Notes, the day RBL is adopted where the evening RBL is measured to be higher than day, evening RBL is adopted where the night RBL is measured to be higher than evening.

3. The energy averaged noise level over the measurement period which is representative of general ambient noise.

4. Existing industrial noise contribution noted from Berrima Cement Works in attended noise surveys conducted by Pacific Environment Limited.

2.3.2 Attended noise monitoring

Short-term 15-minute operator attended noise measurements were conducted at the unattended noise monitoring locations for each round of monitoring to both qualify and quantify the existing noise sources contributing to the ambient noise environment. The monitoring was conducted using a hand held integrating sound level meter in general accordance with the procedures described in Australian Standard AS 1055-1997, “Acoustics - Description and Measurement of Environmental Noise”.

A summary of the general ambient noise environment and main noise sources observed at each location is described below:

- BG1 to BG4:

  The ambient noise environment is typical of a natural setting with noise levels dominated by insects, birds and rustling leaves when winds are present. Distant traffic noise from the Hume Highway is evident at most locations. Occasional local traffic movements on Medway Road and distant trucks passing on the Hume Highway are also audible. General domestic and community noise is audible on occasion and depending on locations. No existing industrial noise contribution was noted.

- BG5 to BG7:

  The acoustic environment consists of natural noise sources including insects, birds and rustling vegetation. The Berrima Cement Works facility is audible and very dominant at times at BG5 and BG6 depending on wind direction and operations. Distant traffic noise from the Hume Highway is generally audible and most prominent at BG7 with local traffic pass-by on local and arterial roads audible at all locations.

- BG9 and BG10:

  The ambient noise environment is typical of a natural setting with noise levels dominated by insects, birds and rustling leaves when winds are present. Distant road traffic noise from the Hume Highway is audible at times.

- BG8, BG11 and BG12:

  Traffic noise from the Hume Highway is dominant and otherwise the noise environment is typical of a natural setting with insects, birds and rustling leaves when winds are present contributing to the ambient noise level.

2.4 Noise catchment areas

The area surrounding the Hume Coal Project is diverse in terms of existing background noise levels and the noise sources which make up the overall acoustic environment. For example, the Hume Highway is a significant noise contributor at properties positioned nearby with its contribution reducing as distance increases. The presence of Berrima Cement Works also provides an existing level of industrial noise for properties in and around New Berrima and at some scattered rural properties to the south. Otherwise properties situated away from these two noise sources generally experience noise levels commensurate with a rural environment.

To capture the differences in noise level in these areas a number of noise catchment areas (NCAs) have been defined which are shown in Figure 2.2. Each NCA contains privately owned land and properties which have similar acoustic environments. Each noise catchment also has specific industrial noise criteria which has been set using background noise monitoring data most applicable to the area. It is acknowledged that there may be many possible variances in overall background and ambient noise levels within each catchment. A conservative approach has therefore been taken in adopting RBLs. For example, where multiple unattended noise monitoring locations are within one catchment, the location with the lowest RBLs has been adopted for all properties in the NCA. This is evident in the assigned RBLs with the majority of catchments assigned the INP minimum background noise level threshold of 30 dB day, evening and night, which is commensurate with the general rural setting surrounding the Hume Coal Project. The adopted background noise levels for each catchment are presented in Table 2.2 with an explanation as follows:

- NCA1:

  Background noise levels in this area have been defined using noise logging results from BG1 and BG4. These correspond to the INP minimum and most conservative values. It is noted from locations BG2 and BG3 there is evidence to suggest that background noise levels may be higher. Notwithstanding, the area contained within this catchment is generally rural in nature and most likely to possess noise levels commensurate with such an environment which are typically 30 dB, during day, evening and night.

- NCA2:

  The land contained within the catchment is generally rural in nature and with similar proximity relative to Hume Highway as NCA1. Background noise levels measured at BG1 and BG4 have therefore also been adopted for this NCA (ie most conservative possible according to the INP).

- NCA3:

  The town of New Berrima is best classified as suburban and the noise monitoring results at BG5 indicate background noise levels slightly higher than those at BG1 and BG4 and more commensurate with the suburban locality. Existing industrial noise from Berrima Cement Works and therefore the potential for cumulative noise impacts have also been considered for this catchment.

- NCA4:

  The land contained within this noise catchment is generally rural in nature and there is limited noise data available across this area. Hence, the INP minimum background noise level has been assumed for this NCA which provides a conservative approach.

- NCA5:

  The land contained within the catchment is generally rural in nature and with similar proximity relative to Hume Highway as some parts of NCA1. The same RBLs to NCA1 have therefore been adopted (ie most conservative possible according to the INP).

- NCA6:

  This catchment includes all privately owned land within a 50m offset from the Hume Highway and is based on background noise levels measured at BG11.

- NCA7:

  This catchment includes all privately owned land between a 50 m and 100 m offset from the Hume Highway and is based on background noise levels measured at BG12.

Table 2.2 Noise catchment areas - adopted RBLs and estimated existing industrial noise levels

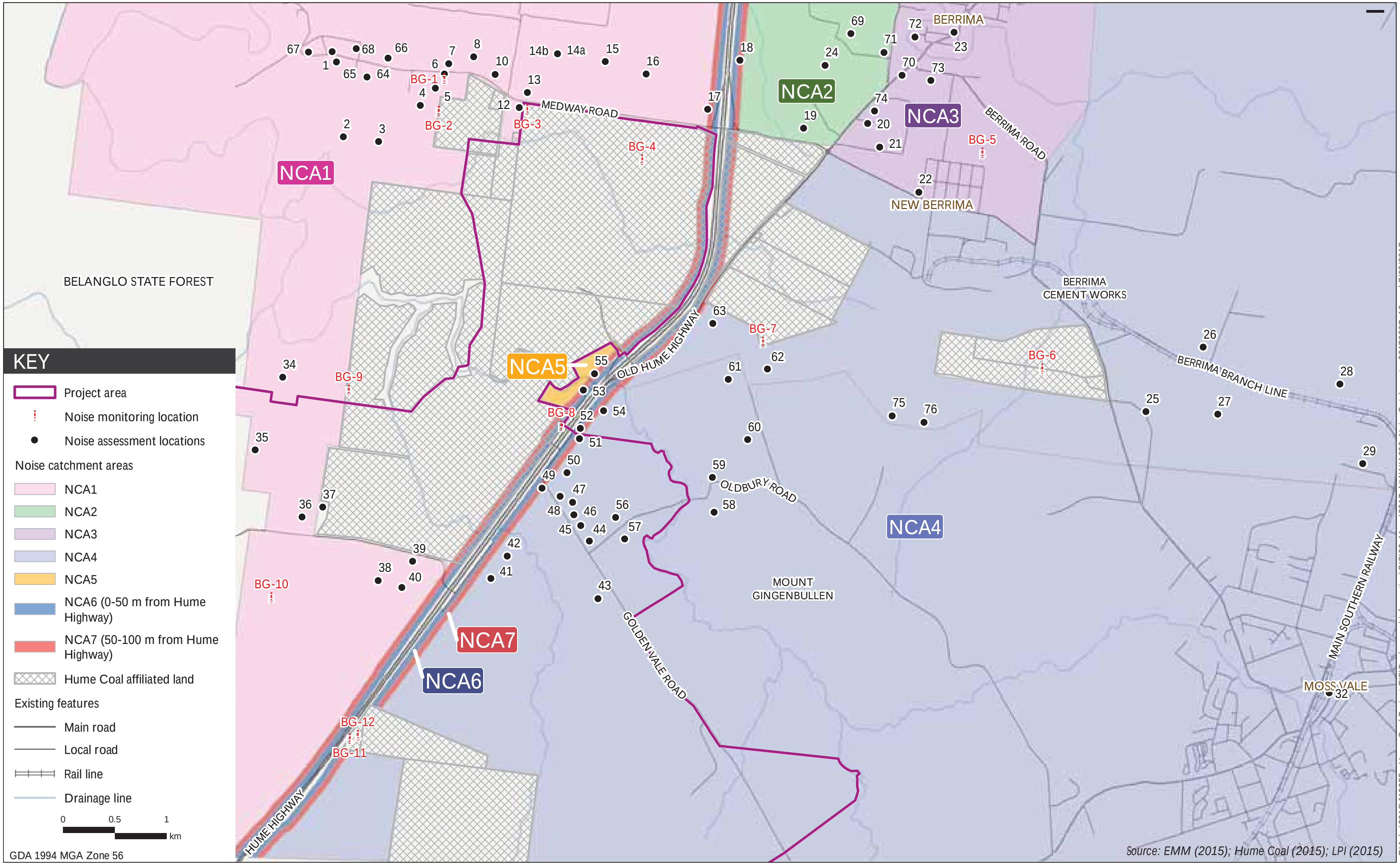
Noise catchment area (adopted noise logger results)	Period	Adopted background noise level, RBL, dB[1,2]	Estimated existing L_{Aeq} industrial noise contribution, dB
NCA1, NCA2, NCA5 (BG1 and BG4)	Day	30	Nil
	Evening	30	Nil
	Night	30	Nil
NCA3 (BG5)	Day	35	45
	Evening	34	45
	Night	31	45
NCA4 (INP minimum)	Day	30	39
	Evening	30	39
	Night	30	39
NCA6 (BG11)	Day	45	Nil
	Evening	45[1]	Nil
	Night	38	Nil
NCA7 (BG12)	Day	41	Nil
	Evening	41[1]	Nil
	Night	35	Nil

Notes: 1. In accordance with the INP Application Notes, the day RBL is adopted where the evening RBL is measured to be higher than day, evening RBL is adopted where the night RBL is measured to be higher than evening.

2.5 Meteorology

The INP provides procedures for identifying and combining prevailing meteorological conditions at a site (referred to in the INP as a 'feature' of the area) and assessing the noise levels against the relevant criteria.

Site specific weather data was obtained from the Hume Coal Project's weather stations Met1 and Met2 as displayed in Figure 2.1. Met1 was installed early in the environmental assessment process and data from 2013, 2014 and 2015 calendar years where full annual datasets were available was used in the analysis of prevailing weather conditions. Met2 was installed in October 2015 shortly after the surface infrastructure location layout was confirmed. One year of weather data from Met2 (October 2015 to October 2016) was also used to support the assessment of noise enhancing prevailing weather conditions.



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Noise catchment areas and noise monitoring locations

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Figure 2.2

2.5.1 Winds

During certain wind conditions, the noise levels at the assessment locations may increase or decrease compared with noise during calm conditions. This is due to refraction caused by the varying speed of sound with increasing height above the ground. The received noise level increases when the wind blows from the source to the assessment location, and conversely, decreases when the wind blows from the assessment location to the source.

As per the INP, winds of up to 3 m/s must be considered in noise predictions when they occur for greater than 30% of the time during day, evening or night periods. Winds were analysed to determine the percentage occurrence. The analysis is provided in Table 2.3 and Table 2.4 for Met1 and Met2 respectively with the wind directions triggering the 30% INP threshold identified by shading. It can be seen that winds which trigger the 30% INP threshold from Met1 and Met2 generally prevail from a similar north-east or westerly direction across the evening and night periods. There are no prevailing winds during the day identified from either weather station.

Table 2.3 Percentage occurrence of wind speeds between 0.5 to 3 m/s (vector at 22.5^{o} intervals), Met1 combined 2013, 2014 and 2015 calendar year datasets

Direction	Day				Evening				Night			
	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer
NNE	12.1	14.9	10.7	14.9	15.1	22.1	29.7	28.1	10.1	18.7	21	32.1
NE	9	13.8	9.7	15.7	13.7	24.1	28.7	30.1	7.5	17.1	20.8	34.4
ENE	8	13.2	8.7	14.4	13.7	25.9	24.8	31	6.7	17.6	19.5	32.7
E	8.1	12.1	7.8	13	13.6	25.6	22.2	27.6	8.5	16.9	19.5	27.6
ESE	9.2	12.2	7.8	11.4	14.8	24.5	20.5	23.6	11.8	17.6	19.4	24.5
SE	12.5	13.2	9.4	9.9	17.2	22.8	19.1	17.5	19	20.8	20.8	22.3
SSE	16.9	14.6	11.4	8.7	23	23.6	17.1	12.8	26.3	24.7	21.3	20.2
S	18.8	15.2	12.2	7.7	26.1	24.6	14	10.6	29.9	27.5	20.2	17
SSW	20.5	14.7	13.5	6.7	28	20.8	12.3	8.9	31.9	26.5	18.1	13.8
SW	22.3	14.4	14.6	6.6	31.8	17.8	11.8	8	34.2	23.4	17	11.6
WSW	24.3	15.9	15.8	7.3	31.2	15.8	12.3	7.5	33.9	22	17.3	10.2
W	25.4	17.4	16.6	9.2	30.8	15.9	16.4	8.2	32	22.1	20.2	10.8
WNW	23.6	18	15.5	10.3	28.8	17.5	20.2	10.2	27.1	22	20.4	16.5
NW	20.6	17.3	13.7	11.5	24.7	19.1	22.4	15.2	22.7	21.7	21.3	21.9
NNW	18.4	16.4	12.4	12.8	21.8	21.1	24.9	20.5	19.2	21.1	21.6	25.8
N	15.6	15.6	11.3	14.1	18.3	21.6	27.6	25.2	14.4	20.3	21.5	29.2

Notes: 1. Based on 2013, 2014 and 2015 calendar year data from the Hume Coal weather station Met1 indicated on Figure 2.1.

Table 2.4 Percentage occurrence of wind speeds between 0.5 to 3 m/s (vector at 22.5° intervals), Met2 data from October 2015 to October 2016

Direction	Day				Evening				Night			
	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer	Winter	Autumn	Spring	Summer
NNE	14	17.1	11.3	15.5	21.5	30.1	26.1	32.5	17.9	26.6	27.2	31.1
NE	12.1	15.3	10.4	16.3	18.4	29.2	27.1	34.3	14.1	22.2	24.6	30.9
ENE	11.1	13.9	10	16	15.7	26.9	26.7	35.7	11	17.5	22	31.2
E	10.8	12.3	9.4	16	14.1	23.2	24.1	34	8.5	13.2	20.2	31.2
ESE	11.3	11.6	9.4	15.9	15	20.8	20.4	28.5	8.7	11.3	17.2	29.2
SE	13	11.8	9.1	15.5	14.9	15.5	15.4	20.8	10	10.4	14.6	26.3
SSE	14.3	12.6	10.4	15	15.2	12.9	13.6	15.5	12.7	10.2	14.6	24.2
S	16.5	14.1	12.1	13.9	18	13.6	14.8	13.9	17.2	11.5	16.9	22.1
SSW	18.3	14.6	12.4	12.4	21	14.7	15.1	10.3	22.5	13.7	19.2	19.3
SW	20.2	15.1	13.5	11.8	22.7	15	14.8	6.9	26.7	15	20.8	15.4
WSW	21	15.7	14.3	10.7	23.1	14.5	15.3	5.8	28.8	15.4	21.6	11.9
W	21.3	17	15.4	11.5	25.3	16.2	17.7	6.9	31.6	18.3	25.5	13.3
WNW	22.5	19.5	16.4	13.1	29.2	21.2	22.1	10.7	34.3	24.7	30.6	19.6
NW	23.3	21.6	16	14.2	31.2	26.9	25.5	17.1	34.7	31	33.7	25.4
NNW	21.5	21.4	14.7	15	29.4	29.9	26.5	24.1	30.2	31.6	33.8	28.7
N	18.3	19.9	13.4	15.5	25.9	30.9	25.8	30.2	23.4	30.4	30.9	30.5

Notes: 1. Based on data from Oct 2015 to October 2016 from the Hume Coal weather station Met2 indicated on Figure 2.1.

2.5.2 Temperature inversions

Temperature inversions (ie where atmospheric temperature increases with altitude) typically occur during the night-time period in the winter months and can also increase site noise levels at surrounding assessment locations. As per the INP, temperature inversions are to be assessed when they are found to occur for 30% of the time (about two nights per week) or greater during the winter months.

Drainage flow winds (ie localised cold air travelling in a direction of decreasing altitude) can occur during temperature inversion conditions. The increase of noise levels caused by a drainage flow wind needs consideration if a development (ie noise source) is at a higher altitude to surrounding assessment locations, and where there is no intervening topography. Noise sources are typically at a similar elevation to surrounding assessment locations or there is intervening topography separating site and surrounding properties. The potential for source to receptor drainage flow winds to occur is therefore not considered relevant.

Table 2.5 provides a summary of the Pasquill atmospheric stability categories (or a measure of temperature gradients). The analysis is based on the weather data from the Met1 weather station as this station has a larger and therefore more representative dataset. The Noise enhancement due to temperature inversions occurs when the atmosphere is relatively stable which corresponds with stability class category F and G. It can be seen that the occurrence of "F" stability class conditions (ie temperature gradients of 1.5 to less than 4 degrees Celsius per 100m elevation) trigger the INP assessment requirement (ie equal or greater than 30%).

Table 2.5 Percentage occurrence of Pasquill stability categories

Pasquill stability category	Percentage occurrence (night period)				
	Annual	Summer	Autumn	Winter	Spring
A	0.0%	0.0%	0.0%	0.0%	0.0%
B	0.0%	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%	0.0%
D	36.0%	44.5%	32.3%	27.4%	40.0%
E	16.6%	17.8%	15.1%	17.3%	16.4%
F	40.6%	30.8%	45.5%	47.7%	38.0%
G	6.8%	6.9%	7.1%	7.6%	5.6%

Notes: The results indicate that ‘F’ class temperature inversions are a feature of the area as they occur for more than 30% of the time during the winter and therefore have been considered in the assessment.

3 Assessment criteria

3.1 Operation

The INP provides a framework and process for deriving noise criteria for consents and licences that enable the EPA to regulate premises that are scheduled under the NSW *Protection of the Environment Operations Act 1997* (POEO Act). The policy objectives are:

- to establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses;
- to use the criteria as the basis for deriving project specific noise levels;
- to promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects;
- to outline a range of mitigation measures that could be used to minimise noise impacts;
- to provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development; and
- to carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the POEO Act.

The INP provides two criteria to assess industrial noise sources, namely, the intrusiveness criteria and the amenity noise criteria.

3.1.1 Assessing intrusiveness

For assessing intrusiveness, the background noise level must be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5dB above the representative or rating background level (RBL).

3.1.2 Assessing amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail and/or community noise. The existing noise level from industry must be quantified. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion.

An extract from the INP that relates to the amenity noise criteria relevant to the Hume Coal Project is given in Table 3.1.

Table 3.1 Amenity noise criteria - Recommended L_{Aeq} noise levels from industrial noise sources

Type of receptor	Indicative noise amenity area	Time of day	Recommended $L_{Aeq(Period)}$ noise level, dBA	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75
Active recreation	All	When in use	55	60

Notes: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

3.1.3 Project specific noise levels

Project specific noise level (PSNL) criteria are generally equal to the lower of the derived intrusiveness and amenity criteria. It is commonly acknowledged and accepted amongst regulators and industry that energy average noise levels are typically 3 dB louder over a 15 minute worst case assessment period when compared to an entire day (11 hour), evening (4 hour) and night (8 hour) assessment period. Therefore, where the amenity criterion is less than the intrusiveness criteria minus 3 dB, it typically must be shown that the project can satisfy both.

PSNL criteria for the operational phase of the project with respect to the above are provided in Table 3.2. It can be seen that the INP intrusive criterion (ie RBL plus 5 dB) becomes the PSNL for all NCAs for day, evening and night periods.

Table 3.2 Project specific noise levels, dB

NCA	Amenity Area	Period	Adopted rating Background Level (RBL)[1]	Intrusive noise criteria[2], $L_{Aeq,15minute}$	Amenity noise criteria[3], $L_{Aeq,period}$	Project specific noise level (PSNL)[6]
NCA1, NCA2, NCA4, NCA5	Rural	Day	30	35	50	35 $L_{Aeq,15min}$
		Evening	30	35	45	35 $L_{Aeq,15min}$
		Night	30	35	40	35 $L_{Aeq,15min}$
NCA3	Suburban	Day	35	40	55	40 $L_{Aeq,15min}$
		Evening	34	39	37[5]	39 $L_{Aeq,15min}$
		Night	31	36	35[5]	36 $L_{Aeq,15min}$
NCA6	Rural	Day	45	50	50	50 $L_{Aeq,15min}$
		Evening	45	50	50[4]	50 $L_{Aeq,15min}$
		Night	38	43	48[4]	43 $L_{Aeq,15min}$

Table 3.2 Project specific noise levels, dB

NCA	Amenity Area	Period	Adopted rating Background Level (RBL)[1]	Intrusive noise criteria[2], $L_{Aeq,15minute}$	Amenity noise criteria[3], $L_{Aeq,period}$	Project specific noise level (PSNL)[6]
NCA7	Rural	Day	41	46	50	46 $L_{Aeq,15min}$
		Evening	41	46	48[4]	46 $L_{Aeq,15min}$
		Night	35	40	47[4]	40 $L_{Aeq,15min}$

Notes: *1. RBL value taken from Table 2.2.*

2. Equal to the RBL plus 5 dB.

3. Representative acceptable amenity noise criteria from Table 2.1 of the INP.

4. The ANL has been corrected in accordance with the INP Application notes due to the high influence of existing road traffic noise levels, i.e., measured $L_{Aeq.period\ (traffic)}$ minus 10 dB.

5. The ANL has been corrected in accordance with Table 2.2 of the INP to account for the existing industrial noise contribution from Berrima Cement Works.

6. Typically the lowest of the intrusive and amenity noise criteria. Where the amenity noise criteria is lower than the intrusive minus 3 dB, it must been demonstrated that the amenity noise criteria can also be satisfied.

3.1.4 Voluntary land acquisition and mitigation policy

The *Voluntary Land Acquisition and Mitigation Policy* (VLAMP November 2014) seeks to balance acquisition and mitigation obligations for mining operators that provide appropriate protections for landholders, where impacts are identified. The VLAMP states:

> The Government has established a range of policies and guidelines to guide the assessment of the potential impacts of mining, petroleum and extractive industry developments in NSW. These policies and guidelines include assessment criteria to protect the amenity, health and safety of people. They typically require applicants to implement all reasonable and feasible avoidance and/or mitigation measures to minimise the impacts of a development.
>
> In some circumstances however, it may not be possible to comply with these assessment criteria even with the implementation of all reasonable and feasible avoidance and/or mitigation measures. This can occur with large resource projects – such as large open cut mines - where the resources are fixed, and there is limited scope for avoiding and/or mitigating impacts.
>
> However, it is important to recognise that:
>
> - Not all exceedances of the relevant assessment criteria equate to unacceptable impacts;
> - Consent authorities may decide that it is in the public interest to allow the development to proceed, even though there would be exceedances of the relevant assessment criteria, because of the broader social and economic benefits of the development; and
> - Some landowners may be prepared to accept higher impacts on their land, subject to entering into suitable negotiated agreements with applicants, which may include the payment of compensation.

Consequently, the assessment process can lead to a range of possible outcomes. Figure 3.1 provides the general decision making process that will be applied by consent authorities at the development application stage when assigning voluntary land acquisition and mitigation obligations.

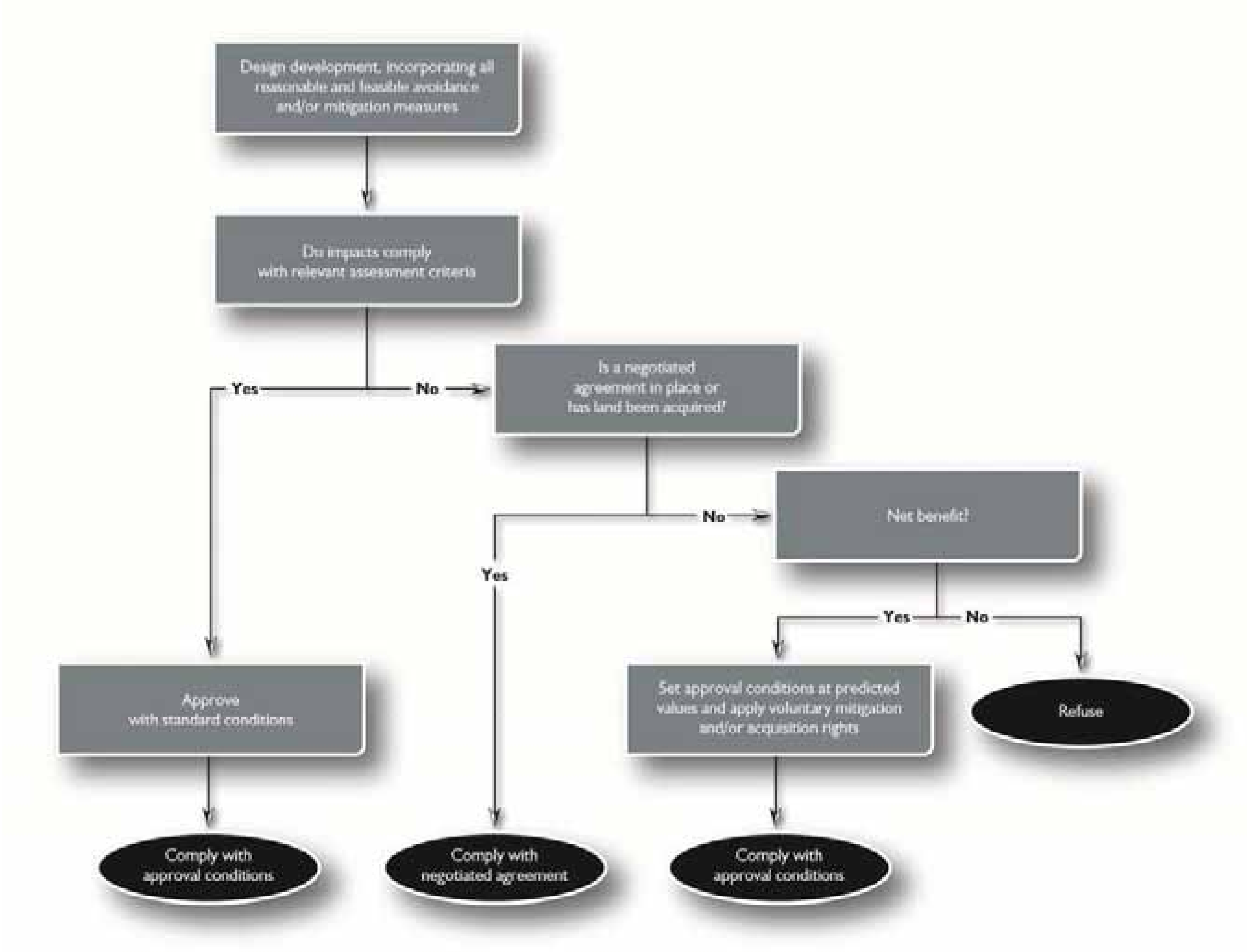


Figure 3.1 General approach to decision making during the assessment process (VLAMP 2014)

3.1.5 Characterisation of noise impacts

Voluntary land acquisition and mitigation rights in the VLAMP are assigned to privately owned dwellings based on the level of predicted noise above the project noise criteria, or the PSNL. The characterisation of the noise impacts are generally based around the human perception to changes in noise levels as explained in glossary of the acoustic terms. For example, a change in noise level of 1 to 2 dB is typically indiscernible to the human ear. The characterisation of a residual noise impact of 0 to 2 dB above the PSNL is therefore considered negligible. This characterisation of residual noise impacts is outlined further in Table 3.3.

Table 3.3 Characterisation of noise impacts and potential treatments

Residual noise exceeds INP criteria by	Characterisation of impacts	Potential treatment
0-2 dBA PSNL	Impacts are considered to be **negligible**	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls.
3-5 dBA above the PSNL in the INP but the development would contribute less than 1 dB to the total industrial noise level	Impacts are considered to be **marginal**	Provide mechanical ventilation / comfort condition systems to enable windows to be closed without compromising internal air quality / amenity.
3-5 dBA above the PSNL in the INP and the development would contribute more than 1 dB to the total industrial noise level	Impacts are considered to be **moderate**	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
>5 dBA above the PSNL in the INP	Impacts are considered to be **significant**	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions.

Source: VLAMP

3.1.6 Acquisition of privately owned land

The VLAMP provides noise acquisition criteria for privately owned land parcels. The policy assigns acquisition rights if the noise generated by a development contributes to an exceedance of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land, where a dwelling could be built on the land under existing planning controls.

The VLAMP defines land as "...the whole of a lot, including contiguous lots owned by the same landowner".

Accordingly, voluntary land acquisition policy for the Hume Coal Project is presented in Table 3.4.

Table 3.4 Privately owned land voluntary acquisition criteria

NCA	Amenity area	Period	25% privately owned land area trigger level, $L_{Aeq, period,}$ dB
NCA1, NCA2, NCA4 to NCA7	Rural	Day	55
		Evening	50
		Night	45
NCA3	Suburban	Day	60
		Evening	50
		Night	45

Notes: 1. Based on the INP maximum amenity noise criteria.

3.1.7 Low frequency noise

i INP method

Section 4 of the INP provides guidelines for applying 'modifying factor' adjustments to account for low frequency noise emissions. The INP states that where there is a difference of 15 dB or more between the measured 'C' weighted (dBC) and measured 'A' weighted (dBA) levels, and then a correction factor of 5 dB is applicable. Sources that could contain relatively higher components of low frequency noise energy may include pumps, screens, centrifuges and other plant typically found in a material processing facility.

The INP's low frequency noise criteria are being reviewed in light of the problematic issues in practice at large distances. For example, sounds that do not poses low frequency dominated spectra at close range, would by virtue of enough distance loss factors, unfairly attract the INP penalty for low frequency, as higher frequencies in their spectra are considerably more abated than the lower frequencies. The INP low frequency noise criteria were originally intended for testing sources at a relatively close range.

A perverse outcome can therefore arise in strictly applying the INP procedure in isolation which has been acknowledged by regulators and hence the motivation to revise the low frequency noise assessment method as provided in the draft Industrial Noise Guideline (draft ING) (EPA 2015). The draft ING method, along with other alternate methods for assessing low frequency noise, is provided below.

ii Draft ING method

The Draft Industrial Noise Guideline (draft ING) was released by the EPA in September 2015 for stakeholder comment and further refinement of the guideline based on submissions is still underway. The intent is that the draft ING would supersede the INP once finalised.

The draft ING presents a contemporary method for identifying low frequency noise. The revised method is based on the low frequency noise assessment procedure developed by the Department of Environment Food and Rural Affairs (DEFRA) (UK). The frequency based reference curve approach is based on a range of factors with a key factor being human hearing thresholds at low frequencies. Because the draft ING method is based on the well-researched and endorsed DEFRA method it is considered very unlikely that the procedure will change as part of the final guideline.

The draft ING method involves a two stage assessment approach:

1. Compare overall site dBC and dBA noise levels. If dBC minus dBA is less than or equal to 15 dB then no correction is applied. If dBC minus dBA is greater than 15 dB then step two is applied;

2. Compare the one third octave band noise level to the ING reference curve provided in Table 3.5 (ie Table C.2 of the draft ING). If the curve is exceeded by up to 5 dB in any one third octave band, a 2 dB positive adjustment applies for the evening and night period. If the curve is exceeded by greater than 5 dB, a 2 dB penalty applies for the day and evening, and a 5 dB penalty applies for the night period.

Table 3.5 Draft ING – external low frequency reference curve (open window)

Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB, Leq	92	89	86	77	69	61	54	50	50	48	48	46	44

The draft ING method adopts a slightly modified version of the current INP approach as a screening method and applies a reference curve if exceeded to prevent possible perverse outcomes as explained in Section 3.1.7.i. The reference curve is largely based on human hearing thresholds and for practicality reasons has been corrected from the internally based DEFRA curve so that it can be assessed externally. The internal to external correction is based on the typical facade reduction provided by a partially open window and is therefore conservative if occupants keep windows closed.

This draft ING method increases the rigour around the identification of LFN and provides a more representative and balanced outcome for the community and industry. It has therefore been applied as the primary low frequency assessment method in this assessment.

3.1.8 Sleep disturbance

The Hume Coal Project seeks approval to operate during the night-time period (10 pm to 7 am) which requires assessment of sleep disturbance in accordance with the INP.

The operational criteria described in Section 3.1.3 considers average noise emission of a source over 15 minutes and are appropriate for assessing noise from generally steady-state sources (e.g. conveyors). However, transient noise from sources such as rail movements are intermittent (rather than continuous) and need to be assessed using the $L_{A1,1min}$ or L_{Amax} noise metric.

Prior to the EPA finalising a standard method to determine potential for sleep disturbance, the INP guideline suggests that $L_{A1(1min)}$ level of 15 dB above the RBL is a suitable screening criteria for sleep disturbance for the night-time period. Guidance regarding potential for sleep disturbance is also provided in the NSW Road Noise Policy (RNP). The RNP calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. However, the RNP provides the following conclusions from the research on sleep disturbance:

- *maximum internal noise levels (L_{Amax}) below 50 to 55 dB are unlikely to awaken people from sleep; and*

- *one or two noise events per night, with maximum internal noise levels (L_{Amax}) of 65 to 70 dB, are not likely to affect health and wellbeing significantly.*

It is commonly accepted by acoustic practitioners and regulatory bodies that a facade of a residential building of standard construction including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60 to 65 dB L_{Amax} calculated at the facade of a residence is unlikely to cause awakening effects.

When assessing sleep disturbance, the L_{Amax} and $L_{A1,1min}$ descriptors may be interchanged. This is accepted by the EPA.

If noise levels over the screening criteria are identified, then additional analysis would consider factors such as:

- how often the events would occur;
- the time the events would occur (between the hours 10 pm to 7 am); and
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

Table 3.6 provides the sleep disturbance screening criteria for the residential assessment locations.

Table 3.6 Sleep disturbance screening criteria, residential assessment locations

NCA	Adopted RBL, dB[1]	Sleep disturbance screening criteria dB, L_{max}
NCA1, NCA2, NCA4, NCA5	30	45
NCA3	31	46
NCA6	38	53
NCA7	35	50

Notes: 1.Night-time RBLs adopted from Table 2.2.

3.2 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) was recently amended and now includes clause 12AB Non-discretionary development standards for mining. The clauses relevant to the project are listed below.

Clause 12AB(1):

> The object of this clause is to identify development standards on particular matters relating to mining that, if complied with, prevents the consent authority from requiring more onerous standards for those matters (but that does not prevent the consent authority granting consent even though any such standard is not complied with).

Clause 12AB(3) Cumulative noise level:

> The development does not result in a cumulative amenity noise criterion greater than the acceptable noise levels, as determined in accordance with Table 2.1 of the Industrial Noise Policy, for residences that are private dwellings.

Other clauses of interest for this project are listed below.

Clause 12AB(5) Air blast overpressure:

> Air blast overpressure caused by the development does not exceed:
>
> (a) 120 dB (Lin Peak) at any time, and
>
> (b) 115 dB (Lin Peak) for more than 5% of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.

Clause 12AB(6) Ground vibration:

> Ground vibration caused by the development does not exceed:
>
> (a) 10 mm/sec (peak particle velocity) at any time, and
>
> (b) 5 mm/sec (peak particle velocity) for more than 5% of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.

The above clauses are consistent with noise and blasting criteria adopted for the Hume Coal Project.

3.3 Construction noise

The *Interim Construction Noise Guideline* (ICNG) (DECC 2009) has been jointly developed by NSW Government agencies including the EPA and DP&E. The objectives of the guideline relevant to the planning process are to promote a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' work practices. The guideline recommends standard construction hours where noise from construction activities is audible at residential premises (ie assessment locations):

- Monday to Friday 7.00 am to 6.00 pm;
- Saturday 8.00 am to 1.00 pm; and
- No construction work is to take place on Sundays or public holidays.

The ICNG acknowledges that works outside standard hours may be necessary, however justification should be provided to the relevant authorities.

The DP&E generally requires that noise emissions from construction associated with mining projects should be assessed under the INP. This is normally because noise from construction activity associated with such projects is similar in nature to that generated by the operation of the Hume Coal Project. In the case of the Hume Coal Project, construction activity will be very different in nature to the proposed operations (ie unlike an open-cut mine) and thus, it is considered appropriate to apply construction noise criteria in accordance with the ICNG.

The ICNG provides two methodologies to assess construction noise emissions. The first is a quantitative approach, which is suited to major construction projects with typical durations of more than three weeks. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.

The second is a qualitative approach, which is a simplified assessment process that relies more on noise management strategies. This method is suited to short-term infrastructure and maintenance projects of less than three weeks.

This assessment has adopted a quantitative approach. The qualitative aspects of the assessment include identification of assessment locations, description of works involved including predicted noise levels and proposed management measures that include a complaints handling procedure.

i Noise management level

Table 3.7 provides noise management levels for assessment locations provided in the ICNG which have been adopted for the quantitative construction noise assessment.

Table 3.7 ICNG construction noise management levels for residential land uses

Time of day	Management level $L_{eq(15\text{-}min)}$	Application
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm, No work on Sundays or public holidays	Noise-affected RBL + 10 dB	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{eq(15\text{-}min)}$ is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise-affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: i) times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); ii) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise-affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise-affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Source: ICNG (EPA, 2009).

The Hume Coal Project's construction NMLs for recommended standard and out of hour periods are presented in Table 3.8 as applicable to residences. It is noted the sleep disturbance criteria in Section 3.1.8 will also be applied to the limited construction activity during the night-time period.

Table 3.8 Hume Coal Project's - Construction noise management levels for residences

NCA	Period	Adopted RBL[1]	NML $L_{Aeq,15min}$, dB
NCA1, NCA2, NCA4, NCA5,	Day (standard ICNG hours)	30	40
	Evening (out of hours)	30	35
	Night (out of hours)	30	35
NCA3	Day (standard ICNG hours)	35	45
	Evening (out of hours)	34	39
	Night (out of hours)	31	36
NCA6	Day (standard ICNG hours)	45	55
	Evening (out of hours)	45	50
	Night (out of hours)	38	43
NCA7	Day (standard ICNG hours)	41	51
	Evening (out of hours)	41	46
	Night (out of hours)	35	40

Notes: 1.The RBLs adopted from Table 2.2.

3.4 Road noise

Construction and operational related traffic requires assessment for potential noise impact. The principle guidance to assess the impact of the road traffic noise on assessment locations is in the NSW RNP. Table 3.9 presents the road noise assessment criteria for residential land uses (ie assessment locations), reproduced from Table 3 of the RNP for road categories relevant to the Hume Coal Project.

Table 3.9 Road traffic noise assessment criteria for residential land uses

Road Category	Type of project/development	Assessment criteria – dBA	
		Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{eq,15hr}$ 60 (external)	$L_{eq,9hr}$ 55 (external)
Local Roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{eq,1hr}$ 55 (external)	$L_{eq,1hr}$ 50 (external)

Additionally, the RNP states that where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to +2 dB.

In addition to meeting the assessment criteria (Table 3.9), any significant increase in total traffic noise at the relevant assessment locations must be considered. Assessment locations experiencing increases in total traffic noise levels above those presented in Table 3.10 should be considered for mitigation.

Table 3.10 Road traffic relative increase criteria for residential land uses

Road Category	Type of project/development	Total traffic noise level increase – dBA	
		Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 am)
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{eq(15\text{-}hr)}$+12 dB (external)	Existing traffic $L_{eq(9\text{-}hr)}$+ 12 dB (external)

3.5 Rail noise

The principle guidance to assess rail traffic on non-network rail lines on or exclusively servicing industrial sites is provided in Appendix 3 of the NSW EPA 2013 *Rail Infrastructure Noise Guideline* (RING).

The RING (EPA 2013) states that rail related activities (such as movement of rolling stock on rail loops or sidings, loading and shunting activities etc.) occurring within the boundary of an industrial premises as defined in an environment protection licence are to be assessed as part of the industrial premises using the NSW INP (EPA 2000). This approach has been adopted for the rail loading and movement activities confined to the rail loop (i.e. rail actually west of the Hume Highway) for Hume Coal Project. The project's rail movements beyond the rail loop are the subject of a separate application and assessment.

3.6 Operational and construction vibration

3.6.1 Human comfort

i General discussion on human perception of vibration

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not, in itself, be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2 1975. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 3.11.

Table 3.11 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: *These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hz to 80 Hz.*

Table 3.11 suggests that people will just be able to feel floor vibration at levels of about 0.15 mm/s and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

ii Assessing vibration a technical guideline

Environmental Noise Management – Assessing Vibration: a technical guideline (DEC 2006) (the guideline) is based on guidelines contained in *BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz).*

The guideline presents preferred and maximum vibration values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended that the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 3.12.

Table 3.12 Examples of types of vibration (from Table 2.1 of the guideline)

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Intermittent vibration (as defined in *Section 2.1* of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of operational rail pass-bys and construction activities such as impact hammering, rolling or general excavation work.

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz. To calculate VDV the following formula is used (refer to Section 2.4.1 of the guideline):

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted rms of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV for intermittent vibration are reproduced in Table 3.13.

Table 3.13 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night-time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: 1. Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.

2. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline recommends that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

Impulsive vibration as defined in Table 3.14 can be caused by blasting which is discussed further in Section 3.7 and otherwise not applicable to the general operations or construction phase of the Hume Coal Project.

Continuous vibration is not likely to be a project risk given the depth of mining. Nonetheless, potential continuous vibration from underground mine construction is discussed generally in Section 5.5.3.

3.6.2 Structural vibration

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 "*Explosives* - Storage *and Use - Use of Explosives*" recommends that the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2"* be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (e.g. compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to manage minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 3.14 and graphically in Figure 3.2.

Table 3.14 Transient vibration guide values - minimal risk of cosmetic damage

Line[1]	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: Refers to the "Line" in Figure 3.2.

The standard notes that the guide values in Table 3.14 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 3.14 may need to be reduced by up to 50%.

Some construction or tunnelling activities (for example) are considered to have the potential to cause dynamic loading in some structures and therefore transient values in Table 3.14 have been reduced by 50% for assessment purposes, with a vibration screening criteria set at 7.5 mm/s.

Further, in the absence of specific structural vibration criteria for other infrastructure surrounding the project, this criterion has also been conservatively applied to assess potential structural vibration impacts on the Hume Highway as requested by RMS.

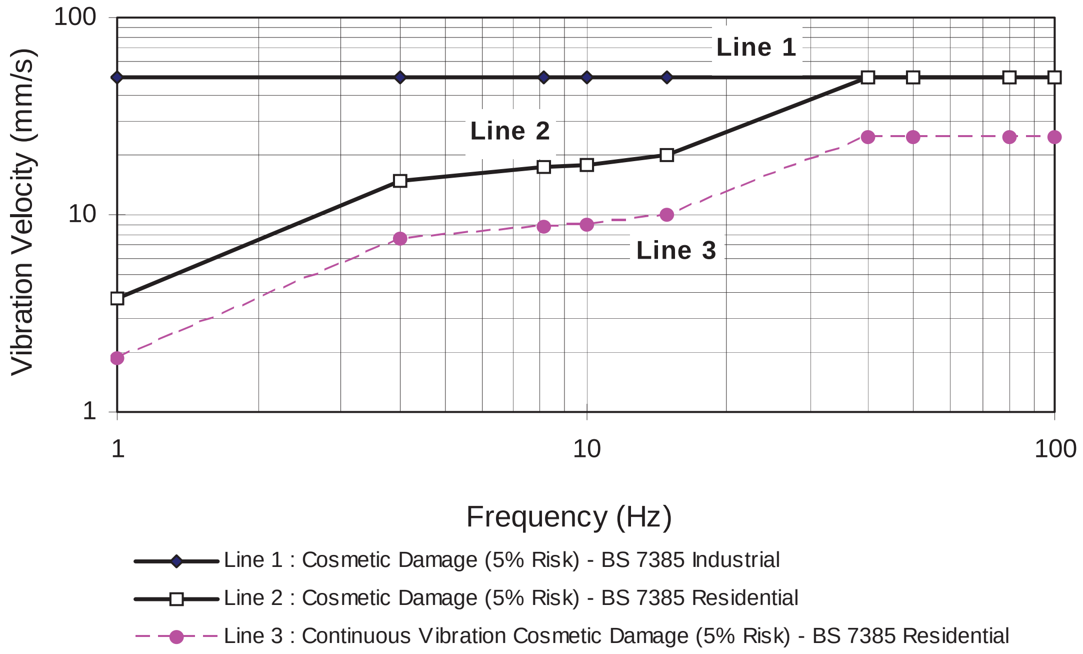


Figure 3.2 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz (as shown in Figure 3.2).

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 3.14 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measured should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 3.14.

It is noteworthy that in addition to the guide values nominated in Table 3.14, the standard states that:

> Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

Also that:

> A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

3.7 Construction blasting

The limits adopted by the EPA for blasting are provided in the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZECC 1990).

The blasting limits address two main effects of blasting:

- air blast noise overpressure; and
- ground vibration.

3.7.1 Air blast

The recommended maximum vibration level for air blast is 115 dB linear peak. The vibration level of 115 dB may be exceeded on up to 5% of the total number of blasts over 12 months. However, the level should not exceed 120 dB linear peak at any time.

3.7.2 Ground vibration

Peak particle velocity (PPV) from ground vibration should not exceed 5 mm/s for more than 5% of the total number of blasts over 12 months. However, the maximum level should not exceed 10 mm/s at any time.

A summary of blast limits are provided in Table 3.15.

Table 3.15 Air blast overpressure and ground vibration limits

Blasting	Criteria	Allowable exceedance
Air blast overpressure	115 dB(L_{inpeak})	5% of the total number of blasts over 12 months
	120 dB(L_{inpeak})	0%
Ground vibration	5 mm/s (PPV)	5% of the total number of blasts over 12 months
	10 mm/s (PPV)	0%

4 Assessment method

4.1 Overview

This section presents the methods and base parameters used to model noise emissions from the Hume Coal Project, including the effects of prevailing meteorological conditions.

Noise modelling was based on three-dimensional digitised ground contours of the surrounding land and surface infrastructure for construction and operational phases of the Hume Coal Project. The construction and operational noise models represent snapshots, with equipment placed at various locations and heights, representing realistic scenarios.

Noise predictions were carried out using the Brüel and Kjær Predictor Version 11 software. 'Predictor' calculates total noise levels at assessment locations from concurrent operation of multiple noise sources. The model considers factors such as the lateral and vertical location of plant, source-to-receptor distances, ground effects, atmospheric absorption, topography of the site and surrounding area and applicable meteorological conditions.

4.2 Operational noise modelling

4.2.1 Noise enhancing meteorology

A summary of calm and identified prevailing weather conditions that were considered in the noise modelling which are provided in Table 4.1, determined as required by the INP (refer to Section 2.5). The wind directions that trigger the 30% INP threshold from Met1 and Met2 have been included in the assessment of noise enhancing prevailing wind conditions.

Table 4.1 Relevant site-specific meteorological parameters

Assessment condition	Period	Temperature	Wind speed (m/s)/ direction	Relative humidity	Stability class
Calm	Day	20°C	n/a	70%	n/a
	Evening/Night	10°C	n/a	90%	n/a
Prevailing winds	Evening/Night	10°C	3 / NNE (22.5°)	90%	n/a
			3 / NE (45°)		
			3 / ENE (67.5°)		
			3/ E (90°)		
			3 / SSW (202.5°)		
			3 / SW (225°)		
			3 / WSW (247.5°)		
			3 / W (270°)		
			3 / WNW (292.5°)		
			3 / NW (315°)		
			3 / NNW (337.5°)		
			3 / N (0°)		
'F' class temperature inversion	Night	10°C	n/a	90%	F

Noise sources are typically at a similar elevation to surrounding assessment locations or there is intervening topography separating site and surrounding properties. The potential for source to receptor drainage flow winds to occur is therefore not considered relevant.

4.2.2 Operating scenarios and equipment noise levels

i Continuous operations

Acoustically significant fixed and mobile equipment items considered in the noise model are provided for day, evening and night operations in Table 4.2. Equipment sound power levels have been taken from published manufacturer and supplier data where it was available or otherwise from an EMM database of similar plant and equipment which is based on measurements at other underground mining operations.

Adopted leading practice in noise mitigation has also been indicated as applicable. The sound power levels presented are inclusive of the adopted noise mitigation and/or management.

The indicative location of acoustically significant plant and equipment is displayed in Figure 1.4.

Table 4.2 Indicative operations equipment quantities and sound power levels

Item and location	Mitigated sound power level (Lw), dB $L_{Aeq(15\text{-}min)}$	Quantity			Adopted noise mitigation/management
		Day	Evening	Night	
Mining infrastructure area					
Ventilation fan	93 (total)	2	2	2	Fan attenuation
Compressors	77	5	5	5	Enclosed
Sewage treatment (pumps)	85	1	1	1	Enclosed
Fuel pump	89	1	1	1	
Workshop activity (eg hand and power tools)	103	1	1	1	Limited activities in the evening and night period
Vehicle wash-down / service area (pump/gerni)	90	1	1	1	
Load-haul-dump (LHD) truck	85	1	1	1	
Man transport	85	4	4	4	
Tele handler	95	1	0	0	
Coal handling and preparation plant area					
D9 dozer	115	1	0	0	Noise attenuated
Loader	105	1	1	1	3.5m bund around rejects load hopper
Overland conveyor	65/m (east side) 75/m (west side)	1780 m	1780m	1780 m	Machined steel idlers and enclosed (roof and east side)
ROM stockpile (radial stacker/reclaimer)	104	1	1	1	Drives enclosed
Crushing station	106	1	1	1	Sheet metal enclosure
Tertiary screens	105	1	1	1	Sheet metal enclosure

Table 4.2 Indicative operations equipment quantities and sound power levels

Item and location	Mitigated sound power level (Lw), dB $L_{Aeq(15-min)}$	Quantity			Adopted noise mitigation/management
		Day	Evening	Night	
CPP	94	1	1	1	Fully enclosed in metal clad building, variable voltage, variable frequency (VVVF) drives, concrete platforms for screens, increased steel work to stiffen structure
Product stacker	104	2	2	2	Drives enclosed
Product reclaimer	104	1	1	1	Drives enclosed
Rejects stacker	104	1	1	1	Drives enclosed
Reject plant (paste plant)	102	1	1	1	Fully enclosed in metal clad building
Product stockpile conveyors	75/m	770 m	770 m	770 m	Machined steel idlers
Enclosed conveyors	65/m	890 m	890 m	890 m	Machined steel idlers and full enclosure
All other conveyors	75/m	1000 m	1000 m	1000 m	Machined steel idlers
Conveyor drive small (<500 kW)	90	9	9	9	Sheet metal enclosure
Conveyor drive large (>500 kW)	100	7	7	7	Sheet metal enclosure
Water treatment plant	85	1	1	1	Sheet metal enclosure
Train load out					
Bin, feeder and train load out	103	1	1	1	Enclosed
Train load out conveyor	65/m	650 m	650 m	650 m	Machined steel idlers and full enclosure
Locomotives (idle to slow moving < 10km/h)	101	4	4	4	Latest generation locomotives

ii Night-time maximum noise level events and sleep disturbance

Intermittent noises, such as vehicle start-ups, equipment start-up alarms or rail pass-bys were assessed against the sleep disturbance criteria. Typical noise levels from the loudest of these events are presented in Table 4.3. The adopted sound power levels have been taken from a measurement data of similar equipment. The locomotive pass-by sound power level is based on measurements carried out by EMM on the existing Berrima Branch Line which was verified against a database of rail noise measurements from other similar projects.

Table 4.3 Maximum noise from intermittent sources

Noise source	Measured L_{max} noise level, dBA
Locomotive pass-by (<20 km/h)	122
Stacker/ reclaimer start-up alarm	105
Haul dump start-up	115

Table 4.3 indicates the highest maximum noise levels expected would likely result from a rail pass-by on the rail loop or load haul dump truck start-ups at the surface infrastructure area. Maximum noise levels at each assessment location were calculated under adverse meteorological conditions using the sound power levels in Table 4.3 and based on worst case equipment placements in relation to surrounding receivers.

4.3 Construction noise

The overall noise characteristic of an operational underground mine will be materially different to that of the mine construction, which will include bulk earthworks and infrastructure construction over an expansive project area. Noise emissions from site construction have therefore have been assessed separately and appropriately using ICNG noise criteria.

The construction noise assessment has been separated into the following project components:

- Early works phase;
- Portals and portals access;
- surface infrastructure area construction;
- Overland conveyor;
- Ventilation shaft; and
- CPP precinct construction.

Most construction activities will occur during standard hours, however some works are proposed 24 hours 7 days. This is generally related to the conveyor portal, personnel and material portal and ventilation shaft construction. Continuous construction of these elements is required namely to maintain a safe level of geotechnical stability which can be time dependant. Some limited internal activity within the CPP building is also proposed 24 hours 7 days which is required due to the specialist nature of this equipment item and the need for a continuous construction methodology.

Construction noise predictions for the above components were carried out using the Brüel and Kjær Predictor Version 11 software. Appendix C details the construction scenarios and equipment considered in the construction noise assessment along with associated sound power levels, hours of operation and indicative scheduling.

4.4 Road traffic noise

The Calculation of Road Traffic Noise (CoRTN) (UK Department of Transport) method was used to predict noise levels at the nearest assessment locations for additional traffic from construction and operation of the Hume Coal Project. CoRTN, which was developed by the UK Department of Transport, considers traffic flow volume, average speed, percentage of heavy vehicles and road gradient to establish noise source strength, and includes attenuation due to distance, ground, atmospheric absorption and screening from buildings or barriers.

Road traffic movements associated with operation and construction of the Hume Coal Project have been referenced from the *Hume Coal Project Project Traffic Impact Assessment* (EMM 2017).

4.4.1 Operational

Project related road traffic movements adopted in the operational road traffic assessment are presented in Table 4.4. The typical transport routes to and from site during the operations phase are shown in Figure 4.1.

Table 4.4 Traffic generation on public roads during operations

Description	Period	Light vehicle[2] movements	Heavy vehicle[3] movements	Total vehicle movements
Operations	Day (7.00 am to 10.00 pm)	205	16	221
	Night (10.00 pm to 7.00 am)	153	4	157

Notes: 1.Volumes taken from Hume Coal Project Traffic Impact Assessment (EMM 2017).

2. A vehicle with a gross vehicle mass (GVM) of 4.5 tonnes or less.

3. A vehicle with a GVM of greater than 4.5 tonnes.

4.4.2 Construction

Project related road traffic movements adopted in the construction road traffic assessment are presented in Table 4.5. The typical transport routes to and from site during the construction phase are shown in Figure 4.2.

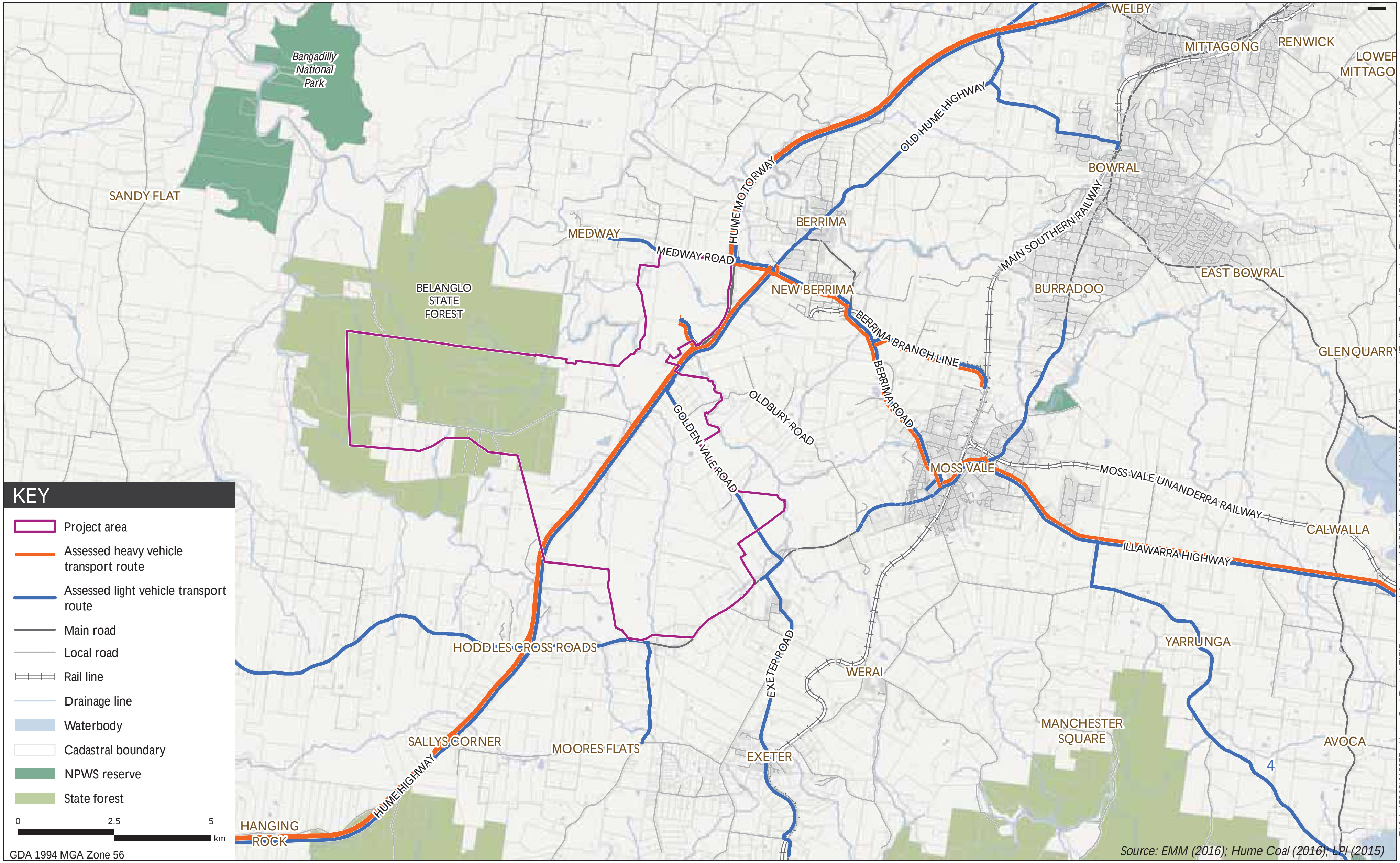
Table 4.5 Traffic generation on public roads during construction

Construction stage	Period	Light vehicle[2] movements	Heavy vehicle[3] movements	Total vehicle movements
Early	Day (7.00 am to 10.00 pm)	132	70	202
	Night (10.00 pm to 7.00 am)	90	8	98
Peak	Day (7.00 am to 10.00 pm)	150	116	266
	Night (10.00 pm to 7.00 am)	18	12	30

Notes: 1.Volumes taken from Hume Coal Project Traffic Impact Assessment (EMM 2017).

2. A vehicle with a GVM of 4.5 tonnes or less.

3. A vehicle with a GVM of greater than 4.5 tonnes.

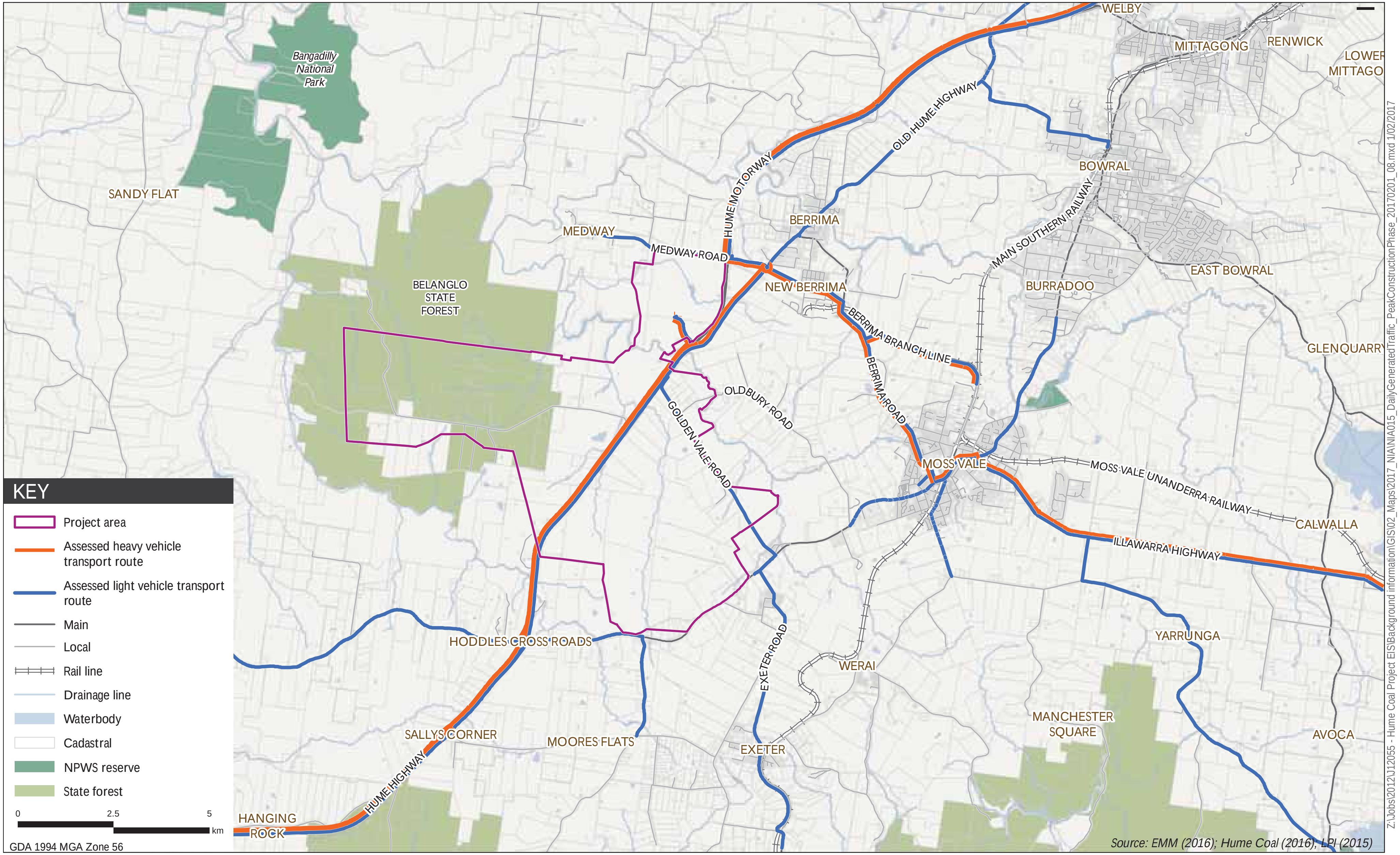


Assessed transport routes during project operation

Hume Coal Project

Noise Impact Assessment

Figure 4.1



Assessed transport routes during project construction

Hume Coal Project

Noise Impact Assessment

Figure 4.2

4.5 Blasting

Blast design will be managed by site personnel and the blasting contractor to control the air blast overpressure and ground vibration. Notwithstanding a quantitative assessment of blast overpressure and vibration levels has been prepared using the method given in *AS2187-2-2006: Explosives – Storage and Use Part 2: Use of Explosives and the Imperial Chemical Industries (ICI) Explosives Blasting Guide* (ICI Technical Services 1995), as applicable to blasting in hard rock. This formula has been shown to be conservative in calculating overpressure and vibration.

The relevant formulae are as follows:

PVS = $K (R/Q\ \hat{}^{0.5})\hat{}^{-1.6}$

dB = $164.2 - 24(\log_{10} R - 0.33 \log_{10} Q)$

Where,

PVS = peak vector sum ground vibration level (mm/s)

dB = peak air blast level (dB Linear)

K = factor applied according to blasting type

R = distance between charge and residence (m)

Q = charge mass per delay (kg) or maximum instantaneous charge (MIC)

It should be noted that a K factor of 1140 (for average rock) was used to calculate levels associated with the personnel and materials portal, drift portal and ventilation shaft construction.

5 Impact assessment

5.1 Operational noise modelling results

The predicted noise levels at each assessment location for each meteorological condition with all feasible and reasonable mitigation measures applied are provided in Table 5.1. Noise contours are provided in Figures 5.1 to 5.3.

The green, orange and blue shading indicates assessment locations where noise predictions fall into negligible (1 to 2 dB above PSNL), moderate (3 to 5 dB above PSNL) or significant (greater than 5 dB above PSNL) noise impact characterisations (respectively) as described in the VLAMP (Table 3.3). Otherwise predicted noise levels satisfy PSNLs.

Table 5.1 Predicted operations noise levels

Assessment location (NCA)	Predicted noise level, $L_{Aeq,15min}$, dB			PSNL (D/E/N), $L_{Aeq,15min}$ dB	Voluntary mitigation noise level trigger (D/E/N), $L_{Aeq,15min}$ dB	Voluntary acquisition noise level trigger (D/E/N), $L_{Aeq,15min}$ dB
	Day	Night				
	Calm	Calm	Adverse[1]			
1 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
2 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
3 (NCA1)	<35	<35	35	35/35/35	37/37/37	>40/40/40
4 (NCA1)	37	35	38	35/35/35	37/37/37	>40/40/40
5 (NCA1)	37	35	38	35/35/35	37/37/37	>40/40/40
6 (NCA1)	37	35	38	35/35/35	37/37/37	>40/40/40
7 (NCA1)	37	<35	37	35/35/35	37/37/37	>40/40/40
8 (NCA1)	38	35	38	35/35/35	37/37/37	>40/40/40
10 (NCA1)	40	37	40	35/35/35	37/37/37	>40/40/40
12 (NCA1)	44	41	43	35/35/35	37/37/37	>40/40/40
13 (NCA1)	43	39	42	35/35/35	37/37/37	>40/40/40
14A, 14B (NCA1)	37	36	38	35/35/35	37/37/37	>40/40/40
15 (NCA1)	40	36	39	35/35/35	37/37/37	>40/40/40
16 (NCA1)	40	37	40	35/35/35	37/37/37	>40/40/40
17 (NCA7)	<46	<39	40	46/46/40	48/48/42	>51/51/45
18 (NCA7)	<46	<39	<39	46/46/40	48/48/42	>51/51/45
19 (NCA2)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
20 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
21 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
22 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
23 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
24 (NCA2)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
25 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
26 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
27 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
28 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
29 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40

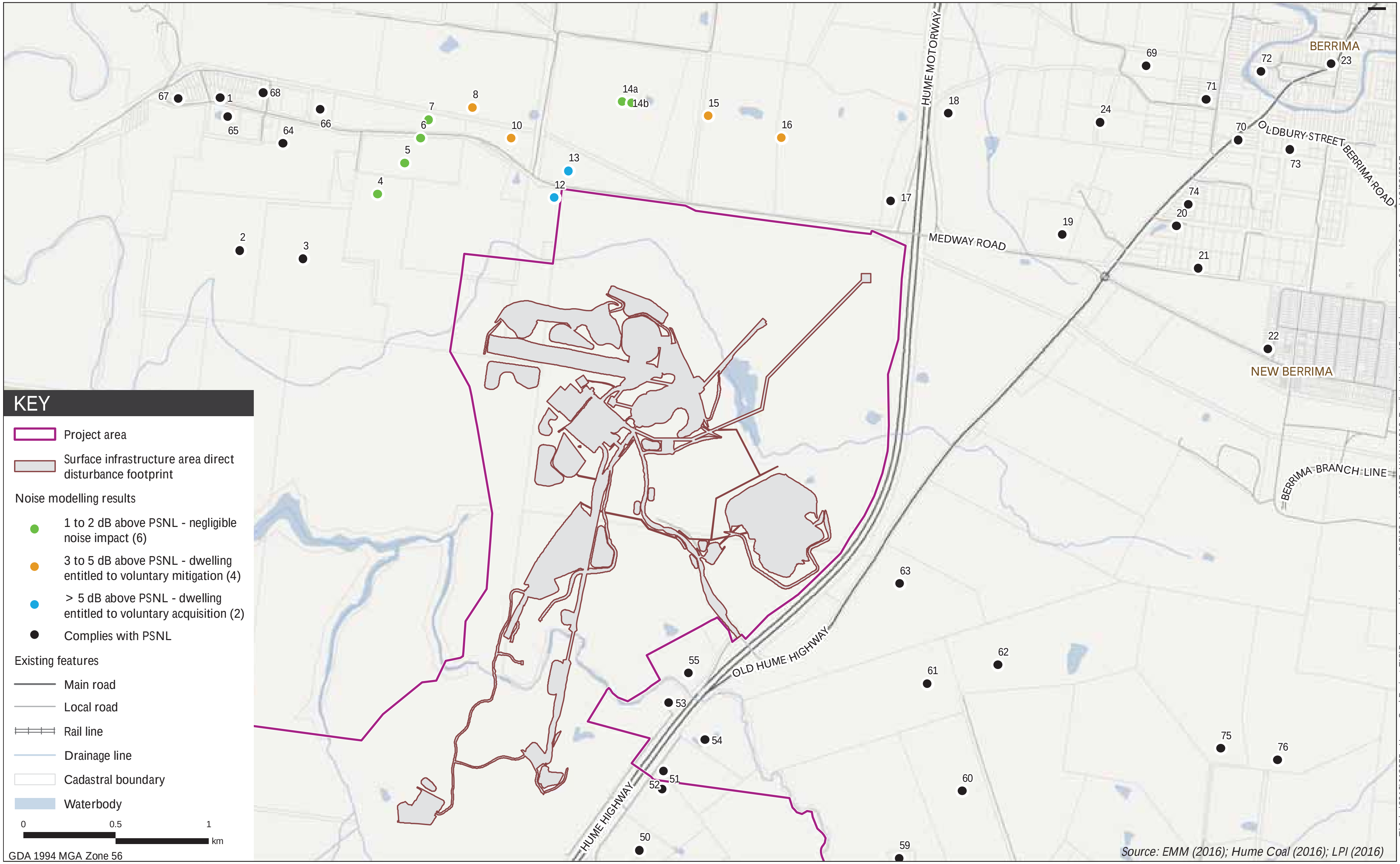
Table 5.1 Predicted operations noise levels

Assessment location (NCA)	Predicted noise level, $L_{Aeq,15min}$, dB			PSNL (D/E/N), $L_{Aeq,15min}$ dB	Voluntary mitigation noise level trigger (D/E/N), $L_{Aeq,15min}$ dB	Voluntary acquisition noise level trigger (D/E/N), $L_{Aeq,15min}$ dB
	Day	Night				
	Calm	Calm	Adverse[1]			
30 (n/a2)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
31 (n/a2)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
32 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
33 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
34 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
35 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
36 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
37 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
38 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
39 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
40 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
41 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
42 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
43 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
44 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
45 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
46 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
47 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
48 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
49 (NCA7)	<46	<39	<40	46/46/40	48/48/42	>51/51/45
50 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
51 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
52 (NCA7)	<46	<39	<40	46/46/40	48/48/42	>51/51/45
53 (NCA7)	<46	<39	<40	46/46/40	48/48/42	>51/51/45
54 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
55 (NCA7)	<46	<39	<40	46/46/40	48/48/42	>51/51/45
56 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
57 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
58 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
59 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
60 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
61 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
62 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
63 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
64 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
65 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
66 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
67 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
68 (NCA1)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
69 (NCA2)	<35	<35	<35	35/35/35	37/37/37	>40/40/40

Table 5.1 Predicted operations noise levels

Assessment location (NCA)	Predicted noise level, $L_{Aeq,15min}$, dB			PSNL (D/E/N), $L_{Aeq,15min}$ dB	Voluntary mitigation noise level trigger (D/E/N), $L_{Aeq,15min}$ dB	Voluntary acquisition noise level trigger (D/E/N), $L_{Aeq,15min}$ dB
	Day	Night				
	Calm	Calm	Adverse[1]			
70 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
71 (NCA2)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
72 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
73 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
74 (NCA3)	<40	<36	<36	40/39/36	42/41/38	>45/44/41
75 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40
76 (NCA4)	<35	<35	<35	35/35/35	37/37/37	>40/40/40

Notes: 1. Maximum predicted noise level from all assessed prevailing meteorological conditions in Table 4.1.

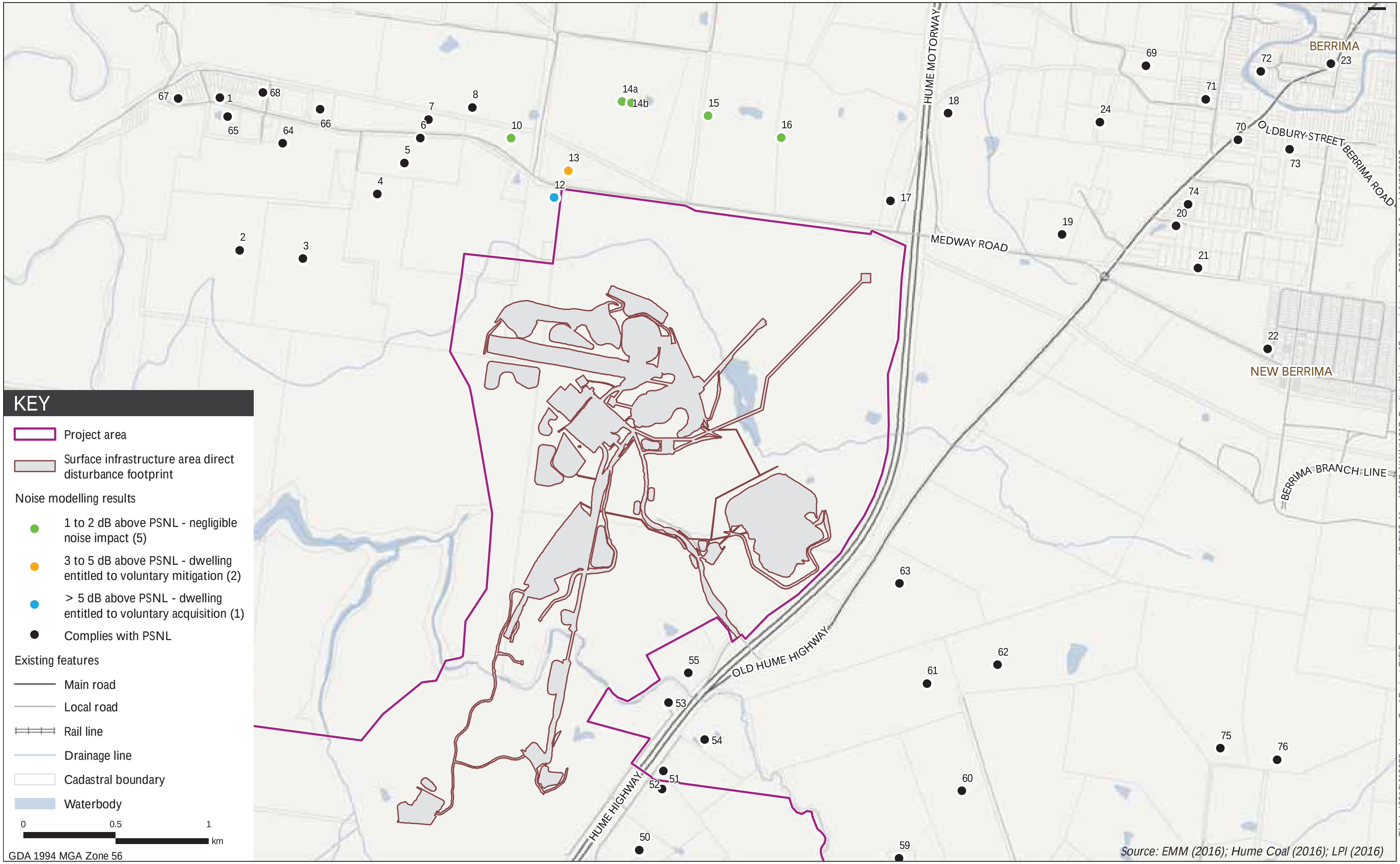


Predicted $L_{Aeq,15min}$ noise levels for operations, day, calm weather

Hume Coal Project

Noise Impact Assessment

Figure 5.1

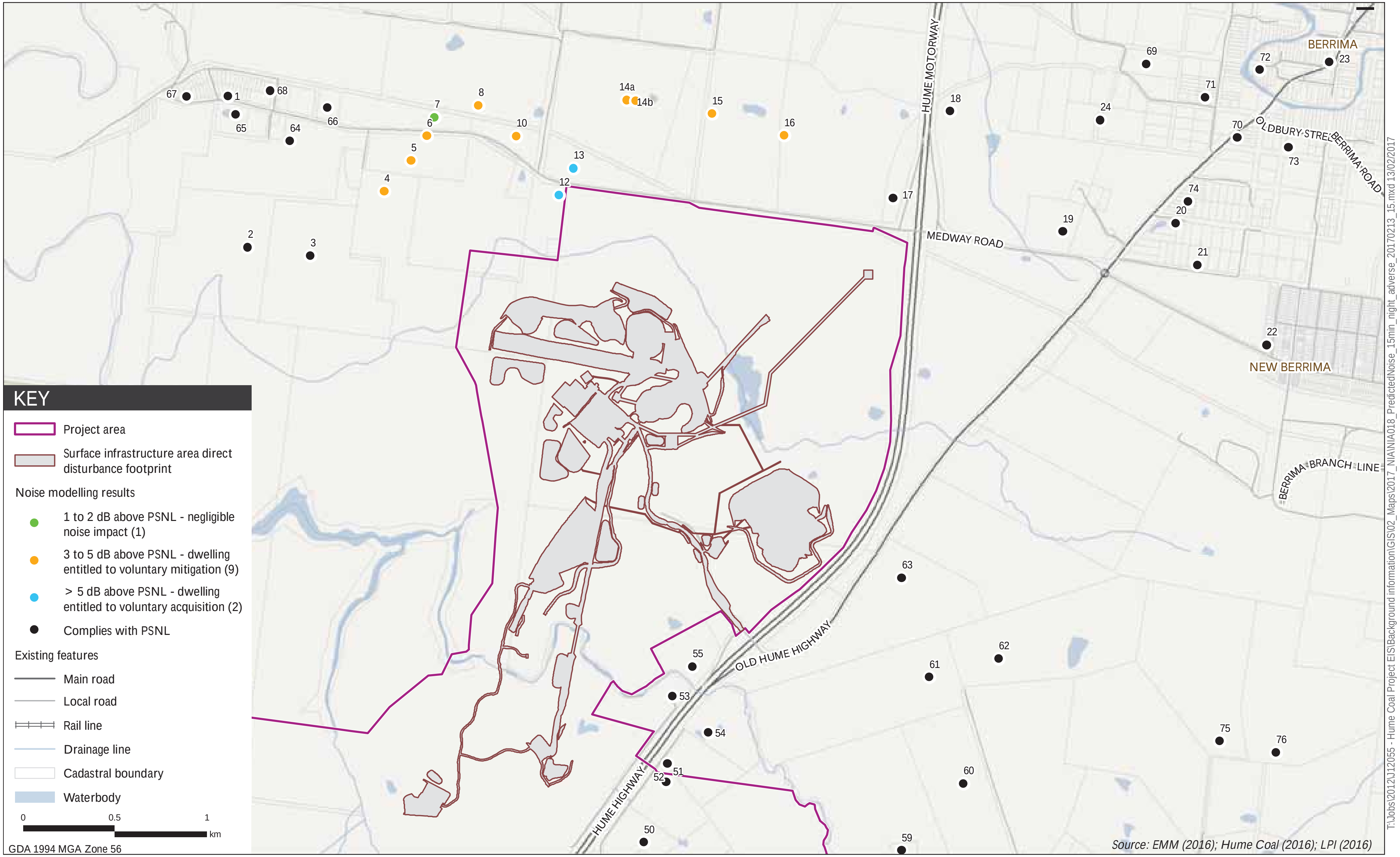


Predicted $L_{Aeq,15min}$ noise levels for operations, night, calm weather

Hume Coal Project

Noise Impact Assessment

Figure 5.2



Predicted $L_{Aeq,15min}$ noise levels for operations, night, adverse weather

Hume Coal Project

Noise Impact Assessment

Figure 5.3

5.2 Summary of operational noise impacts

The noise model predictions have been assessed by comparing the higher of the calm and adverse meteorology results relative to day and night INP criteria. Assessment locations predicted with negligible, moderate or significant residual noise impacts as defined in the VLAMP (Section 3.1.4) across all periods and meteorological conditions are presented in Table 5.2.

Table 5.2 Assessment location IDs characterised according to predicted noise levels and PSNL, all assessable weather conditions, all feasible and reasonable mitigation applied

Negligible (1 to 2 dB above PSNL)	Moderate (3 to 5 dB above PSNL)[1]	Significant (>5 dB above PSNL)[2]
7	4	12
	5	13
	6	
	8	
	10	
	14A, 14B	
	15	
	16	
Total - 1	Total - 8	Total – 2

Notes: *1. Assessment locations entitled to voluntary noise mitigation in the form of mechanical ventilation / comfort condition systems and upgraded facade elements to reduce internal noise levels.*

2. Assessment locations entitled to voluntary acquisition.

During adverse weather conditions for all assessment periods, for the mining life, with all feasible and reasonable mitigation measures applied, the VLAMP assessment indicates:

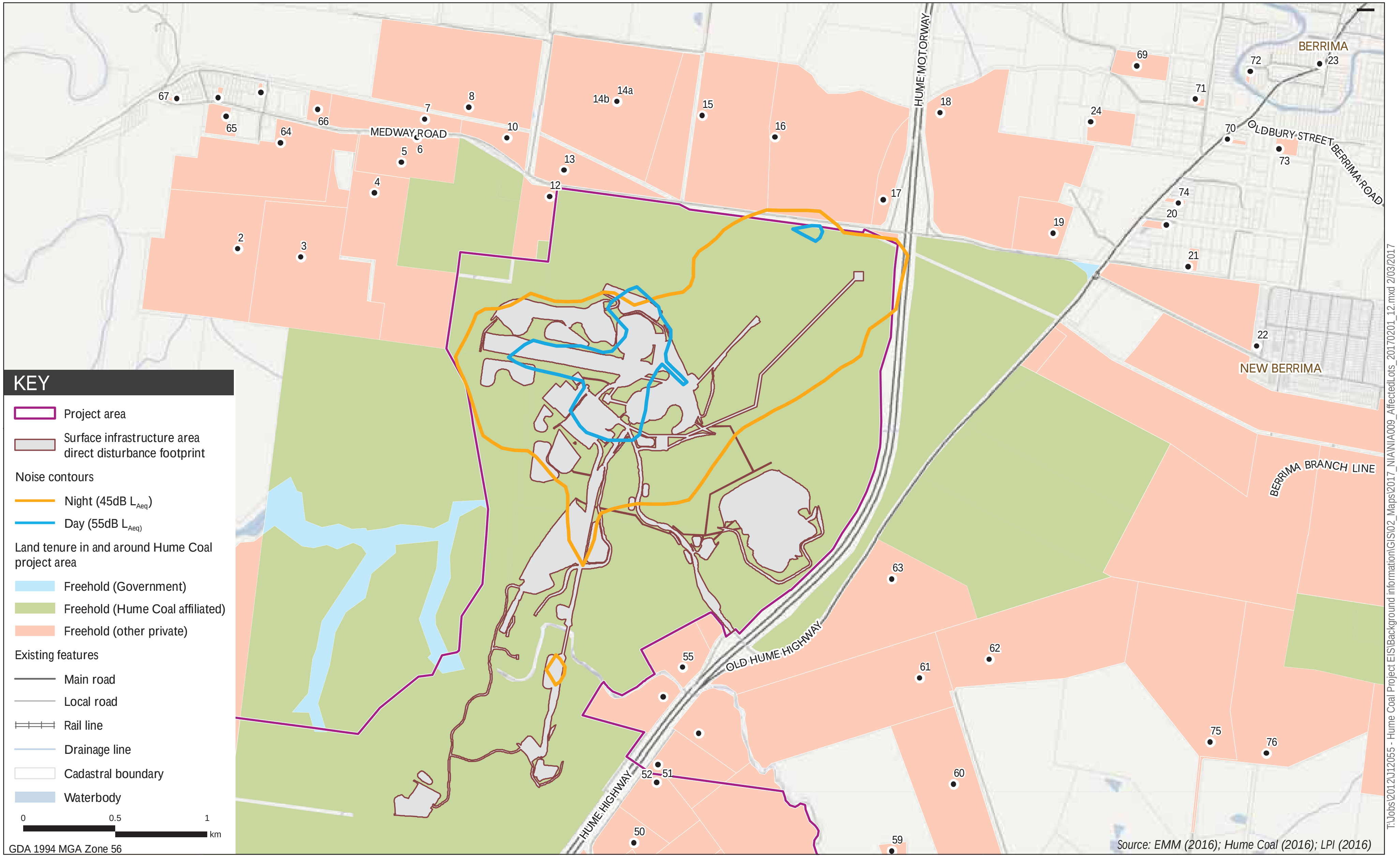
- one assessment location within the area modelled is predicted to experience negligible residual noise levels between 1 to 2 dB above PSNLs;
- eight assessment locations (nine dwellings) within the area modelled are predicted to experience residual noise levels between 3 to 5 dB above PSNLs and therefore entitled to voluntary mitigation upon request; and
- two assessment locations within the area modelled are predicted to experience residual noise levels greater than 5 dB above PSNLs and therefore entitled to voluntary acquisition upon request.

Alternatively, Hume Coal may enter into amenity agreements with the landholders who are entitled to voluntary mitigation or acquisition.

5.3 Privately owned land assessment

The $L_{Aeq,period}$ noise contours for day (calm weather conditions) and night (calm and adverse weather conditions) are presented in Figure 5.1. The 55 dB $L_{Aeq,period}$ day and 45 dB $L_{Aeq,period}$ night noise contours have been used to assess noise over privately owned land parcels. A correction of 3 dB has been applied to convert $L_{Aeq,15min}$ noise levels to $L_{Aeq,period}$ noise levels in line with standard practice. The noise contours represent the recommended maximum amenity noise level for a rural environment, and have been selected for the assessment due to the land nearest to site and most affected by mining noise being classified as rural.

Figure 5.4 shows there are no privately owned land parcels exceeding the 25% area voluntary land acquisition criteria as defined in the VLAMP.



$L_{Aeq,\ period}$ noise contours and privately owned lands assessment - day and night

Hume Coal Project

Noise Impact Assessment

Figure 5.4

5.4 Low frequency noise

There are several limitations in applying the draft ING low frequency noise assessment procedure at the environmental assessment stage. These limitations are as follows:

- The lower frequency limit for contemporary noise modelling packages is typically 25 Hz, and many modelling packages only allow single octave band predictions; and
- It is commonly difficult to measure equipment sound power levels in outdoor test conditions below 50 Hz due to the presence of background noise or the influence of wind at low frequencies.

Due to these limitations, the draft ING LFN assessment procedure is best applied in the operational stage where direct measurement of energy at the frequency bands of interest can be completed. Nonetheless, an assessment of low frequency noise in accordance with the draft ING using best available resources at the environmental assessment stage is provided in this section.

Table 5.3 presents predicted A-weighted (dBA), C-weighted (dBC) and 1/3 octave band centre frequency noise levels for all assessment locations which trigger the draft ING LFN assessment screening criteria described in Section 3.1.7. All other assessment locations not displayed in Table 5.3 do not trigger the draft ING LFN assessment screening criteria.

Table 5.3 Low frequency noise review, worst case meteorology, night

Assessment location	Overall predicted $L_{eq,15 min}$ noise level		1/3 octave band centre frequency predicted noise level, dB[1,2,3]								
	dBA	dBC	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz
4#	38	61	58	58	***58***	49	49	***49***	39	39	39
5#	38	61	58	58	***58***	49	49	***49***	38	38	38
6#	38	60	57	57	***57***	48	48	48	38	38	38
7	37	60	57	57	***57***	48	48	48	38	38	38
8#	38	60	58	58	***58***	49	49	***49***	38	38	38
10#	40	62	59	59	***59***	50	50	***50***	40	40	40
12*	43	65	61	**62**	**62**	***53***	***53***	***53***	43	43	43
13*	42	63	61	61	**61**	***52***	***52***	***52***	41	41	41
14A, 14B#	38	61	59	59	***59***	49	49	***49***	39	39	39
15#	39	61	58	58	***58***	48	48	48	39	39	39
16#	40	60	57	57	***57***	49	49	***49***	39	39	39
draft ING reference curve (windows open)			69	61	54	50	50	48	48	46	44
Alternate reference curve (windows closed)			68	61	61	55	55	56	54	56	54

Notes: **Assessment location currently identified as to voluntary acquisition upon request due to predicted operational noise impacts in Table 5.1.*

#Assessment location identified as entitled to voluntary mitigation upon request due to predicted operational noise impacts in Table 5.1.

*1. **Italicised bold text** denotes exceedance of draft ING LFN reference curve by up to 5 dB.*

*2. **Bold text with grey highlight** denotes exceedance of draft ING LFN reference curve by more than 5 dB.*

*3. **Red bold text** denotes exceedance of alternate reference curve to account for closed windows (Ishac 2015).*

The predicted noise levels in Table 5.3 can be summarised as follows:

- Two assessment locations (12 and 13) exceed the draft ING reference curve by more than 5 dB (bold text and highlight grey). These assessment locations are identified as entitled to voluntary acquisition upon request (as per VLAMP) due to impacts identified in Section 5.1.
- Ten assessment locations (4 to 10 and 14 to 16) exceed the draft ING reference curve by up to 5 dB (bold text). These assessment locations are identified as entitled to voluntary mitigation upon request (as per VLAMP) due to impacts identified in Section 5.1, except for assessment location 7.

As explained in Section 3.1.7, the draft ING reference curve is based on an externally adjusted DEFRA curve which takes in account the facade noise reduction provided by a partially open window. Assessment locations currently entitled to voluntary mitigation upon request would be provided with dwelling treatments and an alternate means of ventilation as part of their mitigation package, allowing these residents to leave their windows closed when so desired.

It is therefore appropriate to apply an externally adjusted reference curve which considers the facade reduction provided when windows are closed. The reference curve adopted is based on extensive field measurements with windows closed and published in the technical paper *Low Frequency Noise and Environmental Assessment* (Ishac 2015) and is presented in Table 5.3. It can be seen from Table 5.3 that no assessment location identified as entitled to voluntary mitigation upon request exceeds this curve. The externally adjusted reference curve for closed windows presented in this paper is based on standard residential glazing. The mitigation package for entitled properties would also include increased single or double glazing which would increase the facade sound insulation above that afforded by the residence the subject of the technical paper. The application of this alternate curve is therefore considered conservative.

It can be concluded that potential increased impacts due to potential low frequency noise are contained to properties identified as those already entitled to voluntary acquisition or mitigation due to operational noise impact described in Section 5.1 and 5.2, and by virtue of these rights, would prevent any increased adverse impact on the internal amenity on these occupants from potential low frequency noise. The exception to this outcome is assessment location 7, which is currently predicted with a negligible (0 to 2 dB) residual noise level exceedance as described in Sections 5.1 and 5.2. A potential 2 dB penalty to the total site noise level would lead to a moderate (3 to 5 dB) residual noise level exceedance which would render this property into a noise mitigation zone. Otherwise all other assessment locations satisfy the draft ING low frequency noise assessment.

It would be unduly stringent to apply mitigation rights as a result of this assessment due to the limitations of applying the draft ING LFN criteria at the environmental assessment stage. Hume Coal is committed to quantifying low frequency noise levels during the mine operation through regular compliance noise monitoring. If potential low frequency noise impacts are identified by Hume Coal in accordance with the draft ING (or its final version), entitlements commensurate with the level of impacts would be offered.

5.5 Sleep disturbance assessment

Predicted L_{Amax} noise levels have been based on typical equipment positions as applicable to the modelled activities described in Section 4.2. Predictions were based on a single event, rather than the simultaneous operation of a number of plant items, because of the low probability of more than one maximum noise event occurring concurrently.

Predicted maximum noise levels for the night-time period during calm and adverse meteorological conditions are provided in Table 5.4. Predictions shown are limited to assessment locations with L_{Amax} noise levels over 30 dB. Noise levels at the remaining assessment locations are predicted to be below this threshold and are not presented in Table 5.4. Shaded cells indicate predicted levels above the INP screening criteria.

Table 5.4 Maximum noise from intermittent sources at assessment locations, dB

Assessment location ID	Modelled L_{Amax} night time noise level, dB		INP Application Notes screening criteria, L_{Amax}, dB
	Calm	Adverse	
3	<30	31	45
4	33	35	45
5	32	35	45
6	32	35	45
7	32	35	45
8	34	37	45
10	36	39	45
12	40	42	45
13	40	43	45
14A, 14B	40	43	45
15	43	**46**	45
16	**48**	**51**	45
17	**52**	**53**	50
18	40	43	50
19	39	42	45
20	35	37	46
21	34	37	46
22	31	33	46
23	<30	30	46
24	34	36	45
46	<30	31	45
48	<30	32	45
49	31	34	50
50	31	34	45
51	33	36	45
52	<30	32	50
53	31	34	50
54	<30	32	45
55	31	34	50
60	<30	30	45
61	31	34	45
62	30	32	45
63	35	38	45
66	<30	31	45
69	34	37	45
70	<30	31	46

Table 5.4 Maximum noise from intermittent sources at assessment locations, dB

Assessment location ID	Modelled L_{Amax} night time noise level, dB		INP Application Notes screening criteria, L_{Amax}, dB
	Calm	Adverse	
71	<30	32	45
73	<30	32	46
74	34	36	46

Notes: 1. Exceedance shown in bold text and grey highlighting.

In summary, noise modelling demonstrates that L_{Amax} external noise levels associated with the site would be below the INP Application Notes sleep disturbance screening criteria (ie background plus 15 dB) at all residential assessment locations for all assessable weather conditions, with the exception of:

- assessment location 15 where a 1 dB exceedance is predicted during adverse weather conditions;
- assessment location 16 where a 3 dB exceedance is predicted during calm conditions and a 6 dB exceedance is predicted during adverse weather conditions; and
- assessment location 17 where a 2 dB exceedance is predicted during calm conditions and a 3 dB exceedance is predicted during adverse weather conditions.

The predicted external maximum noise levels during calm and adverse weather conditions would equate to an internal noise level of 36 dB, 38 to 41 dB and 42 to 43 dB for assessment locations 15, 16 and 17, respectively, based on a partially open window providing 10 dB of sound reduction. Therefore, although the INP screening criteria has been exceeded, the calculated internal noise levels are well below those that are likely to cause awakening reactions (refer to Section 4.2).

Further, two assessment locations (15 and 16) are entitled to voluntary mitigation upon request due to the operational noise impacts identified in Section 5.2. The mitigation afforded to these assessment locations would provide an alternate means of ventilation and therefore allowing these occupants to leave windows closed when so desired, reducing internal maximum noise levels further to 26 dB and 28 to 31 dB, respectively.

The predicted exceedances in all instances relate to a train pass-by arrival event on the rail loop. A maximum of two trains are likely to be loaded in any night period. Therefore the predicted maximum noise level event discussed above would occur for up to two times during the night only. Therefore on the basis of information provided in Section 3.1.8 on typical sleep disturbance and human noise thresholds, sleep disturbance noise impacts from the project are considered unlikely.

5.6 Cumulative noise

The application of the INP and the derivation of amenity criteria for all assessment locations take into account existing industrial noise levels and therefore the potential for cumulative noise impacts from all industrial noise sources. Therefore, where PSNLs are satisfied, it can be inferred that cumulative impacts are highly unlikely as a result of the Hume Coal Project.

There is no existing industrial noise contribution at the assessment locations directly impacted by the Hume Coal Project (ie properties listed in Table 5.2). Therefore the potential for increased impacts due to cumulative noise levels is considered highly unlikely.

The Berrima Rail Project will include a rail maintenance facility located to the east of the Hume Highway. It is a separate project that should be assessed cumulatively in accordance with the INP amenity criteria, together with the Hume Coal Project and other industrial sites. However, the adopted approach conservatively combined 15-minute L_{Aeq} noise levels from this facility with predicted 15-minute L_{Aeq} noise from the Hume Coal Project. The assessment found that total noise levels due to the operation of both facilities when combined would not lead to increased noise impacts. That is, properties currently entitled to voluntary mitigation or acquisition would remain as those identified in this report (Table 5.2).

5.7 Construction noise

Predicted construction noise levels for the early works, and construction of portals and access, surface infrastructure area, overland conveyor, ventilation shaft and CPP are provided in Appendix D. Predictions have been provided for the individual construction scenarios in Appendix C, as well as the predicted total construction noise from each scenario occurring simultaneously. Such a situation is considered highly unlikely however are representative of absolute worst case construction noise levels.

Construction noise levels have been predicted for calm weather conditions during day, evening and night periods as relevant. The proposed 24 hour 7 day construction activity is limited and will not occur for prolonged periods to justify the assessment of noise under seasonal prevailing weather affects. Nonetheless, it's likely that short-term enhanced noise levels due to prevailing weather effects would be within the total predicted noise levels presented herein given the highly conservative nature of the construction noise assessment described above.

The level presented for each assessment location and for each construction scenario represents the energy-average noise level over a 15 minute period which is predicted above the NMLs. For example, a "0" indicates that the predicted construction noise level is at or below the NML, and a level of "1-2" indicates a predicted noise level of 1 dB to 2 dB above the NML. A summary for each main construction stage is provided below.

The proponent will manage construction noise levels where exceedances of NMLs have been identified. The construction noise management methods will be detailed in a construction noise management plan as discussed further in Section 6.2.

The ICNG recommends the following where NMLs are predicted to be exceeded:

- application of feasible and reasonable work practices to minimise noise;
- inform potentially impacted residents of the nature of the works to be carried out, expected noise levels and duration and relevant contact details; and
- negotiation with the community where noise from work outside standard hours is predicted to exceed the relevant NML by more than 5 dB.

5.7.1 Early works

Total construction noise levels are predicted to satisfy NMLs at 56 of the 74 assessment locations during the early works stage. Noise levels above relevant NMLs are predicted to the north to north-west of the surface infrastructure area (ie assessment locations 4 to 16), with the largest being 16 dB above the NML. Most predicted noise levels in other locations range from 1 dB to 3 dB above relevant NMLs. The highly affected NML of 75 dB is satisfied at any assessment location.

Construction noise levels for individual scenarios during the early works are predicted to be at their greatest during the construction of the CPP access road and temporary construction facility (TCF). This is mainly due to the proximity of the CPP access road to surrounding assessment locations to the north to north-west. During the other early works construction scenarios in the highest predicted noise levels are 5 dB above the relevant NML, and others generally range between 1 dB and 3 dB.

5.7.2 Portals and portals access

i Standard hours

Predicted total noise levels for construction of the portals and portals access satisfy NMLs for 56 of the 74 assessment locations. The highly affected NML of 75 dB is satisfied at any assessment location. The Hume Coal Project noise levels predicted at assessment locations to the south and south-east of the portals generally range between 3 dB and 8 dB above NMLs, with the largest being up to 15 dB above the relevant NML. Predicted noise levels of this magnitude will only occur when construction activity is at the surface. At surface construction will be limited for this phase as it will mostly occur underground.

Predicted construction noise levels for individual scenarios during construction of the portals and portals access are similar to each other, with noise levels up to 12 dB above NMLs but generally no more than 10 dB above NMLs. Noise levels above NMLs are expected to the south and south-east of the portal access and NMLs for assessment locations to the north are predicted to be satisfied.

ii Out of hours

Construction noise levels from proposed out of hours activity are predicted to satisfy the evening and night NML at all assessment locations. Maximum noise levels (ie L_{max}) from construction activity are unlikely to be more than 10 dB above the predicted energy-average construction noise level (ie L_{eq}) and therefore the minimum sleep disturbance screening criteria of 45 dB, L_{max} is also likely to be satisfied.

5.7.3 CPP

i Standard hours

Total noise levels for construction of the CPP stage are predicted to satisfy NMLs at 14 of the 74 assessment locations. The highly affected NML of 75 dB is satisfied at any assessment location. However, there are ten construction scenarios proposed for construction of the CPP, as opposed to generally two or three scenarios for construction of other components. This has elevated predicted total construction noise levels and represents an extreme total worst case scenario, which is highly unlikely to occur. For individual scenarios elevated noise levels are much more localised (ie they only occur for assessment locations in certain areas). The expected noise levels for individual construction scenarios are generally between 3 dB and 8 dB above NMLs, with the highest exceedances predicted to occur during the construction of mine water dam 1 (MWD01).

ii Out of hours

Construction noise levels from proposed out of hours activity are predicted to satisfy the evening and night NML at all assessment locations. Maximum noise levels (ie L_{max}) from construction activity are unlikely to be more than 10 dB above the predicted energy-average construction noise level (ie L_{eq}) and therefore the minimum sleep disturbance screening criteria of 45 dB, L_{max} is also likely to be satisfied.

5.7.4 Surface infrastructure area

i Standard hours

Total construction noise levels for the surface infrastructure area stage are predicted to satisfy NMLs at 50 of the 74 assessment locations. The highly affected NML of 75 dB is satisfied at any assessment location. Noise levels above NMLs are predicted to the north and south of the surface infrastructure area and are no more than 6 dB above the relevant NML for individual construction scenarios. The largest predicted noise level for total construction noise is up to 8 dB above the relevant NML and occurs to the north-east of the surface infrastructure area.

ii Out of hours

Construction noise levels for proposed out of hours activity are predicted to be up to 3 dB above the evening and night NML. These noise levels are generated by ventilation shaft construction and the use of a blind bore rig. Actual noise levels from this activity will be verified during the construction stage and noise mitigation in the form of localised noise barriers or similar will be adopted if noise levels above the NMLs are identified. A localised noise barrier could provide 5 to 10 dB of noise reduction and therefore with such mitigation in place this activity is predicted to satisfy the NML at all assessment locations.

Maximum noise levels (ie L_{max}) from general out of hour construction activities are unlikely to be more than 10 dB above the predicted energy-average construction noise level (ie L_{eq}). Therefore the minimum sleep disturbance screening criteria of 45 dB, L_{max} is also likely to be satisfied. Noise from the blind bore rig will generally be continuous in nature and therefore given the magnitude of predicted energy-average construction noise levels (ie L_{eq}), the maximum noise level (ie L_{max}) from this plant item is also likely to satisfy the minimum sleep disturbance screening criteria across all assessment locations as relevant.

5.7.5 Overland conveyor

Total construction noise levels for the overland conveyor stage are predicted to satisfy NMLs at 62 of the 74 assessment locations. The highly affected NML of 75 dB is satisfied at any assessment location. Noise levels above NMLs are predicted for total construction noise from the overland conveyor to the south of the surface infrastructure area and are generally 1 dB to 2 dB above the relevant NML, with the largest being 12 dB above the relevant NML.

Construction noise levels for individual scenarios are predicted to satisfy NMLs for almost all assessment locations. Predictions generally range from 1 dB to 5 dB above NMLs, with the largest being 9 dB above the relevant NML. These are limited to the south of the surface infrastructure area.

5.7.6 Ventilation shaft

i Standard hours

Total noise levels for construction of the ventilation shaft stage are predicted to satisfy NMLs at 59 of the 74 assessment locations. The highly affected NML of 75 dB is satisfied at any assessment location. Noise levels above NMLs from total construction noise are expected to the south-east and south-west of the surface infrastructure area and generally range between 2 dB and 4 dB, with the largest being up to 10 dB above the relevant NML.

Construction noise levels for individual scenarios are predicted to be the highest during the construction of the shaft site access track and shaft pad dam (MWD07), with noise levels above NMLs generally ranging from 1 dB to 5 dB for assessment locations to the south east and south west. The highest predicted noise levels are up to 8 dB above the NML. NMLs are satisfied for all assessment locations during the shaft pad and dam, shaft drilling and ventilation fan construction scenarios.

ii Out of hours

Construction noise levels from the proposed out of hours activity are predicted to be up to 3 dB above the evening and night NML. These noise levels are generated by ventilation shaft construction and the use of a blind bore rig. Actual noise levels from this activity will be verified during the construction stage and noise mitigation in the form of localised noise barriers or similar will be adopted if noise levels above the NMLs are identified. A localised noise barrier could provide 5 to 10 dB of noise reduction and therefore with such mitigation in place this activity is predicted to satisfy the NML at all assessment locations.

Maximum noise levels (ie L_{max}) from general out of hour construction activities are unlikely to be more than 10 dB above the predicted energy-average construction noise level (ie L_{eq}). Therefore the minimum sleep disturbance screening criteria of 45 dB, L_{max} is also likely to be satisfied. Noise from the blind bore rig will generally be continuous in nature and therefore given the magnitude of predicted energy-average construction noise levels (ie L_{eq}), the maximum noise level (ie L_{max}) from this plant item is also likely to satisfy the minimum sleep disturbance screening criteria across all assessment locations as relevant.

5.8 Vibration

5.8.1 Operations

RMS has raised the issue of potential structural vibration impact on the Hume Highway as underground mining passes below.

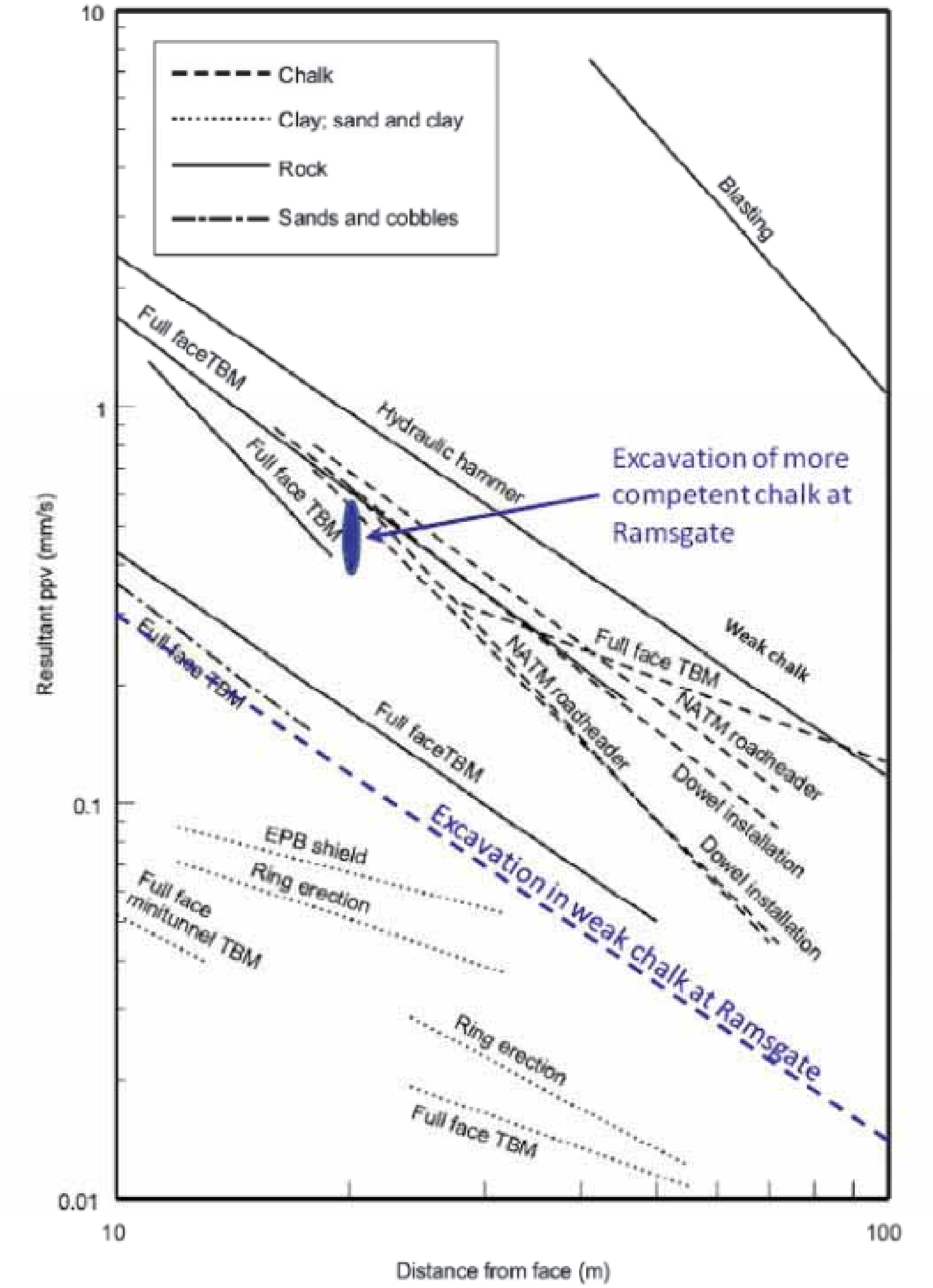
Typical ground vibration levels from various activities that are likely to produce similar levels of vibration to underground mining activities are presented in a technical paper *"The prediction and mitigation of vibration impacts of tunnelling*" (David Hiller, Arup, 2011). Figure 5.5 shows an excerpt from this technical paper which charts measured peak particle velocity (PPV) vibration levels for different activities in different ground types.

The technical paper *"Tunnelling induced ground-borne noise modelling"* (Colin Speakman and Stephen Lyons, Parsons Brinckerhoff 2009) also provides typical PPV vibration levels from a tunnel boring machine in an undefined ground type which is also representative of vibration levels that could potentially be generated from underground mining activity.

Figure 5.5 shows PPV vibration levels significantly less than 1 mm/s for all measured activities and ground types at a distance of 100m, with the exception of blasting which shows a PPV vibration level near to 1 mm/s at 100m. It is noted that blasting is not a representative activity in the vicinity of the Hume Highway.

Figure 5.6 shows PPV vibration levels significantly less than 0.1 mm/s for tunnel boring machine (TBM) operation at a distance of 100 m. This provides a reasonably close approximation of the type of vibration levels that could be expected from the type of mining equipment that will be used by the project.

Underground mining will occur at distances of approximately 110 m under the Hume Highway. Based on the structural vibration screening criteria of 7.5 mm/s (Section 3.6.2) and the charted vibration levels in Figure 5.5 and Figure 5.6 as discussed above, it is highly unlikely that vibration levels will cause structural vibration impacts on the Hume Highway.



Notes: TBM = Tunnel Boring Machine; EPB = Earth Pressure Balance shield; NATM = New Austrian Tunnelling Method.

Figure 5.5 Tunnelling vibration data classified according to geology (Hiller and Crabb, Arup, 2001, amended)

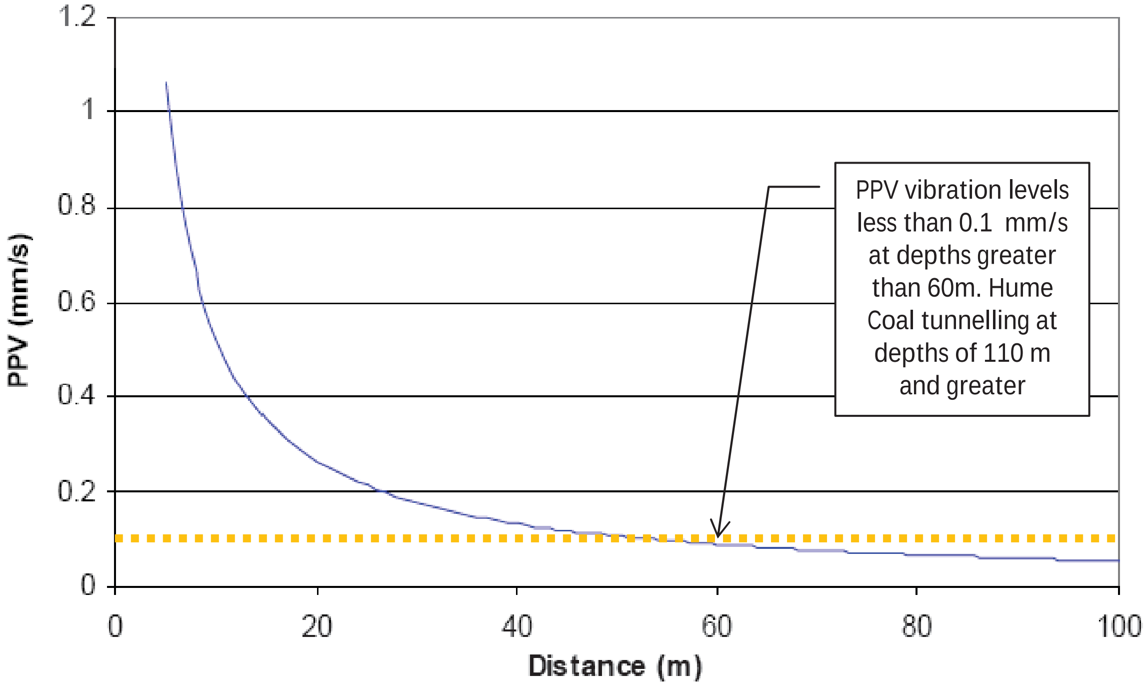


Figure 5.6 Typical TBM vibration propagation at dominant frequency (PB 2009)

5.8.2 Construction

i Ground-borne vibration (safe working distances)

As a guide, safe working distances for typical items of vibration intensive plant are listed in Table 5.5. The safe working distances are quoted for both "Cosmetic Damage" (refer to British Standard BS 7385) and "Human Comfort" (refer to British Standard BS 6472-1).

Table 5.5 Recommended safe working distances for vibration intensive plant

Plant Item	Rating/Description	Safe working distance	
		Cosmetic damage (BS 7385)	**Human response (BS 6472)**
Vibratory Roller	<50kN (Typically 1-2 tonnes)	5 m	15 to 20 m
	<100kN (Typically 2-4 tonnes)	6 m	20 m
	<200kN (Typically 4-6 tonnes)	12 m	40 m
	<300kN (Typically 7-13 tonnes)	15 m	100 m
	>300kN (Typically 13-18 tonnes)	20 m	100 m
	>300kN (>18 tonnes)	25 m	100 m
Small hydraulic hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium hydraulic hammer	(900 kg - 12 to 18t excavator)	7 m	23 m
Large hydraulic hammer	(1600 kg - 18 to 34t excavator)	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Source: From Transport Infrastructure Development Corporation Construction's Construction Noise Strategy (Rail Projects), November 2007.

The safe working distances presented in Table 5.5 are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

In relation to human comfort (response), the safe working distances in Table 5.5 relate to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed, as discussed in BS 6472-1.

ii Summary of potential vibration Impacts

Based on the safe working distances for typical plant items in Table 5.5 and the location of surrounding privately owned residential properties, it is unlikely that human response vibration criteria will be exceeded. For example, the nearest privately owned assessment location to any likely construction activity is approximately 300 m away (Location 56), which is greater than the maximum safe working distance of 100 m for an 18 tonne or greater vibratory roller. Because human response criteria are more stringent than cosmetic damage criteria, it is also highly likely that cosmetic damage criteria would be satisfied at privately owned residential properties.

Despite this, Hume Coal will monitor and manage construction noise and vibration, which will include preparing a construction noise and vibration management plan discussed further in Section 7.2.

iii Typical vibration levels for drift construction

Tunnelling under the Hume Highway will also occur during the construction phase. Nonetheless, tunnelling methods used will be similar to those adopted during operations and will occur at similar distances of greater than 110 m beneath the Hume Highway. Therefore, based on the information provided in Section 5.8.1, structural vibration impacts on the Hume Highway during construction are considered highly unlikely.

5.9 Blasting

Minor blast activity will be required for personnel material portal, drift portal and ventilation shaft construction. There is capacity in the blast design process to limit certain parameters to prevent excessive blast overpressure and vibration levels. One of the key parameters used to control blast overpressure and vibration is the maximum instantaneous change (MIC), quantified in kilograms (kg).

A quantitative blast assessment has been prepared which calculates the maximum allowable MIC (kg) based on the distance between blasting and assessment locations. Blast predictions are based on conservative empirical prediction formula provided in AS2187-2-2006 as referenced in Section 4.5. Results are presented in Table 5.6.

The results convey that a range of MICs can be adopted based on the location of blasting to the nearest assessment locations. For example, a maximum MIC of 180 kg for the personnel and materials portal construction is predicted to result in an overpressure level of ≤115 and a peak particle velocity vibration level of ≤5 mm/s at the nearest assessment location, satisfying ANZECC blast criteria (Section 3.7). This is well in excess of the maximum potential MIC that would be employed in any drift shotfiring that may be undertaken during drift construction. As blast overpressure and ground vibration typically decrease over distance, emissions at other assessment locations located further away would also satisfy ANZECC blast criteria.

In summary, with appropriate blast design and management there is minimal risk of exceeding ANZECC blast criteria during the construction phase.

Table 5.6 Construction blast overpressure and ground vibration results

Activity	Distance from nominal blast location to nearest assessment location	Highest allowable MIC to satisfy criteria	Resulting overpressure (dB(L)peak)	Resulting ground vibration PPV (mm/s)
Personnel and materials portal	600 m	180 kg	≤115	≤5
Drift portal	990 m	820 kg	≤115	≤5
Ventilation shaft	950 m	720 kg	≤115	≤5
ANZECC criteria			**115**	**5**

Notes: 1. Based on A22187-2.2006 empirical formula and assuming "average rock type".

5.10 Road traffic noise

Road traffic noise levels during construction and operation phases have been assessed initially by calculating the potential increase from project related traffic movements when added to existing traffic movements. This has been calculated using the following formula.

Noise level increase, dB = 10 x Log_{10} *(total movements/existing movements)*

Where total movements = project movements + existing movements

The RNP sets a noise level increase threshold of 2 dB, that is, if project related road traffic movements increase total road traffic noise levels by more than 2 dB, then mitigation for affected properties should be considered. A detailed calculation of total road traffic noise levels has been completed where a potential noise level increase of greater than 2 dB has been identified.

5.10.1 Operations

Table 5.7 presents existing and project related traffic movements during year 2020. The noise level increase due to the additional project related road traffic movements has been provided and compared to the RNP 2 dB increase threshold to determine if further detailed assessment is required. Note that there are no residences on or near Mereworth Road, the mine access route, and therefore calculations are not provided.

Table 5.7 Road traffic noise screening assessment - operations

Road	2020 existing movements[1]				2020 project movements				Noise level increase due to the Hume Coal Project, dB	
	Day		Night		Day		Night		Day	Night
	Total	%HV	Total	%HV	Total	%HV	Total	%HV		
Hume Highway at Penrose	21,165	18%[2]	3,735	18%[2]	15	7%	11	3%	0	0
Hume Highway south of Golden Vale Road	17,085	18%	3,015	18%	20	7%	14	3%	0	0
Hume Highway south of Mereworth Road	17,510	18%	3,090	18%	27	7%	19	3%	0	0

Table 5.7 Road traffic noise screening assessment - operations

Road	2020 existing movements[1]				2020 project movements				Noise level increase due to the Hume Coal Project, dB	
	Day		Night		Day		Night		Day	Night
	Total	%HV	Total	%HV	Total	%HV	Total	%HV		
Hume Highway north of Medway Road	18,870	17%	3,330	17%	43	7%	31	3%	0	0
Hume Highway at Mittagong Bypass	19,550	18%[2]	3,450	18%[2]	17	7%	13	3%	0	0
Old Hume Highway south of Medway Road	978	8%	173	8%	193	7%	139	3%	0	2
Old Hume Highway north of Medway Road	1,445	5%	255	5%	75	7%	55	3%	0	1
Medway Road west of Old Hume Highway	1,870	4%	330	4%	45	7%	33	3%	0	0
Medway Road west of Hume Highway	357	14%	63	14%	2	7%	2	3%	0	0
Golden Vale Road east of Hume Highway	714	3%	126	3%	7	7%	5	3%	0	0
Taylor Avenue east of Old Hume Highway	2,338	14%	413	14%	72	7%	52	3%	0	0
Taylor Avenue west of Berrima Road	2,253	9%	398	9%	64	7%	46	3%	0	0
Berrima Road south of Taylor Avenue	3,570	6%	630	6%	64	7%	46	3%	0	0
Berrima Road north of Douglas Road	3,825	10%	675	10%	64	7%	46	3%	0	0
Berrima Road south of Douglas Road	3,315	7%	585	7%	61	7%	45	3%	0	0
Douglas Road east of Berrima Road	629	29%	111	29%	2	7%	2	3%	0	0
Waite Street north of Argyle Street	6,248	4%	1,103	4%	44	7%	32	3%	0	0
Illawarra Highway at Sutton Forest	3,485	10%[2]	615	10%[2]	3	7%	3	3%	0	0
Argyle Street west of Waite Street	8,840	3%	1,560	3%	17	7%	13	3%	0	0
Argyle Street east of Waite Street	13,430	3%	2,370	3%	27	7%	19	3%	0	0
Argyle Street east of Lackey Road	16,405	3%	2,895	3%	27	7%	19	3%	0	0
Illawarra Highway east of Robertson	3,230	10%[2]	570	10%[2]	5	7%	3	3%	0	0

Notes: 1. Based on data provided in the Hume Coal Project Traffic Impact Assessment (EMM 2017) unless indicated otherwise.
2. Existing survey data not available. Estimate based on similar road type.

All roads that will be used to access the Hume Coal Project where adjacent assessment locations exist will experience zero to negligible (1-2 dB) noise level increases during operations. In summary, road traffic noise levels are predicted to satisfy RNP assessment requirements.

5.10.2 Construction

i Early stage construction

Table 5.8 presents existing and project related traffic movements during year 2020. The noise level increase due to the additional project related road traffic movements has been provided and compared to the RNP 2 dB increase threshold to determine if further detailed assessment is required.

Table 5.8 Road traffic noise screening assessment – early stage construction

Road	2020 existing movements				2020 project movements				Noise level increase due to the Hume Coal Project, dB	
	Day		Night		Day		Night		Day	Night
	Total	%HV	Total	%HV	Total	%HV	Total	%HV		
Hume Highway at Penrose	21,165	18%[2]	3,735	18%[2]	42	35%	20	8%	0	0
Hume Highway south of Golden Vale Road	17,085	18%	3,015	18%	43	35%	21	8%	0	0
Hume Highway south of Mereworth Road	17,510	18%	3,090	18%	46	35%	22	8%	0	0
Hume Highway north of Medway Road	18,870	17%	3,330	17%	63	35%	31	8%	0	0
Hume Highway at Mittagong Bypass	19,550	18%[2]	3,450	18%[2]	51	35%	25	8%	0	0
Old Hume Highway south of Medway Road	978	8%	173	8%	156	35%	76	8%	1	2
Old Hume Highway north of Medway Road	1,445	5%	255	5%	30	35%	14	8%	0	0
Medway Road west of Old Hume Highway	1,870	4%	330	4%	65	35%	31	8%	1	0
Medway Road west of Hume Highway	357	14%	63	14%	1	35%	1	8%	0	0
Golden Vale Road east of Hume Highway	714	3%	126	3%	3	35%	1	8%	0	0
Taylor Avenue east of Old Hume Highway	2,338	14%	413	14%	62	35%	30	8%	0	0
Taylor Avenue west of Berrima Road	2,253	9%	398	9%	59	35%	29	8%	0	0
Berrima Road south of Taylor Avenue	3,570	6%	630	6%	59	35%	29	8%	0	0
Berrima Road north of Douglas Road	3,825	10%	675	10%	59	35%	29	8%	0	0
Berrima Road south of Douglas Road	3,315	7%	585	7%	48	35%	24	8%	0	0

Table 5.8 Road traffic noise screening assessment – early stage construction

Road	2020 existing movements				2020 project movements				Noise level increase due to the Hume Coal Project, dB	
	Day		Night		Day		Night		Day	Night
	Total	%HV	Total	%HV	Total	%HV	Total	%HV		
Douglas Road east of Berrima Road	629	29%	111	29%	11	35%	5	8%	0	0
Waite Street north of Argyle Street	6,248	4%	1,103	4%	40	35%	20	8%	0	0
Illawarra Highway at Sutton Forest	3,485	10%[2]	615	10%[2]	3	35%	1	8%	0	0
Argyle Street west of Waite Street	8,840	3%	1,560	3%	9	35%	5	8%	0	0
Argyle Street east of Waite Street	13,430	3%	2,370	3%	31	35%	15	8%	0	0
Argyle Street east of Lackey Road	16,405	3%	2,895	3%	31	35%	15	8%	0	0
Illawarra Highway east of Robertson	3,230	10%[2]	570	10%[2]	16	35%	8	8%	0	0

Notes: 1. Based on data provided in the Hume Coal Project Traffic Impact Assessment (EMM 2017) unless indicated otherwise.
2. Existing survey data not available. Estimate based on similar road type.

All roads that will be used to access the Hume Coal Project where adjacent assessment locations exist will experience zero to negligible (1-2 dB) noise level increases during operations. In summary, road traffic noise levels are predicted to satisfy RNP assessment requirements.

ii Peak construction

In addition to the above, the peak construction period has also been assessed, as this period will introduce the greatest increase in road traffic volumes throughout the construction phase. Table 5.9 presents existing and project related traffic movements during year 2020. The noise level increase due to the additional project related road traffic movements has been provided and compared to the RNP 2 dB increase threshold to determine if further detailed assessment is required.

Table 5.9 Road traffic noise screening assessment – peak construction

Road	2020 existing movements				2020 project movements				Noise level increase due to the Hume Coal Project, dB	
	Day		Night		Day		Night		Day	Night
	Total	%HV	Total	%HV	Total	%HV	Total	%HV		
Hume Highway at Penrose	21,165	18%[2]	3,735	18%[2]	32	35%	4	8%	0	0
Hume Highway south of Golden Vale Road	17,085	18%	3,015	18%	36	35%	4	8%	0	0
Hume Highway south of Mereworth Road	17,510	18%	3,090	18%	43	35%	5	8%	0	0

Table 5.9 Road traffic noise screening assessment – peak construction

Road	2020 existing movements				2020 project movements				Noise level increase due to the Hume Coal Project, dB	
	Day		Night		Day		Night		Day	Night
	Total	%HV	Total	%HV	Total	%HV	Total	%HV		
Hume Highway north of Medway Road	18,870	17%	3,330	17%	72	35%	8	8%	0	0
Hume Highway at Mittagong Bypass	19,550	18%[2]	3,450	18%[2]	54	35%	6	8%	0	0
Old Hume Highway south of Medway Road	978	8%	173	8%	223	35%	25	8%	2	1
Old Hume Highway north of Medway Road	1,445	5%	255	5%	50	35%	6	8%	0	0
Medway Road west of Old Hume Highway	1,870	4%	330	4%	74	35%	8	8%	0	0
Medway Road west of Hume Highway	357	14%	63	14%	2	35%	0	8%	0	0
Golden Vale Road east of Hume Highway	714	3%	126	3%	7	35%	1	8%	0	0
Taylor Avenue east of Old Hume Highway	2,338	14%	413	14%	99	35%	11	8%	0	0
Taylor Avenue west of Berrima Road	2,253	9%	398	9%	92	35%	10	8%	1	0
Berrima Road south of Taylor Avenue	3,570	6%	630	6%	92	35%	10	8%	0	0
Berrima Road north of Douglas Road	3,825	10%	675	10%	92	35%	10	8%	0	0
Berrima Road south of Douglas Road	3,315	7%	585	7%	68	35%	8	8%	0	0
Douglas Road east of Berrima Road	629	29%	111	29%	23	35%	3	8%	0	0
Waite Street north of Argyle Street	6,248	4%	1,103	4%	56	35%	6	8%	0	0
Illawarra Highway at Sutton Forest	3,485	10%[2]	615	10%[2]	4	35%	0	8%	0	0
Argyle Street west of Waite Street	8,840	3%	1,560	3%	14	35%	2	8%	0	0
Argyle Street east of Waite Street	13,430	3%	2,370	3%	41	35%	5	8%	0	0
Argyle Street east of Lackey Road	16,405	3%	2,895	3%	41	35%	5	8%	0	0
Illawarra Highway east of Robertson	3,230	10%[2]	570	10%[2]	25	35%	3	8%	0	0

Notes: 1. Based on existing traffic volume data provided in the Hume Coal Project Traffic Impact Assessment (EMM 2017) unless indicated otherwise.

2. Existing survey data not available. Estimate based on similar road type.

All roads that will be used to access the Hume Coal Project where adjacent assessment locations exist will experience zero to negligible (1-2 dB) noise level increases during operations. In summary, road traffic noise levels are predicted to satisfy RNP assessment requirements.

6 Monitoring and management

6.1 Operational noise

6.1.1 Feasible and reasonable measures

The INP states the following with respect to feasible and reasonable noise management measures:

> Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgment in arriving at a decision, taking into account the following factors:
>
> - noise mitigation benefits (amount of noise reduction provided, number of people protected);
> - cost of mitigation (cost of mitigation versus benefit provided);
> - community views (aesthetic impacts and community wishes);and
> - noise levels for affected land uses (existing and future levels, and changes in noise levels).

The site has committed to leading noise mitigation and management measures including:

- overall site design to reduce the height of acoustically significant plant and equipment wherever practicable;
- highly considered placement of the surface infrastructure in coordination with other environmental constraints and flood levels as to maximise distance to surrounding residential properties;
- automated coal handling using stackers and reclaimers to minimise the reliance on mobile plant and equipment (eg dozers);
- machined steel idlers on all conveyors;
- enclosures on conveyor drives, crushing plant, tertiary screens, paste plant and CPP;
- low frequency noise mitigation to the CPP, including variable voltage variable frequency (VVVF) drives, concrete platforms for screens, increased steelwork to stiffen the structure and bespoke cladding system;
- ventilation fan attenuation;
- dozer operation during the day time only;
- limited workshop activities during the evening and night periods;
- procurement of latest generation low noise emission AC locomotives with electronically controlled pneumatic brakes; and
- constructing a rail noise barrier to the north of the rail loop to attenuate noise levels from loading and rail loop activity.

The noise model assumed worst case plant and equipment locations and therefore represents the worst case noise 'envelope' from the project area over the mine life.

6.1.2 Noise management plan

A noise management plan (NMP) will detail activities to manage noise emissions from operations. The NMP will:

- identify noise affected properties consistent with the environmental assessment and any subsequent assessments;
- outline mitigation measures to achieve the noise limits established;
- outline measures to reduce the impact of intermittent, low frequency and tonal noise (including truck reversing alarms using broadband quackers and ambient noise level adjusting alarms or in-cabin alarms);
- specify measures to document any higher level of impacts or patterns of temperature inversions, and detail actions to quantify and ameliorate enhanced impacts if they occur;
- specify protocols for routine attended and real-time unattended noise monitoring of the Project, including provision for regular low frequency noise monitoring;
- outline the procedure to notify property owners and occupiers that could be affected by noise from the mine;
- establish a protocol to handle noise complaints that includes recording, reporting and acting on complaints; and
- specify procedures for undertaking independent noise investigations.

6.2 Construction

A construction environmental management plan (CEMP) that will address noise and vibration management and mitigation options (where required) will be completed prior to construction.

The main objective of the CEMP would be to manage construction activities to meet ICNG NMLs and applicable vibration criteria across the project as far as practicable.

6.2.1 Noise

The CEMP will describe how construction noise levels will be managed where predicted noise levels above the NMLs have been identified, most notably during out of hours periods if relevant. This would include:

- Measure construction noise levels at early stages to validate the predicted construction noise levels.

- Re-evaluate the predicted construction noise levels at assessment locations, and where required review noise management and mitigation measures to reduce levels below the NMLs. This may include (but is not limited to):
  - limiting construction within a certain distance of assessment locations during the evening and night time period;
  - selecting quieter equipment or reduced equipment fleet; or
  - measuring construction noise levels at assessment locations, especially during the evening and night-time period, if relevant, and implementing real-time noise management and mitigation measures where an exceedance of NMLs is identified.

Affected landholders should be consulted prior to and during construction where an exceedance of NMLs has been predicted, and should be notified of proposed mitigation measures that will be used to manage construction noise levels to below ICNG NMLs where practicable.

6.2.2 Vibration

A construction vibration management plan will be prepared which will include as a minimum:

- identification of nearby residences and sensitive land uses;
- a description of approved hours of work and what work will be undertaken;
- a description of what work practices will be applied to minimise vibration;
- a description of the complaints handling process; and
- a description of monitoring that is required.

If the safe working distances in Section 5.5 are encroached vibration monitoring will be carried out at nearby structures. If required, the monitoring system will be fitted with an auditory and visual alarm that triggers when vibration levels reach the nominated criteria. This would indicate if and when alternate work practices should be adopted (such as decrease vibratory intensity, alternate equipment selection, etc).

Supplementary vibration monitoring will be carried out in response to any complaints, exceedance or for the purpose of refining construction techniques in order to minimise vibration emissions (if required). Monitoring will be attended under these circumstances, in order to provide immediate feedback to the operators.

7 Conclusion

EMM has completed a noise and vibration impact assessment for the construction and operations phase of the Hume Coal Project in accordance with contemporary policies and guidelines as required by the SEARs for the Hume Coal Project.

Based on government policy, the operational noise assessment identified that during calm and adverse weather conditions and with all feasible and reasonable mitigation measures applied:

- one assessment location within the area modelled is predicted to experience negligible residual noise levels between 1 to 2 dB above PSNLs;
- eight assessment locations (nine dwellings) within the area modelled are predicted to experience residual noise levels between 3 to 5 dB above PSNLs and therefore entitled to voluntary mitigation upon request; and
- two assessment location within the area modelled are predicted to experience residual noise levels greater than 5 dB above PSNLs and therefore entitled to voluntary acquisition upon request.

Alternatively, Hume Coal may enter into amenity agreements with landholders identified as entitled to mitigation or acquisition.

No privately owned land parcels are predicted to exceed the 25% area voluntary land acquisition criteria as defined in the VLAMP.

The potential for low frequency noise impacts has been reviewed using the method provided in the NSW draft ING (EPA 2015). The draft ING LFN assessment procedure is best applied in the operational stage where direct measurement of energy at the frequency bands of interest can be complete.

The low frequency noise assessment found that increased impacts due to potential low frequency noise are generally contained to properties already entitled to voluntary acquisition or mitigation, and by virtue of these rights, would prevent any increased adverse impact on the internal amenity on these occupants from potential low frequency noise. The exception to this outcome is assessment location 7, which would be rendered into a noise mitigation zone due to a potential 2 dB penalty to total noise level. It would be unduly stringent to apply mitigation rights as a result of this assessment due to the limitations of applying the draft ING LFN criteria at the environmental assessment stage. Hume Coal is committed to quantifying low frequency noise levels during the mine operation through regular compliance noise monitoring. If potential low frequency noise impacts are identified by Hume Coal in accordance with the draft ING or its final version, entitlement commensurate with the level of impacts would be offered as per the VLAMP.

The sleep disturbance assessment identified three assessment locations (15, 16 and 17) where maximum noise levels are predicted to be above the INP screening criteria. These maximum noise events are related to a train pass-by arrival event on the rail loop, which generates internal maximum noise levels of 36 dB, 38 to 41 dB and 42 to 43 dB, respectively when these properties have their windows open for natural ventilation. Two of these assessment locations (15 and 16) are entitled to voluntary mitigation upon request due to operational noise impacts identified in Section 5.1. The mitigation afforded to these assessment locations would provide an alternate means of ventilation allowing these occupants to leave windows closed when so desired, reducing internal maximum noise levels further to 26 dB and 28 to 31 dB, respectively. Calculated internal noise levels for both windows open and closed scenarios are well below those that are likely to cause awakening reactions (refer Section 4.2).

The application of the INP and the derivation of amenity criteria for all assessment locations take into account existing industrial noise levels and therefore the potential for cumulative noise impacts from all industrial noise sources. Therefore, where PSNLs are satisfied, it can be inferred that cumulative impacts are highly unlikely as a result of the Hume Coal Project. There is no existing industrial noise contribution at assessment locations directly impacted by the Hume Coal Project (ie properties listed in Table 5.2). Therefore the potential for increased impacts due to cumulative noise levels is considered highly unlikely. The Berrima Rail Project will include a rail maintenance facility located to the east of the Hume Highway. Noise levels from this facility have been assessed with noise from the Hume Coal Project. The assessment found that total noise levels due to the operation of both facilities when combined would not lead to increased noise impacts. That is, properties currently entitled to voluntary mitigation or acquisition would remain as those identified in this report (Table 5.2).

Construction noise levels from the Hume Coal Project during standard ICNG construction hours are predicted to be above the noise affected NML (or noise measurement level) at several assessment locations during construction. The ICNG highly affected of NML 75 dB is predicted to be satisfied at all times. This outcome is not uncommon for construction projects, and it is important to note that the Noise Management Level (NML) is not a criterion (as are operational noise limits). It is simply a trigger for when construction noise management is to be considered and implemented. The proponent will manage construction noise levels where noise levels above NMLs have been identified. The construction noise management methods will be detailed in a construction noise management plan.

Construction noise levels from proposed out of hours activity are predicted to satisfy the evening and night NML at all assessment locations with feasible and reasonable noise mitigation and management in place.

Maximum noise levels (ie L_{max}) from general construction activity during out of hour periods are likely to satisfy criteria. The proponent will monitor construction noise levels during out of hour periods during initial construction and will implement noise management and mitigation measures. Based on the safe working distances for typical construction plant items and the location of surrounding privately owned residential properties, it is unlikely that human response vibration criteria will be exceeded. Because human response criteria are more stringent than cosmetic damage criteria, it is also highly likely that cosmetic damage criteria would be satisfied at privately owned residential properties. Notwithstanding, construction vibration will be managed by the proponent, which will include the preparation of a construction vibration management plan.

The assessment of potential vibration impacts on the Hume Highway requested by the RMS has been conducted. Underground mine construction will occur at distances of approximately 110 m under the Hume Highway. Based on the structural vibration screening criteria of 7.5 mm/s and the identified vibration levels from similar construction activities, it is highly unlikely that vibration levels would cause structural vibration impacts to the Hume Highway.

Minor blast activity will be required for personnel and material portal, drift portal and ventilation shaft construction. There is capacity in the blast design process to limit certain parameters to prevent excessive blast overpressure and vibration levels. Assessment results confirm that a range of measures can be adopted to satisfy ANZECC blast criteria. In summary, with appropriate blast design and management there is minimal risk of exceeding ANZECC blast criteria during the construction phase.

Road traffic noise has been assessed for all public roads potentially used for the operation and construction phases of the Hume Coal Project. All roads that will be used to access the Hume Coal Project where adjacent assessment locations exist will experience zero to negligible (1-2 dB) noise level increases which satisfies RNP (EPA 2013) requirements.

References

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