Central Queensland Coal Project

Appendix 8 – Noise and Vibration Technical Report

Environmental Impact Statement

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CDM Smith Australia Pty Ltd

Styx Coal EIS - Air and Noise

Noise Impact Assessment

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EXECUTIVE SUMMARY

Potential noise and vibration impacts from the construction and operation of the Project were assessed against applicable criteria based on the Department of Environment and Heritage Protection's Model Mining Conditions and Queensland *Environmental Protection (Noise) Policy 2008*.

Future potential noise levels at the nearest noise sensitive and commercial receptors were predicted using the SoundPlan noise model for the construction and operational scenarios. For the operational scenario mining activities in year 12 of the mining schedule was modelled as it has the greatest potential for noise impacts.

Noise levels for construction and operation are predicted to exceed the noise criteria at the nearest receptors and noise mitigation would be required. Noise mitigation using quieter equipment and management measures has been investigated.

For construction, noise levels are predicted to comply with the criteria with noise mitigation in the form of replacing CAT793D trucks with quieter CAT793 XQ trucks.

For operation, noise mitigation in the form of replacing CAT793D trucks with quieter CAT793 XQ trucks would result in compliance with the noise criteria at most receptors for both average and worst case climatic conditions. However, noise level exceedances are predicted at Brussels during the day, evening, and night, at Tooloombah Creek Service Station during the evening, and at Strathmuir during the night.

Further noise mitigation measures of limiting Train Loadout Facility operational hours (to day and evening only) and using enclosed overland conveyors is predicted to result in noise level compliance at Tooloombah Creek Service Station and Strathmuir; however, not at Brussels.

It is recommended that a noise management plan include consultation and engagement with potentially affected receptors to achieve alternative arrangements, in particular with the receptor at Brussels.

Potential ground vibration and airblast overpressure levels were predicted based on AS2187.2-2006. Blasting impacts are expected to comply with blasting criteria with appropriate stemming.

TABLE OF CONTENTS

1 INTRODUCTION

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by CDM Smith Australia Pty Ltd (CDM Smith) to prepare a Noise Impact assessment for the Styx Coal Project. The purpose of this assessment is to evaluate the potential impacts of noise generated from the construction and operational stages of the Project and to provide recommendations to mitigate any potential impacts that might have an effect on nearby sensitive receptors.

2 PROJECT DESCRIPTION

Styx Coal Proprietary Limited (Styx Coal) and Fairway Coal Proprietary Limited (Fairway Coal) (the joint Proponent), propose to develop the Styx Coal Project (the Project) located 130 km northwest of Rockhampton in the Styx Basin in Central Queensland. The Project will be located within Mining Lease Application (MLA) 80187, MLA 700022 and Exploration Permit for Coal (EPC) 1029. This location is shown in Figure 2-1.

The Project is generally within the Livingstone Shire Regional Council area and is located on gently undulating plains and slopes.

2.1 PROPOSED OPERATIONS

The Project comprises three open cut pit operations that will be mined using a truck and shovel method. The Run-of-Mine (ROM) coal will ramp up to approximately 2 Mtpa during Stage 1 (Year 1 – 4), where coal will be crushed and screened. Stage 2 of the Project (Year 4-20) will include further processing of up to an additional 4 Mtpa ROM coal with another coal handling and preparation plant (CHPP). The two CHPP will be located in two Mine Industrial Areas (MIAs). During Stage 2 of operation, production could potentially increase to 10 Mtpa. Overland conveyors will transport material between the two CHPP's.

A new train loadout facility (TLF) will be developed to connect into the existing North Coast Rail Line. This connection will allow the product coal to be transported to the established coal loading infrastructure at the Dalrymple Bay Coal Terminal (DBCT). The nearest major regional centre is Rockhampton, located approximately 130 km to the southeast of the Project.

The proposed coal mine layout and associated infrastructure is shown in Appendix B. The key components of the Project include:

- Three open cut mine pits;
- Two CHPPs;
- Two MIAs;
- Haulage and site access; and
- Rail facilities and TLF.

Strips or blocks will be mined in succession, allowing waste from one strip or block to be dumped into a previously mined out area. Waste from an initial strip or box cut will be dumped into a predetermined out of pit dump. Stripped topsoil and box cut spoil will be stockpiled for later use in mine rehabilitation.

Figure 2-1: Styx Coal Project Location [CDM Smith, July 2017]

Three open cut pits will be developed – two on the northern side of the Bruce Highway (Open Cut 2 and 4) one on the southern side of the Bruce Highway (Open Cut 1). After topsoil has been removed from a strip, the overburden waste material, where necessary, will be drilled and blasted and subsequently removed by a combination of truck/shovel, truck/excavator or dozer push methods in order to expose the top coal seam. Dozer ripping will be considered if the waste thickness is too thin for blasting.

The coal will be mined using front end loaders or small hydraulic excavators or surface miners and placed into rear dump trucks or B Double side tippers for haulage. The haul trucks will transport the coal along the strip or terrace, up a coal ramp out of the pit, then along a haul road to a ROM stockpile area located adjacent to the MIA. The coal will be dumped onto a stockpile or, if certain coal quality requirements are met, may be dumped directly into the ROM hopper where it will be crushed and conveyed to the CHPP feed stockpile ready for processing.

2.2 TOPOGRAPHY

Elevations within the MLA area vary between 4.5 m and 155 m AHD, with the disturbance area located between 11.4 and 43.8 m AHD. Further inland the terrain increases to 584 m west of the MLA.

2.3 SENSITIVE RECEPTORS

The locations of the nearest confirmed noise sensitive and commercial receptors to the Project were provided by CDM Smith on 30 May 2017. In total, 8 sensitive receptors are located within the locality of the proposed Project and are shown in Figure 2-2. Note that the entire township of Ogmore has been counted as one noise sensitive receptor.

It is anticipated that the Project personnel will be accommodated locally; however, if this is not practicable a Mine Camp Site will be constructed outside the Mining Lease. The Mine Camp Site will be owned by the proponent to accommodate the Project workforce and visitors. Under the Model Mining Conditions a camp associated with the Project is not considered a sensitive receptor and has not been assessed in this report.

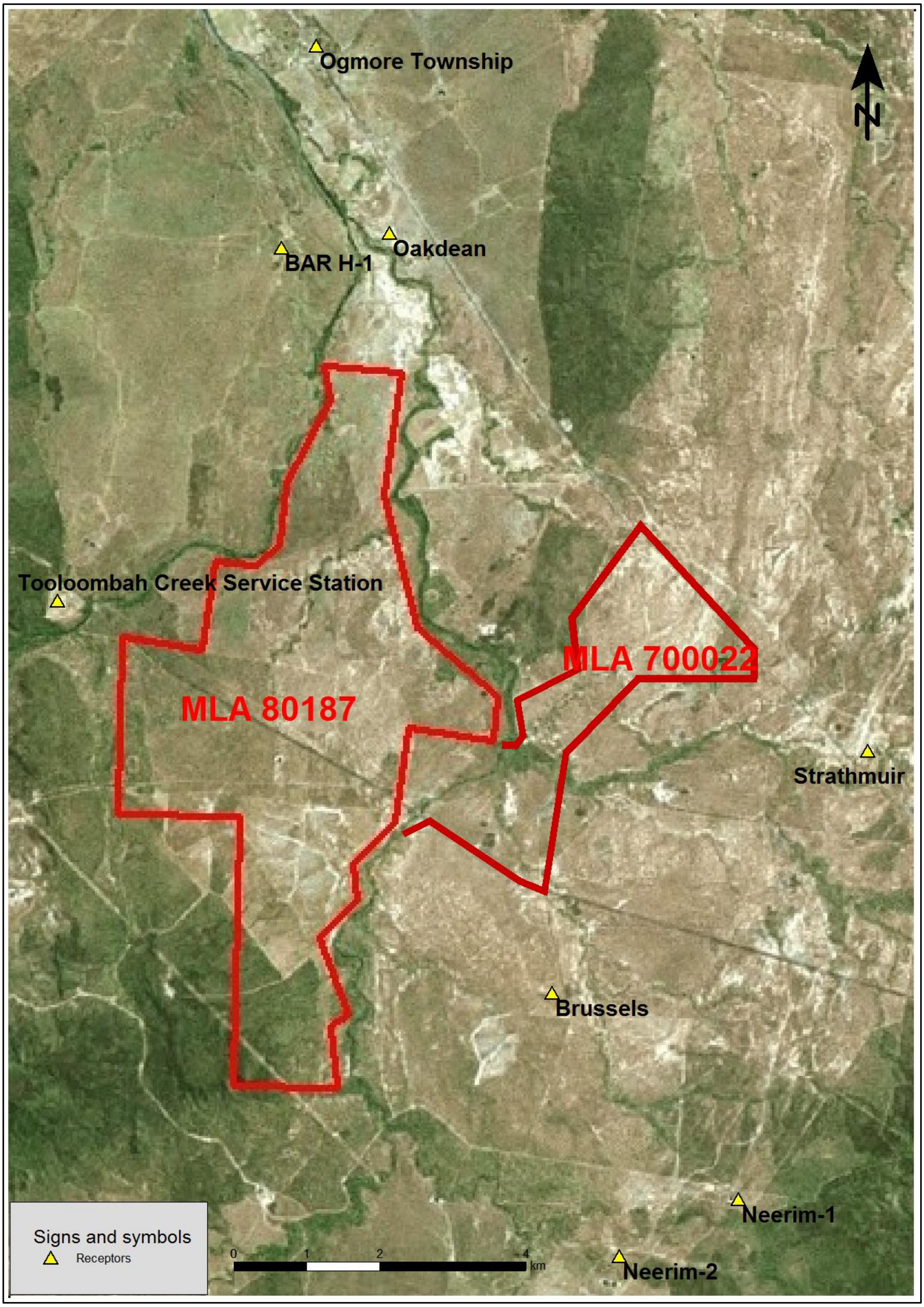


Figure 2-2: Receptor Locations Surrounding the MLA

3 REGULATORY FRAMEWORK

This section outlines the regulatory requirements the Project consisting of the Department of Environment and Heritage Protection's Model Mining Conditions, and Queensland *Environmental Protection (Noise) Policy 2008*.

3.1 MODEL MINING CONDITIONS

The Queensland *Environmental Protection Act 1994* (EP Act) provides for the granting of environmental authorities for resource activities – mining activities. In giving approval under the EP Act, the administering authority must address the regulatory requirements set out in the Environmental Protection Regulation 2008 and the standard criteria contained in the EP Act.

In December 2014, the '*Guideline Mining - Model Mining Conditions (MMC)'* were published by the Department of Environment and Heritage Protection. The purpose of this Guideline is to provide a set of model conditions to form general environmental protection commitments for the mining activities and the environmental authority conditions pursuant to the EP Act. A revised version (version 6.01) was published in May 2016 that accounts for the Environmental Offsets Act 2014 and repeal of the Wild Rivers Act 2000.

The Guideline states that the '*model conditions should be applied to all new mining project applications lodged after the guideline is approved'*, therefore this Project is subject to the noise criteria outlined in the guidelines. Noise and blasting criteria have been discussed below.

3.1.1 NOISE

The methodology to derive the Project specific noise criteria is presented in Table 3-1.

Table 3-1: Noise Limits as Proposed by Model Mining Conditions [DEHP, 2016]

The holder of this environmental authority must ensure that noise generated by the mining activities does not exceed the criteria in Table D1 – *Noise Limits* of the EHP MMC at a sensitive place or commercial place.

Sensitive Place						
Noise level dB(A) measured as:	Monday to Saturday			Sundays and Public Holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
$L_{Aeq,Adj,15min}$	CV = 50 AV = 5	CV = 45 AV = 5	CV = 40 AV = 0	CV = 45 AV = 5	CV = 40 AV = 5	CV = 35 AV = 0
$L_{A1,Adj,15min}$	CV = 55 AV = 10	CV = 50 AV = 10	CV = 45 AV = 5	CV = 50 AV = 10	CV = 45 AV = 10	CV = 40 AV = 5
Commercial Place						
Noise level dB(A) measured as:	Monday to Saturday			Sundays and Public Holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	7am to 6pm	6pm to 10pm	10pm to 7am
$L_{Aeq,Adj,15min}$	CV = 55 AV = 10	CV = 50 AV = 10	CV = 45 AV = 5	CV = 50 AV = 10	CV = 45 AV = 10	CV = 40 AV = 5

CV = Critical Value, AV = Adjustment Value

To calculate noise limits in Table D1:

- If background ≤ (CV – AV), then the noise limit = background + AV
- If (CV – AV) < background ≤ CV, then the noise limit = CV
- If background > CV, then the noise limit = background + 0
- In the event that measured background $L_{A90,adj,15min}$ is less than 30 dB(A), then 30 dB(A) can be substituted for the measured background level.
- If the project is unable to meet the noise limits as calculated above alternative limits may be calculated using the processes outlined in the "Planning for Noise Control" guideline.

3.1.2 BLASTING NOISE AND VIBRATION

Airblast overpressure and ground vibration limits for blasting are presented in Table 3-2.

Table 3-2: Blasting Noise and Ground Vibration Limits as Proposed by Model Mining Conditions [DEHP, 2016]

The holder of this environmental authority must ensure that blasting does not cause the limits for peak particle velocity and air blast overpressure in Table D2 – Blasting noise limits to be exceeded at a sensitive place or commercial place.

Blasting noise limits	Sensitive or Commercial Place Limits	
	7am to 6pm	6pm to 7am
Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time	<insert either no blasting or limits justified by proponent not less stringent than 7am – 6pm>
Ground vibration peak particle velocity	5mm/second peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/second peak particle velocity at any time	<insert either no blasting or limits justified by proponent not less stringent than 7am – 6pm>

3.1.3 LOW FREQUENCY NOISE

The Model Mining Conditions contains measurement and reporting requirements for low frequency noise complaints, these requirements are based on the Ecoaccess Draft *Assessment of Low Frequency Noise Guideline* (Department of Environment, Resources and Management, 2004).

This assessment will assess the likelihood of low frequency noise complaints in accordance with the initial screening criteria as per the Ecoaccess Guideline:

> *'Where a noise occurs exhibiting an unbalanced frequency spectra, the overall sound pressure level inside residences should not exceed 50 dB(Linear) to avoid complaints of low frequency noise annoyance. If the dB(Linear) measurement exceeds the dB(A) measurement by more than 15 dB, a one-third octave band measurement in the frequency range 10 to 200 Hz should be carried out'.*

A traditional Queenslander may only provide noise attenuation in the order of 7 dB (*EIS Guidelines for Noise and Vibration* (Department of Environment and Heritage Protection, No Date)) (assumed to be with windows open or partially open). Taking into account the rural Queensland location of the Project, the adjusted external criteria of 57 dB(Lin) has been adopted for this assessment.

3.2 ENHEALTH COUNCIL 2004

The enHealth document *'The Health Effects of Environmental Noise – Other Than Hearing Loss'* (Australian Government Department of Health and Ageing, 2004), presents a review of the health effects, other than hearing loss. The document also reviews both national and international measures directed at management of environmental noise, and provides recommendations on this aspect. For short-term or transient noise events, the maximum instantaneous indoor sound pressure level should not exceed approximately 45 dB(A) L_{Amax} more than 10 or 15 times per night over an 8 hour period.

3.3 ENVIRONMENTAL PROTECTION (NOISE) POLICY 2008

The Queensland *Environmental Protection (Noise) Policy 2008* does not include mining related construction noise limits (other than those which apply to blasting). In the absence of noise limits for construction in Queensland, the *Environmental protection (Noise) Policy 2008* as shown in Table 3-3 has been applied for the construction phase. The values in brackets are the external values using a transmission loss of 7 dB for a standard Queenslander home based on construction materials. This methodology is consistent with the EIS Guidelines - Noise and Vibration (EHP 2014), which recommends 7 dB for Queensland buildings (assumed to be with windows open or partially open). For commercial building, a minimum of 15 dB transmission loss has been assumed.

It is noted that due to the temporary nature of the construction phase of the Project, any potential noise impacts will also be temporary.

Table 3-3: EPP (Noise) Acoustic Quality Objectives for Dwellings

Sensitive Receptor	Time of Day	Acoustic Quality Objectives at Receptor, dB(A)			Environmental Value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,hr}$	$L_{A1,adj,1hr}$	
Dwelling (outdoors)	Daytime & evening	50	55	65	Health & Wellbeing
Dwelling (indoors)	Daytime & evening	35 (42)	40 (47)	45 (52)	Health & Wellbeing
	Night-time	30 (37)	35 (42)	40 (47)	Sleeping
Commercial and retail activity	When the activity is open for business	45 (60)	-	-	-

The time periods referred to in the Environmental Protection (Noise) Policy 2008 are defined as: Day: 7 am to 6 pm, Evening: 6 pm to 10 pm, Night: 10 pm to 7 am. Brackets = external values of 7 dB transmission loss in a typical Queenslander home, and 15dB for a commercial/retail building.

3.4 DERIVING PROJECT SPECIFIC NOISE CRITERIA

Based on the measured background noise levels (Section 5.2.2), the applicable noise limits according to the Model Mining Conditions are presented in Table 3-4. Note that the most conservative limits are shown in Table 3-4 and these have been used in this assessment.

Table 3-4: Site Specific Noise Criteria as per Model Mining Conditions Methodology [EHP, 2014]

Sensitive Receptor						
Noise level dB(A) measured as:	Monday to Saturday			Sundays and Public Holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
$L_{Aeq,Adj,15\ min}$	37	37	30	37	37	30
$L_{A1,Adj,15\ min}$	42	42	35	42	42	35
Commercial Place						
Noise level dB(A) measured as:	Monday to Saturday			Sundays and Public Holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
$L_{Aeq,Adj,15\ min}$	42	42	35	42	42	35

The operation of the Project will be 24 hours per day; therefore, the Project will be subject to the daytime, evening and night time criteria presented in Table 3-4.

For low frequency noise, Ecoaccess Draft *Assessment of Low Frequency Noise Guideline* has been adopted as discussed in Section 3.1.3.

For construction noise, EPP(Noise) Acoustic Quality Objectives have been adopted, as shown in Table 3-3.

4 NOISE ASSESSMENT METHODOLOGY

This section outlines the methodologies for the fieldwork, noise monitoring data analysis and noise prediction used for this assessment.

4.1 FIELDWORK

Noise monitoring was carried out by Noise Measurement Services in 2011 as part of a baseline assessment for this Project (report number 1821_R4, 11 July 2011). Noise monitoring was carried out in accordance with Australian Standard AS1055.1-1997 'Acoustics-Description and measurement of environmental noise; Part 1: General procedures' and the results as presented in the Noise Measurement Service report has been referred to for this assessment.

4.2 NOISE PREDICTION METHODOLOGY

4.2.1 MODELLING SOFTWARE

Noise level predictions have been assessed using the SoundPLAN noise modelling software using the CONCAWE (Manning, 1981) noise prediction methodology. The CONCAWE method was originally developed for predicting the long-distance propagation of noise from petrochemical complexes in the United Kingdom. It is especially suited to predicting noise propagation over large distances as it accounts for a range of atmospheric conditions that can significantly influence the propagation of noise over large distances, as required by the '*EIS Information Guideline – Noise and Vibration*' (Department of Environment and Heritage Protection, No Date).

The prediction of noise in the environment requires the definition of the noise sources and sensitive receptors. A number of environmental parameters affect noise propagation, including:

- Geometric spreading;
- Obstacles such as enclosures, barriers, and buildings;
- Meteorological conditions such as air absorption, wind effects, temperature gradient effects; and
- Ground effects.

The SoundPLAN software and calculation methodology allows the environmental parameters identified above to be modelled.

4.2.2 METEOROLOGICAL CONDITIONS

Noise propagation over long distances can be significantly affected by the weather conditions, mainly source-to-receiver winds and temperature inversions, as both these conditions can increase noise levels at sensitive receptors.

The CONCAWE methodology can predict to one of six meteorological categories (CAT). To determine which category is modelled, the Pasquill Stability Classes need to be determined for the Project. For this assessment the weather conditions, including stability class frequencies at the proposed Project have been obtained from The Air Pollution Model (TAPM). TAPM is a three-dimensional prognostic model developed and verified by Commonwealth Scientific and Industrial Research Organisation (CSIRO). TAPM data was generated for the air quality assessment has been used for uniformity. The wind parameters were compared for the Bureau of Meteorology (BOM) and TAPM data and were found to be very similar.

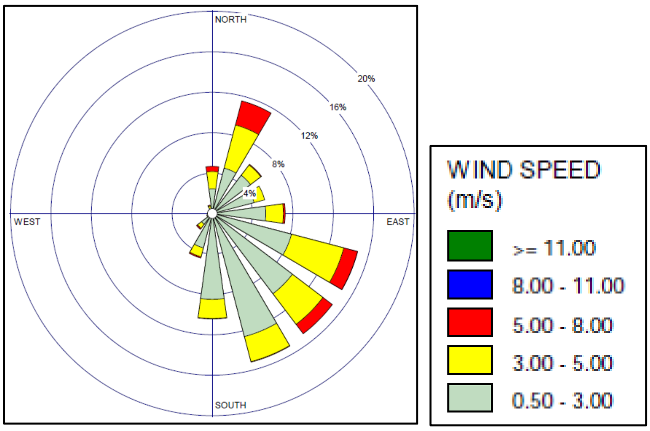
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance the motion of noise. The Pasquill-Gifford Stability Classes define the amount of turbulence in the air, of which the most widely used categories are Classes A-F. The TAPM generated meteorology determined the stability class for each hour of the year. The frequency of each stability class occurrence is shown in Table 4-1. Temperature inversions are defined as Class F. These conditions only occur with clear and calm conditions during the evening and night time periods. During temperature inversions noise emissions from distant sources can be amplified. During the night time period (22:00-07:00 hours), Class F occurs 34.3% of the hours.

Table 4-1: Annual Stability Class Distribution Predicted [TAPM, 2014]

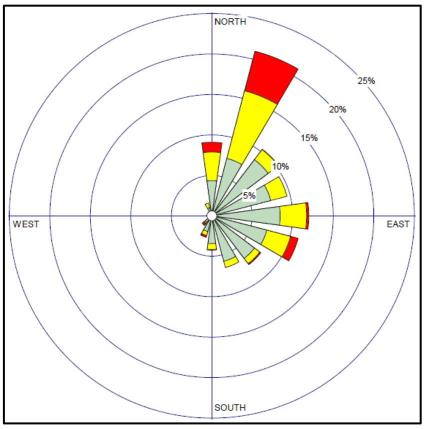
Stability Class	Description	Frequency of Occurrence (%) and Average Wind Speed (m/s)					
		Daytime Period		Evening Period		Night Time Period	
		Freq.	Wind Speed	Freq.	Wind Speed	Freq.	Wind Speed
A	Very unstable low wind, clear skies, hot daytime conditions	1.3%	2.1	-	-	-	-
B	Unstable clear skies, daytime conditions	10.8%	3.0	-	-	-	-
C	Moderately unstable moderate wind, slightly overcast conditions	36.1%	3.4	43.9%	4.2	-	-
D	Neutral high winds or cloudy days and nights	51.8%	3.0	20.1%	2.7	33.5%	1.4
E	Stable moderate wind, slightly overcast night-time conditions	-	-	34.7%	2.4	32.2%	2.0
F	Very stable low winds, clear skies, cold night-time conditions	-	-	-	-	34.3%	2.1

The wind roses are presented in Figure 4-1 and Figure 4-2 for the Project site. Figure 4-1 shows that the dominant wind direction is from NNE during spring, NNE and SE during the summer months. In autumn, the winds are primarily from the south easterly directions. Southerly and SSE winds are more frequent during the winter season.

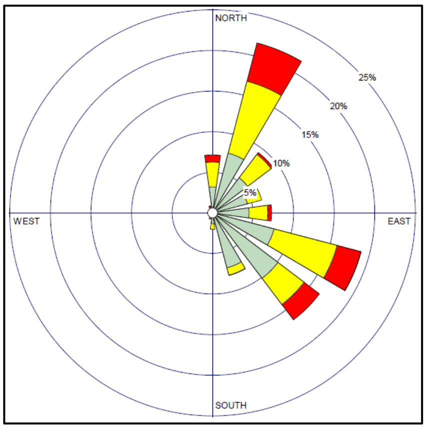
A comparison of the wind roses at 09:00 and 15:00 hours was undertaken with the BOM long-term wind roses at St Lawrence. The 09:00 hours wind roses from BOM and TAPM are very similar with slight differences in the percentage of time the wind blows from the SW; the BOM wind rose, based on 18,029 observations, identifies easterly winds accounting for 7% of the time whereas TAPM identifies the south westerlies accounting for 3% of the hours. The 15:00 hours wind roses are similar; the BOM wind rose shows a lower frequency of easterly winds (12%) to TAPM (21%). These slight differences in wind are influenced by the topography surrounding both the BOM monitoring station and the Project site. Overall, the meteorological data generated by TAPM is considered to be representative of the site.



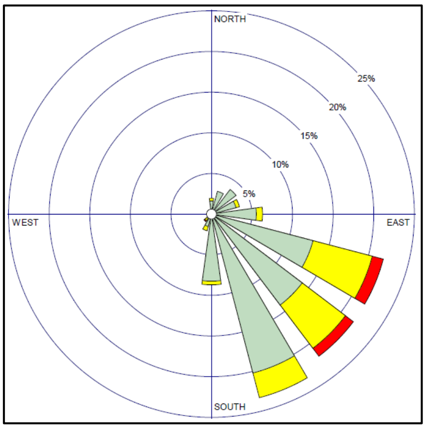
Annual (Calm – 0.97%)



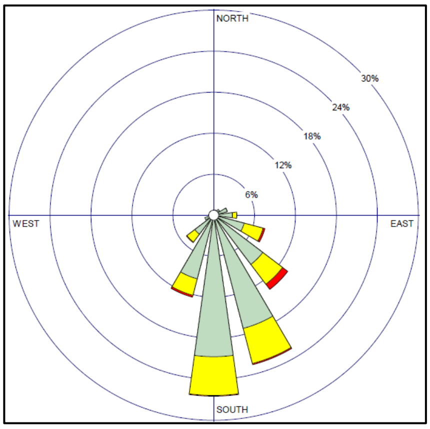
Spring (Calm – 1.10%)



Summer (Calm – 0.51%)

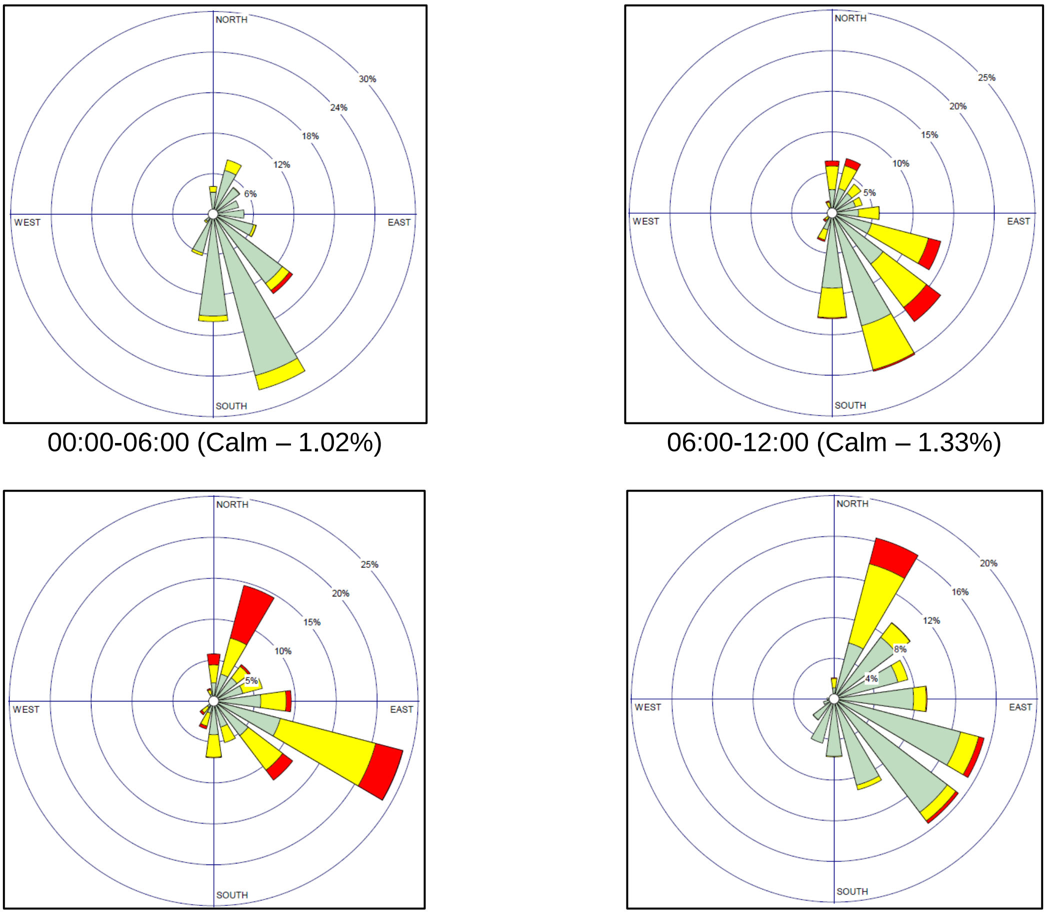


Autumn (Calm – 1.00%)



Winter (Calm – 1.27%)

Figure 4-1: Site-Specific Wind Roses by Season for 2014



00:00-06:00 (Calm – 1.02%)

06:00-12:00 (Calm – 1.33%)

12:00-18:00 (Calm – 1.14%)

18:00-00:00 (Calm – 0.31%)

Figure 4-2: Site-Specific Wind Roses by Time of Day for 2014

4.2.3 MODELLED WEATHER SCENARIOS

The EIS Information Guideline for Noise & Vibration requires the prediction of noise for '*different times of under both average and worst-case climatic conditions'*.

After reviewing the site specific wind speeds, wind direction and stability classes, it has been determined that the sensitive receptors will be generally upwind of mining noise sources. This has been applied for the assessment under average climatic conditions. For the worst case assessment; source to receptor winds have been applied.

Stability classes A, B, and C are associated with an unstable atmosphere and are generally unfavourable for noise propagation. Condition D is a neutral condition for noise propagation while conditions E and F are unfavourable as stable conditions further facilitate noise propagation.

Taking into consideration the time of day the Project will be operating the following weather scenarios have been assessed:

Average Climatic Conditions:

- Class D (neutral) conditions occur for more than 50%, 20%, and 33% of the time during the day, evening and night. Class D has been modelled for the average climatic condition scenarios for day, evening, and night, with south-easterly winds at speeds as applicable for the time of day. It should be noted that under average conditions, noise levels at receptors located north-west of the mine and TLF are likely to experience higher noise levels as sound is carried by south-easterly winds. This would consequently results in lower noise levels at receptors located south-east of the mine and TLF.

Worst Case Climatic Conditions:

- Class E and F (stable) conditions are worst case climatic conditions that occur in the Project area in the evening and night periods respectively. Class E has been assessed for the worst case evening noise, while Class F has been used to assess worst case night time noise levels. Class D is applicable for the day time. Worst case source to receptor winds have been assessed, with wind speeds as applicable for the time of day.

5 EXISTING ENVIRONMENT

This section describes the existing environment in terms of the environmental values of the surrounding area, existing noise sources, which may be of concern and the noise monitoring details.

5.1 EXISTING SOURCES OF NOISE

The noise environment in the vicinity of the Project can be characterised as 'very rural', with only mild sources of activity noise, mostly local activity at dwellings and plant and machinery used for agriculture and livestock. The Bruce Highway cuts through the proposed MLA area and the North Coast Rail Line is located approximately 1.5 km from the northern boundary of the proposed MLA area. These are likely to have an influence on the acoustic environment; however, traffic is intermittent on both road and rail. Environmental noise (wildlife, flora, wind) is the predominant noise (CDM Smith, 2016).

5.2 NOISE MONITORING

Noise monitoring was undertaken by Noise Measurement Services in March 2011. It is likely that the noise data includes contribution from seasonal sources such as insects. However, it could not be determined whether noise measurement data was processed to remove seasonal noises in accordance with EHP guidelines.

Measurement results for this assessment have been supplemented by estimated average background noise levels from Australian Standard AS1055.2 for a noise area category R1 which is expected to be representative of a rural area with negligible transportation noise.

5.2.1 MEASUREMENT PARAMETERS AND WEATHER CONDITIONS

Type 2 environmental noise loggers were used to record L_{01}, L_{10}, L_{90} and L_{eq} levels in 15 minute intervals. Noise logging equipment was calibrated before and after measurements. Noise monitoring was conducted at the following four locations:

- ML1 - Lease office 'Mamelon';
- ML2 - Strathmuir property;
- ML3 - Neerim property; and
- ML4 - Gravel track adjacent to energy easement (approximately 2km west of ML1).

A weather station was set up at ML1. Weather conditions during monitoring included periods of rain and wind. Intervals that included rainfall events or an average wind speed above 5.5 m/s were removed from the datasets.

5.2.2 SUMMARY OF NOISE LEVELS

Summary of noise measurement results from the Noise Measurement Services report have been reproduced in Table 5-1 to Table 5-4 for the four monitoring locations.

Table 5-1 Noise Levels Measured at ML1 Mamelon

Description	L1 dB(A)	L10 dB(A)	L90 dB(A)	Leq dB(A)
Day	53.5	40.5	34.3	40.3
Evening	56.3	48.9	44.7*	49.2
Night	53.4	46.3	39.5	45.3

* May be affected by seasonal insect or fauna noise.

Table 5-2 Noise Levels Measured at ML2 Strathmuir

Description	L1 dB(A)	L10 dB(A)	L90 dB(A)	Leq dB(A)
Day	69.6	45.6	35.5	49.8
Evening	53.1	43.5	37.8	46.1
Night	71.3	44.1	38.2	50.9

Table 5-3 Noise Levels Measured at ML3 Neerim Property

Description	L1 dB(A)	L10 dB(A)	L90 dB(A)	Leq dB(A)
Day	56.7	42.2	32.7	41.3
Evening	57.8	47.8	38.1	45.6
Night	50.3	42.2	32.6	39.5

Table 5-4 Noise Levels Measured at ML4 Gravel Road (2km West of ML1)

Description	L1 dB(A)	L10 dB(A)	L90 dB(A)	Leq dB(A)
Day	52.1	39.6	31.7	39.7
Evening	50.4	40.5	32.4	38.1
Night	49.8	40.0	28.1	37.4

Estimated background levels for difference areas containing residences are provided in Australian Standard AS1055.2-1997 'Acoustics-Description and measurement of environmental noise; Part 2: Application to specific situations'. For a noise area category R1, average $L_{A90,T}$ for day, evening and night are 40 dB(A), 35 dB(A), and 30 dB(A) respectively.

In comparison to AS1055.2 estimated levels, measured noise levels at all measurement locations were lower during the day. Measured noise levels at all locations were higher at evening and night, with the exception of ML4.

6 NOISE MODELLING DETAILS

This section details the noise sources used in the prediction of the noise levels at the sensitive receptors, including the proposed equipment, location of the equipment and the associated sound power levels (SWL).

6.1 Scenarios Modelled

Noise modelling has been conducted for the construction phase and year 12 of the operational phase when mining activities are expected to be the highest.

During the construction phase, the Project will use standard construction equipment, general trade equipment and specialised equipment as required. Construction equipment will, where practicable, be serviced and maintained at the site workshop.

For operation, the proposed mining method involves large truck and excavator mining with truck haulage direct to the crusher dump hopper or the ROM pad adjacent to each of the CHPPs. From the CHPP's coal will be hauled to the TLF.

6.2 EQUIPMENT

CDM Smith provided the equipment list schedules for the life of the Project for the mobile plant for construction and operation. The equipment schedules for construction and operation are presented in Table 6-1 and Table 6-2 respectively.

Table 6-1: Equipment Schedule for Construction

Equipment	Quantity
Generator (1MW)	1
CAT 631G Scrapper	2
785D Haul Truck	4
789D Haul Truck	4
793D Haul Truck	5
RH170 Excavator	1
Liebherr 996 Excavator	1
EX1200 Excavator	1
960 Front End Loader	1
980 Front End Loader	1
992 Front End Loader	1
Volvo Semi-Tippers	8
UDR800 Drill	1
D9 Dozer	1
D11 Dozer	1
D10 Dozer	1
HD605 Water Cart	1
16 Grader	1
Service Truck	1
Pump Truck	1
Fuel Truck	1
Franner Crane	1

Table 6-2: Mining Equipment Schedule for Operation

Equipment	Quantity			
Specification	**Operation Year 4**	**Operation Year 8**	**Operation Year 12**	**Operation Year 14**
CAT 631G Scrapper	1	1	1	1
789D Haul Truck	4	4	8	4
793D Haul Truck	8	12	36	4
RH170 Excavator	1	1	2	1
Leibherr 996 Excavator	2	3	9	1
SKS 270mm Drill	1	2	4	1
MD5150C Track Drill	1	2	3	1
D9 Dozer	1	4	4	1
D10 Dozer	2	3	5	2
D11 Dozer	2	3	4	2
HD605 Water Cart	2	3	4	2
16M Grader	2	2	2	2
24H Grader	1	2	2	1
B-Double Coal Haulage Units	2	3	8	2
992 Front End Loader	3	4	6	3
Service Truck	1	2	2	1
Pump Truck	1	2	2	1
Fuel Truck	1	1	3	1
Franner Crane	1	1	2	1
Service vehicles	10	14	19	10
Generator (520kVA)	3	6	6	3
Generator (300kVA)	3	5	5	3

Based on the above equipment schedule, noise modelling has been conducted for year 12 of mining when mining activities are expected to be the highest.

6.3 SOUND POWER LEVELS

Equipment noise data used for this assessment are shown in Table 6-3 and Table 6-4. The following sources have been referred to in establishing associated sound power levels (SWL) noise sources:

- Vipac's database, which includes noise measurements of plant measured at other mine sites; and
- Noise data from previous similar projects.

L_{A01} noise levels were estimated to be 5dB above the L_{Aeq} levels shown below, based on similar assessments.

Table 6-3: Modelled Sound Power Levels for Construction

Plant	Frequency (dB(A))										SWL dB(A)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	16 kHz	L_{eq}
Generator (1MW)					108						108
CAT 631G Scrapper		77	92	102	103	104	102	96	88	85	109
785D Haul Truck	74	86	97	111	114	106	101	94	86		116
789D Haul Truck	74	86	97	111	114	106	101	94	86		116
793D Haul Truck	81	93	104	118	121	113	108	101	93		123
RH170 Excavator		86	95	103	111	112	113	107	100		118
Liebherr 996 Excavator		91	95	98	104	106	103	93	81		110
EX1200 Excavator		93	97	100	106	108	105	95	83		112
960, 980, 992 Front End Loader		81	101	95	106	107	107	101	94		112
Volvo Semi-Tippers	64	81	96	102	107	108	104	98	92		112
UDR800 Drill		80	89	97	100	105	107	109	107		114
D9, D10, D11 Dozer	72	88	97	96	105	104	103	98	90		110
HD605 Water Cart	67	84	99	105	110	111	107	101	95		115
16 Grader	64	78	94	100	106	110	106	103	98		113
Franner Crane	79	87	94	103	115	118	119	119	114		125

Table 6-4: Modelled Sound Power Levels for Operation

Plant	Frequency (dB(A))										SWL dB(A)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	16 kHz	L_{eq}
CAT 613G Scraper		77	92	102	103	104	102	96	88	85	109
CAT 793D Haul Truck	81	93	104	118	121	113	108	101	93		123
CAT789D Haul Truck	74	86	97	111	114	106	101	94	86		116
RH170 Excavator		86	95	103	111	112	113	107	100		118
Liebherr 996 Excavator		91	95	98	104	106	103	93	81		110
SKS 270mm Drill		80	89	97	100	105	107	109	107		114
MD5150C Track Drill		80	89	97	100	105	107	109	107		114
D9, D10, D11 Dozer	72	88	97	96	105	104	103	98	90		110
HD605 Water Cart	67	84	99	105	110	111	107	101	95		115
16M Grader	64	78	94	100	106	110	106	103	98		113
24H Grader	67	81	96	103	108	113	109	105	101		116
B-Double Coal Haulage Units	64	81	96	102	107	108	104	98	92		112
992 FEL		81	101	95	106	107	107	101	94		112
Service, Pump, Fuel Truck					85						85
Franner Crane	79	87	94	103	115	118	119	119	114		125
Service Vehicles					88						88
Generator 520kVA					108						109
Generator 300kVA					108						108
Conveyors (per meter)		65	69	76	73	76	76	81	81		86
Conveyor Drives		73	81	87	96	103	96	92	84		105
CHPP - total	89	94	98	105	112	114	112	109	98	79	119
Truck Unloading and Primary Crusher	61	79	91	98	107	111	114	113	103	88	118
Secondary Crusher	53	74	91	98	104	104	100	89	80	62	108
CAT 793D XQ Haul Truck	72	84	95	109	112	104	99	92	84		114

6.4 LOCATION OF SOURCES

The noise sources have been modelled to reflect the mining schedule as shown in Appendix C for year 12 of mining. The locations of sources are presented in Figure 6-1 for construction. Locations of sources for operation are shown in Figure 6-2 and Figure 6-3 for mine pits/MIA and the TLF respectively.

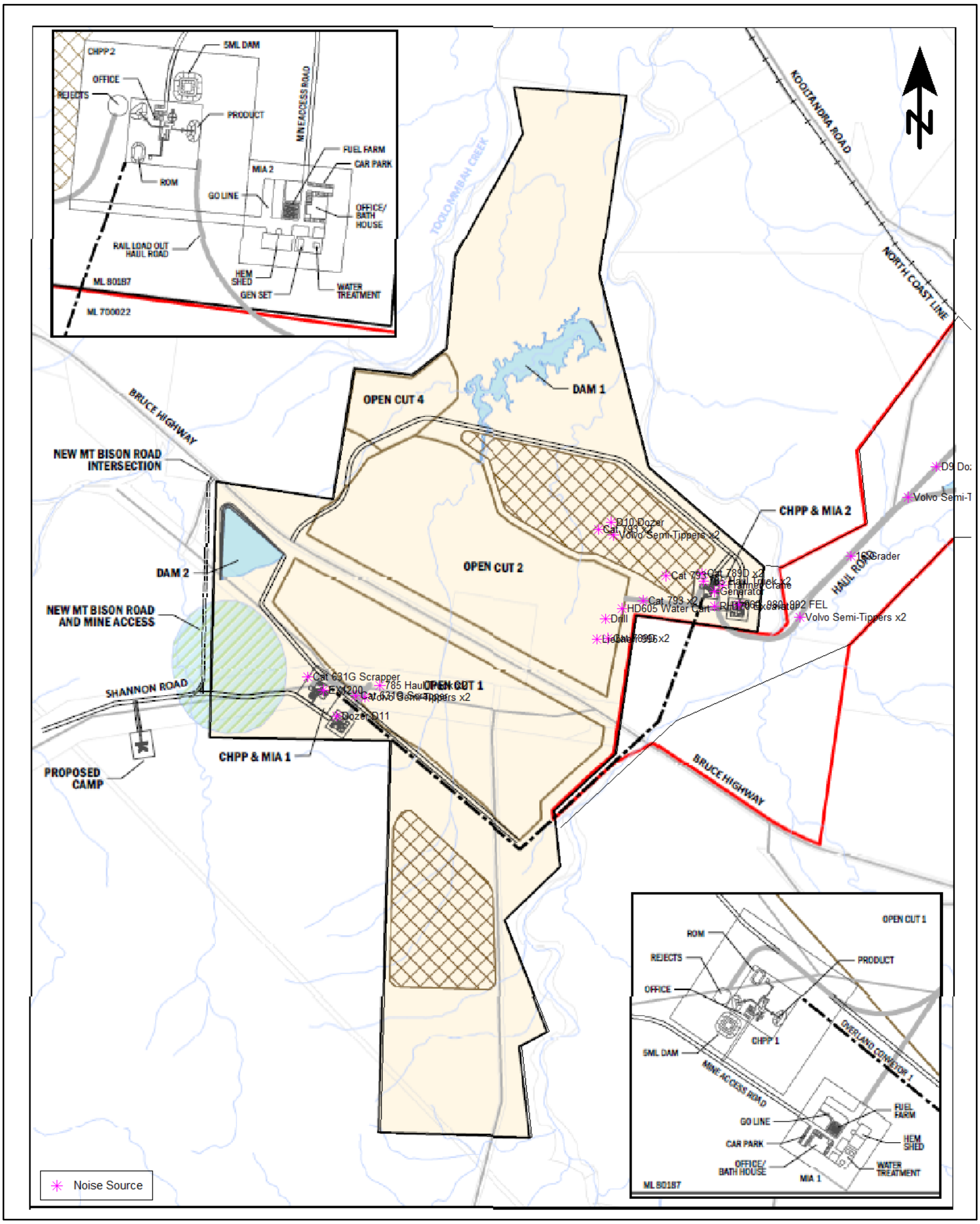


Figure 6-1: Location of Noise Sources as Modelled for Construction

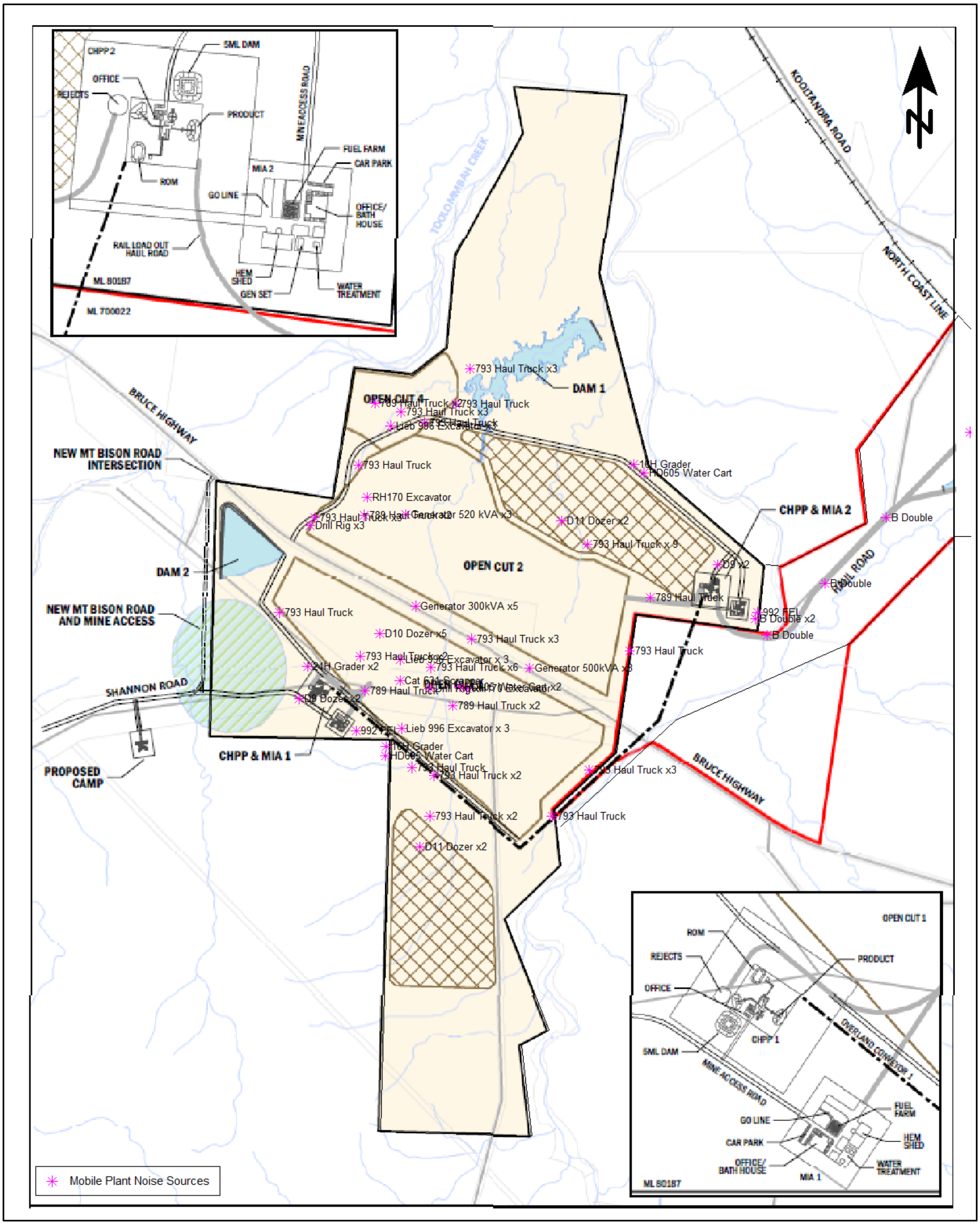


Figure 6-2: Location of Noise Sources at Pits and MIA's as Modelled for Year 12 of Mining

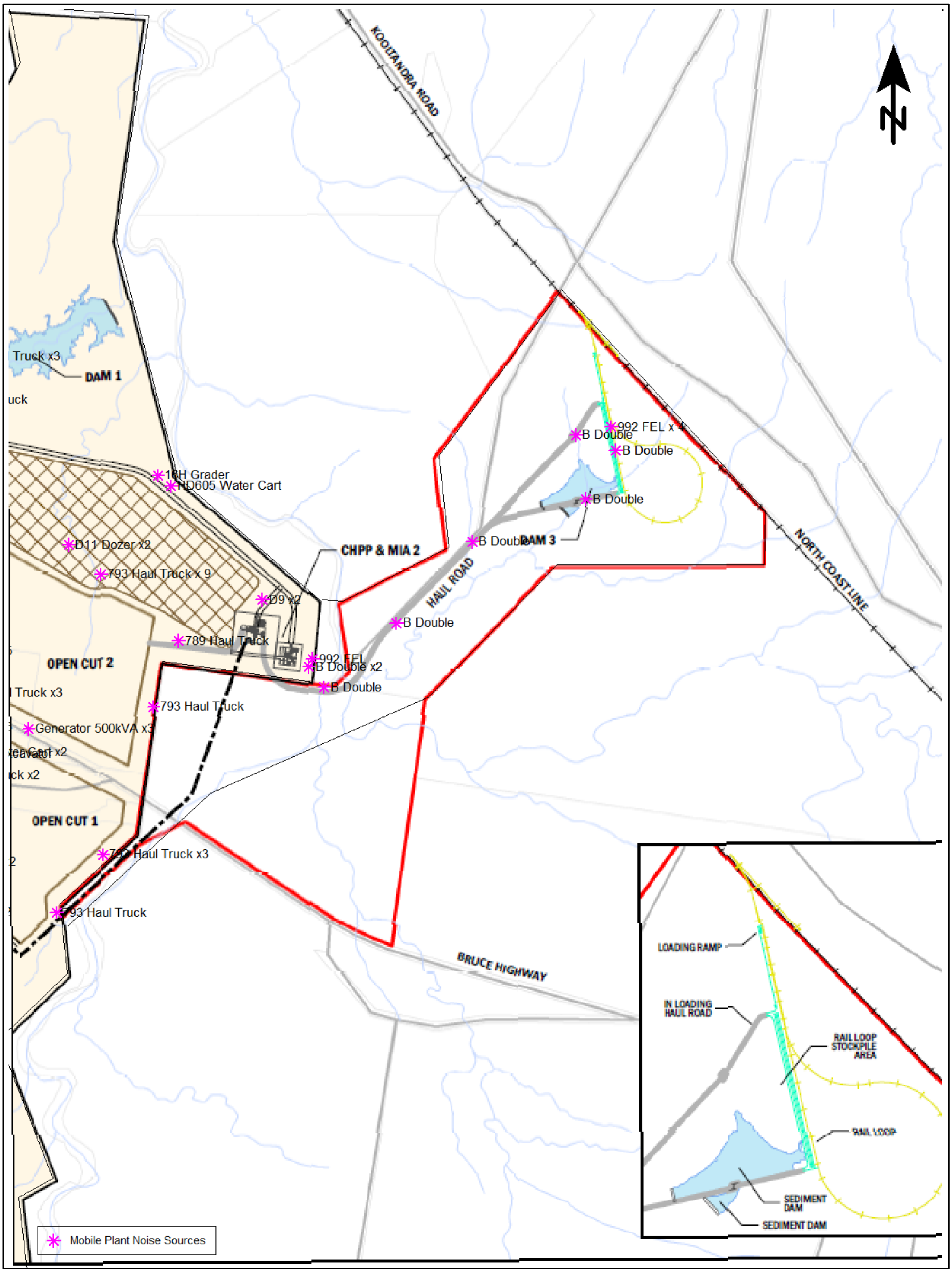


Figure 6-3 Location of Noise Sources at TLF as Modelled for Year 12 of Mining

7 NOISE IMPACT ASSESSMENT

This section details the results of the noise modelling and the impacts at nearby sensitive receptors. For both construction and operation, the following scenarios have been modelled:

Average Climatic Conditions

- Day: Stability Class D 3m/s south-easterly wind, 20 degrees Celsius (that is, wind blowing away from receptors southeast of the mine);
- Evening: Stability Class D 2.7m/s south-easterly wind, 20 degrees Celsius; and
- Night: Stability Class D 1.4m/s south-easterly wind, 20 degrees Celsius.

Worst Climatic Conditions

- Day: Stability Class D 3m/s source to receiver wind, 10 degrees Celsius;
- Evening: Stability Class E 2.4m/s source to receiver wind, 10 degrees Celsius; and
- Night: Stability Class F 2.1m/s source to receiver wind, 10 degrees Celsius.

Note that night time noise levels at Tooloombah Creek Service Station has not been assessed as the service station would not be occupied at night.

It should be noted that actual noise levels may be lower than the predicted noise levels that are presented in the following sections. This is due to the conservative modelling assumption that all equipment listed in Table 6-1 and Table 6-2 will be in operating simultaneously, whereas this is unlikely to occur in actual operations.

7.1 PREDICTED NOISE LEVELS

Predicted noise levels from construction and operation are presented below.

7.1.1 CONSTRUCTION

Construction hours have not yet been confirmed, and 24 hour construction has been assumed for this assessment. Table 7-1 to Table 7-3 contain predicted noise levels from construction activities for day, evening, and night respectively under both average and worst case climatic conditions.

Where noise levels are predicted to exceed, the relevant cells have been highlighted in red.

Table 7-1: Predicted Daytime Noise Levels from Construction

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq, 07:00-18:00 hours}$ dB(A)		$L_{A1, 07:00-18:00 hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	37/42	27	28	32	33
Brussels	37/42	25	39	30	44
Neerim-1	37/42	13	26	18	31
Neerim-2	37/42	13	26	18	31
Oakdean	37/42	28	28	33	33
Ogmore Township	37/42	19	20	24	25
Strathmuir	37/42	18	32	23	37
Tooloombah Creek Service Station	L_{Aeq} 42	34	36	NA	NA

Table 7-2: Predicted Evening Noise Levels from Construction

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq, 18:00-22:00 hours}$ dB(A)		$L_{A1, 18:00-22:00 hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	37/42	27	29	32	34
Brussels	37/42	25	39	30	44
Neerim-1	37/42	13	27	18	32
Neerim-2	37/42	13	27	18	32
Oakdean	37/42	28	29	33	34
Ogmore Township	37/42	20	21	25	26
Strathmuir	37/42	19	33	24	38
Tooloombah Creek Service Station	L_{Aeq} 42	35	36	NA	NA

Table 7-3: Predicted Night Noise Levels from Construction

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq, 22:00-07:00 hours}$ dB(A)		$L_{A1, 22:00-07:00 hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	30/35	28	28	33	33
Brussels	30/35	27	39	32	44
Neerim-1	30/35	14	26	19	31
Neerim-2	30/35	14	26	19	31
Oakdean	30/35	28	28	33	33
Ogmore Township	30/35	22	20	27	25
Strathmuir	30/35	20	32	25	37

L_{Aeq} and L_{A1} noise levels are predicted to comply with the construction noise criteria at all receptors, except at Brussels under worst case worst climatic conditions.

As noise levels exceedances are predicted from construction under worst case conditions, noise mitigation would be required. Noise mitigation has been discussed in Section 8.

7.1.2 OPERATION

Predicted noise levels from Year 12 of operation are shown in Table 7-4, Table 7-5, Table 7-6 for the day, evening, and night respectively.

Where noise levels are predicted to exceed, the relevant cells have been highlighted in red.

Table 7-4: Predicted Daytime Noise Levels from Proposed Operations

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq, 07:00-18:00 hours}$ dB(A)		$L_{A1, 07:00-18:00 hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	37/42	38	39	43	44
Brussels	37/42	30	44	35	49
Neerim-1	37/42	18	32	23	37
Neerim-2	37/42	19	32	24	37
Oakdean	37/42	37	37	42	42
Ogmore Township	37/42	29	30	34	35
Strathmuir	37/42	23	36	28	41
Tooloombah Creek Service Station	L_{Aeq} 42	50	51	NA	NA

Table 7-5: Predicted Evening Noise Levels from Proposed Operations

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq, 18:00-22:00 hours}$ dB(A)		$L_{A1, 18:00-22:00 hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	37/42	38	39	43	44
Brussels	37/42	31	45	36	50
Neerim-1	37/42	18	33	23	38
Neerim-2	37/42	19	33	24	38
Oakdean	37/42	37	38	42	43
Ogmore Township	37/42	30	31	35	36
Strathmuir	37/42	23	37	28	42
Tooloombah Creek Service Station	L_{Aeq} 42	50	51	NA	NA

Table 7-6: Predicted Night Noise Levels from Proposed Operations

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq, 22:00-07:00 hours}$ dB(A)		$L_{A1, 22:00-07:00 hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	30/35	38	39	43	44
Brussels	30/35	32	44	37	49
Neerim-1	30/35	19	32	24	37
Neerim-2	30/35	20	32	25	37
Oakdean	30/35	35	37	40	42
Ogmore Township	30/35	29	30	34	35
Strathmuir	30/35	24	36	29	41

For noise sensitive receptors, L_{Aeq} and L_{A1} noise levels are predicted to exceed at a number of the nearest receptors by up to 7 dB(A) and 8 dB(A) during the day and evening, and by up to 14 dB(A) at night time. For the commercial receptor (Tooloombah Creek Service Station) L_{Aeq} and L_{A1} noise levels are predicted to exceed by up to 9 dB(A) during the day and evening. Under worst case climatic conditions, noise levels are predicted to exceed at most receptors when compared against the night time noise criteria.

As noise levels from operations are expected to exceed the noise criteria, noise mitigation would be required. Noise mitigation has been discussed in Section 8.

7.2 LOW FREQUENCY ASSESSMENT

No low frequency noise impacts will occur during construction because the type of equipment and plant to be used does not cause low frequency emissions at a level that could affect sensitive receptors. A low frequency noise assessment was undertaken for the operations by predicting dB(Lin) at noise sensitive receptors and comparing against a 57 dB(Lin) criteria. Only the evening time predicted noise levels are shown below in Table 7-7 as noise during this time is expected to be the highest due to climatic conditions. Compliance with the noise criteria during this period would also result in compliance for day and night. Predicted noise levels for evening are shown below showing predicted noise levels for the evening under worst climatic conditions.

Table 7-7: Low Frequency Noise Assessment - Evening

Receptor ID	**Criteria**	**$L_{eq,\ 18:00-22:00\ hours}$ dB(Lin)**
		Worst Climatic
BAR H-1	L_{eq} 57 (Lin) outdoors Where the above limit is exceeded, the difference between dB(Lin) and dB(A) is less than 15 dB	47
Brussels		53
Neerim-1		43
Neerim-2		44
Oakdean		47
Ogmore Township		41
Strathmuir		47
Tooloombah Creek Service Station		58 dB(Lin), and dB(Lin)-dB(A) is 7dB

Low frequency noise from mining activities is predicted to comply with Low Frequency Noise criteria and low frequency noise impacts are not predicted.

8 NOISE CONTROL AND MITIGATION OPTIONS

Noise modelling results indicate noise levels from the Project are likely to exceed the noise criteria at a number of receptor locations, and noise mitigation measures would be required.

Section 9 of the *Environmental Protection (Noise) Policy 2008* outlines the hierarchy preference in which noise should be addressed. In the first instance, the Policy recommends that:

1. Noise be avoided; however if this is not possible,
2. The minimisation of noise through either:
    a. Re-orientation of an activity or
    b. Use of Best Available Technology (BAT); and
3. Management of noise.

Key noise sources were identified in noise modelling, and options for reducing potential impacts from these sources have been investigated using equipment modifications or management measures.

Noise mitigation has been discussed for construction and operation below.

8.1 NOISE MITIGATION FOR CONSTRUCTION

Noise modelling results indicate that CAT 793D haul trucks are a major contributor of noise. Noise reduction has been investigated using the following mitigation measures:

1 Replacement of CAT793D trucks with CAT793 XQ haul trucks (noise mitigated version of CAT793 truck), achieving a reduced Sound Power Level of 114 dB(A); and

Predicted noise levels with CAT793 XQ are shown in Table 8-1 for the night time under worst case climatic conditions. Only the night time predicted noise levels are shown below as the noise criteria during this time is the most stringent. Compliance with the noise criteria during this period would also result in compliance for day and evening.

Table 8-1: Predicted Night Time Noise Levels from Construction Activities

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq,\ 07:00\text{-}18:00\ hours}$ dB(A) Worst Climatic	$L_{A1,\ 07:00\text{-}18:00\ hours}$ dB(A) Worst Climatic
BAR H-1	37/42	23	28
Brussels	37/42	35	40
Neerim-1	37/42	23	28
Neerim-2	37/42	23	28
Oakdean	37/42	24	29
Ogmore Township	37/42	16	21
Strathmuir	37/42	30	35

With CAT793 XQ trucks, construction noise levels are predicted to comply with the construction noise criteria.

8.2 NOISE MITIGATION FOR OPERATION

Noise modelling results indicate that CAT 793D haul trucks are the major contributor of noise. For receptors near the TLF, other major noise sources include CAT992 FEL's and B-Double Coal Haulage Units.

Noise reduction has been investigated using the following mitigation measures:

1 Replacement of CAT793D trucks with CAT793 XQ haul trucks (noise mitigated version of CAT793 truck), achieving a reduced Sound Power Level of 114 dB(A); and

2 Use of CAT793 XQ trucks **AND** the TLF not operating during the night time (i.e. CAT992 FEL's, B-Doubles, and other TLF related equipment not operating at night time).

Noise levels have been predicted below for both mitigation measures.

8.2.1 PREDICTED NOISE LEVELS WITH CAT793 XQ

Predicted noise levels with CAT793 XQ are shown in Table 8-2, Table 8-3, and Table 8-4 for day, evening and night respectively.

Table 8-2: Predicted Daytime Noise Levels from Proposed Operations

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq, 07:00-18:00 hours}$ dB(A)		$L_{A1, 07:00-18:00 hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	37/42	29	30	34	35
Brussels	37/42	24	38	29	43
Neerim-1	37/42	14	25	19	30
Neerim-2	37/42	14	26	19	31
Oakdean	37/42	29	30	34	35
Ogmore Township	37/42	22	22	27	27
Strathmuir	37/42	20	32	25	37
Tooloombah Creek Service Station	L_{Aeq} 42	41	42	NA	NA

Table 8-3: Predicted Evening Noise Levels from Proposed Operations

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq,\ 18:00\text{-}22:00\ hours}$ dB(A)		$L_{A1,\ 18:00\text{-}22:00\ hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	37/42	30	31	35	36
Brussels	37/42	25	38	30	43
Neerim-1	37/42	14	26	19	31
Neerim-2	37/42	14	27	19	32
Oakdean	37/42	29	30	34	35
Ogmore Township	37/42	22	23	27	28
Strathmuir	37/42	20	33	25	38
Tooloombah Creek Service Station	L_{Aeq} 42	41	43	NA	NA

Table 8-4: Predicted Night Noise Levels from Proposed Operations

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq,\ 22:00\text{-}07:00\ hours}$ dB(A)		$L_{A1,\ 22:00\text{-}07:00\ hours}$ dB(A)	
		Average Climatic	Worst Climatic	Average Climatic	Worst Climatic
BAR H-1	30/35	29	30	34	35
Brussels	30/35	26	38	31	43
Neerim-1	30/35	14	25	19	30
Neerim-2	30/35	14	26	19	31
Oakdean	30/35	28	29	33	34
Ogmore Township	30/35	22	22	27	27
Strathmuir	30/35	21	32	26	37

With the replacement of CAT793D trucks with the quieter CAT793 XQ trucks, noise levels are predicted to comply with the noise criteria at most receptors for both average and worst case climatic conditions.

For the day and evening period, noise levels are predicted to comply with the criteria at Brussels under average climatic conditions. However, marginal noise exceedances of 1dB(A) are predicted at Brussels under worst case climatic conditions. For the night period, exceedances are predicted at at Brussel under worst case climatic conditions.

While noise levels are predicted to exceed under worst case climatic conditions, these conditions (stability Class F) would typically occur on cold nights when windows are likely to be closed. With closed windows noise levels inside residential dwellings are expected to achieve acoustic amenity levels recommended in the *Environmental Protection (Noise) Policy 2008* for daytime, evening, and night time.

Exceedances are also predicted at Tooloombah Creek Service Station during the evening and at Strathmuir during the night under worst case climatic conditions.

It is recommended that a noise management plan include consultation and engagement with potentially affected receptors to achieve alternative arrangements.

8.2.2 PREDICTED NOISE LEVELS WITH CAT793 XQ, ENCLOSED CONVEYORS, AND LIMITED TLF OPERATIONS

Further noise modelling has been conducted with enclosing the overland conveyor, and restricting operation of the TLF to day and evening only (that is, no operation of the TLF during the night 10pm to 7am period). Modelling results have indicated the following:

- Enclosing the conveyor results in Tooloombah Creek Service Station noise level compliance during the evening. Predicted noise level at Tooloombah Creek Service Station is L_{Aeq} 42 dB(A); and
- Restricting TLF operation to day and evening results in noise level compliance at Strathmuir. Predicted night time noise level at Strathmuir is L_{Aeq} 29 dB(A), and L_{A1} 34 dB(A).

With the above measures, noise levels at both Tooloombah Creek Service Station and Strathmuir are predicted comply with the noise criteria.

Noise levels at Brussels are predicted to continue to exceed the criteria due to their close proximity to mine operations.

8.3 GENERAL NOISE CONTROL MEASURES

The following noise control measures should be considered for minimising noise generated from mining activities:

- Providing appropriate training staff to operate the equipment in order to minimise unnecessary noise emissions. This could be achieved during site inductions and regular training programs;
- Avoiding unnecessary revving of engines and switch off equipment when not required;
- Keeping internal roads well maintained;
- Using rubber linings in or constrained layer damping on, for example, chutes and dumpers to reduce impact noise;
- Minimising the drop heights of materials, in particular at the TLF;
- Use ultra-low noise idlers on the conveyors; the noise reduction associated with these are generally 5 - 10 dB(A);
- Positioning of overburden and top soil piles in between haul roads and receptors, where practicable, to provide noise shielding;
- The movement of plant onto and around the site should have regard to the normal operating hours of the site and the location of any sensitive receptors as far as is reasonably practicable;
- Employing audible reversing warning systems on mobile plant and vehicles that are of a type that have minimal noise impact on persons outside sites. This may include alarms that automatically adjust volumes based on the surrounding noise environment or alarms that are non-tonal in nature (such as broadband or 'quack' alarms);
- As far as reasonably practicable, enclosing sources of significant noise. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements. A typical enclosure may provide 10 - 20 dB(A) depending on the material;
- Operating plant in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise sensitive areas. Where possible, loading and unloading should also be carried out away from such areas; and
- Shutting down machines such as cranes that might have intermittent use. Such machines should be shut down between work periods or should be throttled down to a minimum.

8.4 MONITORING PROGRAMME

Given mining noise levels are predicted to exceed the criteria at a number of receptors, it is recommended that the monitoring is undertaken in accordance with the Model Mining Conditions, as detailed in Table 8-5.

Table 8-5: Noise Monitoring and Reporting in Accordance with the MMC [DEHP, 2014]

Noise monitoring and recording must include the following descriptor characteristics and matters: • $L_{AN,T}$ (where N equals the statistical levels of 1, 10 and 90 and T = 15 mins); • Background noise L_{A90}; • The level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to statistical levels; • Atmospheric conditions including temperature, relative humidity and wind speed and directions; • Effects due to any extraneous factors such as traffic noise; • Location, date and time of monitoring; and • If the complaint concerns low frequency noise, Max $Lp_{LIN,T}$ and one third octave band measurements in dB(LIN) for centre frequencies in the 10 – 200 Hz range.

9 BLASTING NOISE AND VIBRATION

Blasting will be required for the removal of overburden and extraction of coal from the open cut pits. Table 9-1 shows the separation distances between blast locations and the nearest receptors.

Table 9-1: Separation Distances for Blasting Assessment

Receptor	Distance to Pit Edge
Tooloombah Creek Service Station	2 km
Brussels	3 km

The nearest commercial receptor (Tooloombah Creek Service Station) is located approximately 2 km from potential blasting activities. The nearest residential receptor (Brussels) is located approximately 3 km from potential blasting activities.

Control of ground vibration is highly dependent on the charge mass per delay (or Mass Instantaneous Charge, MIC), blasting control measures, and local ground properties. Blasting parameters for the Project are shown in Table 9-2.

Table 9-2: Blasting Parameters

Blast Parameter	Value
Blast hole diameter	165 mm to 275 mm
Blast hole depth	15 to 50 m
Explosive	ANFO, Heavy ANFO and Emulsion
MIC	1000 kg / 250 kg

Estimations of potential blasting vibration and airblast overpressure levels have been made using equations outlined in Australian Standard AS2187.2-2006.

At a distance of 2 km, blasting 1,000 kg ANFO MIC is estimated to result in the following vibration and airblast overpressure:

- PPV of 1.5 mm/s; and
- Airblast overpressure of between 107 dB(Lin) and 127 dB(Lin), dependent on stemming.

Blasting is expected to comply with the blasting vibration and airblast overpressure criteria for the proposed blasting parameters with appropriate stemming. Blast control measured is to be refined for local conditions by the blasting contractor. Blast monitoring should be conducted in order to provide feedback on blast control measures.

10 IMPACTS ON FAUNA

The DEHP *EIS Information Guideline – Noise and Vibration* requires that a fauna assessment "*should assess the potential environmental impacts of noise and vibration on terrestrial and marine animals and birds, including migratory species and on any nearby protected areas – also addressing amenity*".

There are no current government policies or other accepted guidelines that provide recommended noise level thresholds or limits in relation to noise impact on terrestrial fauna. In Australia, there are no noise studies presently available that deal with noise impacts on native species for long-term exposure, therefore a general literature review has been carried out for potential fauna impacts.

There is limited knowledge or understanding of the effects of noise on fauna given that the research and studies on animals to date has been limited to small, disconnected, anecdotal or correlational studies as opposed to coherent programs of controlled experiments (Manci et al (1988), Larkin, (1996), Radle, (1998), Wyle (2003), Warren et al, (2006), Dooling and Popper (2007) and (Dooling, Fay, and Popper (2000). Noise may adversely affect wildlife by interfering with communication, masking the sounds of predators and prey and causing stress or avoidance reactions, and in some cases may lead to changes in reproductive or nesting behaviour. At sufficiently high levels, noise could cause temporary or permanent hearing damage.

In general, Radle (2007) states the consensus that terrestrial animals will avoid any industrial or plant or construction area where noise or vibration presents an annoyance to them. Additionally, Radle (2007) observed many animals react to new noise initially as a potential threat (potentially followed by startle/fright and avoidance), but quickly 'learn' that the noise is not associated with a threat. Most wildlife is generally mobile and will act to avoid noise and vibration if it is perceived to be annoying.

The response to noise by animals can depend on a wide variety of factors including noise level, noise spectrum (frequency distribution), noise characteristics (such as impulsiveness, rate of onset, tonality, modulation etc.), duration, temporal variation, number and type of events, level of ambient noise, time of day/season/year, and the animal's age, sex, type of activity at the time, breeding situation and past experience, and the type of animal species/genera, hearing thresholds, individual differences etc.

Studies have shown the reaction to noise can vary from species to species, including those that are known to have adapted to human activity. Environment Australia (1998) suggests that unusual noise, in combination with close proximity visual stimulation, is enough to disturb any animal, including humans. In addition, any sudden and unexpected intrusion, whether acoustic or of another nature, may also produce a startle or panic reaction.

Studies of the impact of the sonic boom on domestic and wild animals show that these species are unaffected by repeated booms and farmers have reported birds actually perching on scare guns after only a couple of days operation (Environment Australia, 1998). From a literature review, it has been considered that noise levels up to 60 dB(A) do not result in negative or adverse response to impacted animals or livestock. Noise levels up to 80 dB(A) can generate startle responses in birds and animals, and noise levels in excess of 90 dB(A) may cause negative impact such as behavioural responses.

The predicted noise levels from the Project operations are approximately 60 dB(A) at the MLA boundary and these noise levels are not expected to cause adverse response to animals or livestock. Typically, animals will avoid high noise areas and it is expected that animals will relocate away from such areas. In addition, the relatively low level of impulsive or low frequency noise at distance from mine operations is not likely to cause effects on domestic or wild animals. The noise and vibration from haul truck movements could potentially produce the most likely occurrence of impact on animals (that are located near the haul road at the time of such truck passby events).

To summarise, the impacts of noise on animals is generally inconclusive. In general, there is no or little evidence of cause and effect regarding behavioural or physiological effects on domestic animals, and possibly slight evidence of some effects on some types of wild animals (especially for high or impulsive levels of noise).

Finally, it is noted that animals tend to habituate to disturbances over time, particularly when it is steady and associated with non-threatening activity.

11 CONCLUSIONS

Potential noise and vibration impacts from the construction and operation of the Project were assessed against applicable criteria based on the Department of Environment and Heritage Protection's Model Mining Conditions and Queensland *Environmental Protection (Noise) Policy 2008*.

Future potential noise levels at the nearest noise sensitive and commercial receptors were predicted using the SoundPlan noise model for the construction and operational scenarios. For the operational scenario, mining activities in year 12 of the mining schedule was modelled as this has greatest potential for noise impacts.

Noise levels for construction and operation are predicted to exceed the noise criteria at the nearest receptors and noise mitigation would be required. Noise mitigation using quieter equipment and management measures has been investigated.

For construction, noise levels are predicted to comply with the criteria with noise mitigation in the form of replacing CAT793D trucks with quieter CAT793 XQ trucks.

For operation, noise mitigation in the form of replacing CAT793D trucks with quieter CAT793 XQ trucks would result in compliance with the noise criteria at most receptors for both average and worst case climatic conditions. However, noise level exceedances are predicted at Brussels during the day, evening and night, at Tooloombah Creek Service Station during the evening, and at Strathmuir during the night.

Further noise mitigation measures such as limiting TLF operational hours (to day and evening only) and using enclosed overland conveyors are predicted to result in noise level compliance at Tooloombah Creek Service Station and Strathmuir, however, not at Brussels.

It is recommended that a noise management plan is developed in consultation and engagement with potentially affected receptors to achieve alternative arrangements, in particular with the receptor at Brussels.

Potential ground vibration and airblast overpressure levels were predicted based on AS2187.2-2006. Blasting impacts are expected to comply with blasting criteria with appropriate stemming.

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Appendix A GLOSSARY

Ambient noise – the totally encompassing noise in a given situation at a given time; it is usually composed of noise from many sources, near and far.

Attenuation – a general term used to indicate the reduction of noise or vibration, by whatever method or for whatever reason, and the amount in decibels, by which it is reduced.

A-weighting – a frequency weighting devised to attempt to take into account the fact human response to sound not equally sensitive to all frequencies.

Background noise level - The INP defines the background noise level as '*the underlying level of noise present in ambient noise when all unusual extraneous noise is removed'*. Additionally, the INP states that *'sound levels contributing to background levels can include sound from nearby traffic, birds, insects, animals, machinery and similar sources if these sounds are a normal feature of the location'*.

dB(A) – the A-weighted sound pressure level.

dB(Z) or dB(Lin) – the Z-weighted (linear) sound pressure level.

Decibel (dB) – the logarithmic-scaled unit used to report the level or magnitude of sound.

Hertz (Hz) - the unit of frequency.

L (Level) – the sound pressure level (SPL); it implies the use of decibels related to the ratio of powers or the power related quantities such as sound intensity or sound pressure.

Loudness – the measure of the subjective impression of the magnitude or strength of a sound.

Noise descriptors – A noise descriptor is a measure of noise used to define a specific characteristic of noise, e.g. average energy, variation (maximum and minimum) and annoyance. Noise descriptors are based on measurements of the sound pressure level. Common noise descriptors are provided below:

$L_{Aeq,T}$	Time–average A-weighted sound pressure level
$L_{A90,T}$	Background A-weighted sound pressure level. Corresponds to the level that is exceeded for 90% of the measured time interval
$L_{Amax,T}$	Maximum A-weighted sound pressure level, obtained by arithmetically averaging of the maximum levels of the noise under investigation
$L_{Amin,T}$	Minimum A-weighted sound pressure level, obtained by arithmetic averaging of the minimum levels of the noise under investigation
$L_{A10,T}$	Level that is exceeded for 10% of the measured time interval. The L_{10} is typically used to measure road traffic noise
$L_{A1,T}$	Level that is equal to or exceeded for 1% of the time interval considered in the absence of the noise under investigation

Noise criteria – a maximum or minimum value imposed on a noise index e.g. a legal purpose.

RBL – Rating Background Level: Statistical noise descriptor used to describe the lowest noise levels (background) on site.

Sound power – the sound energy radiated per unit time by a sound source, measured in watts.

Sound propagation – the transfer of sound from one point to another.

Velocity – a vector quantity that specifies the time derivative of displacement.

Appendix B MINE INFRASTRUCTURE

The mine arrangement and the proposed Train Loadout Facility (TLF) are shown below.

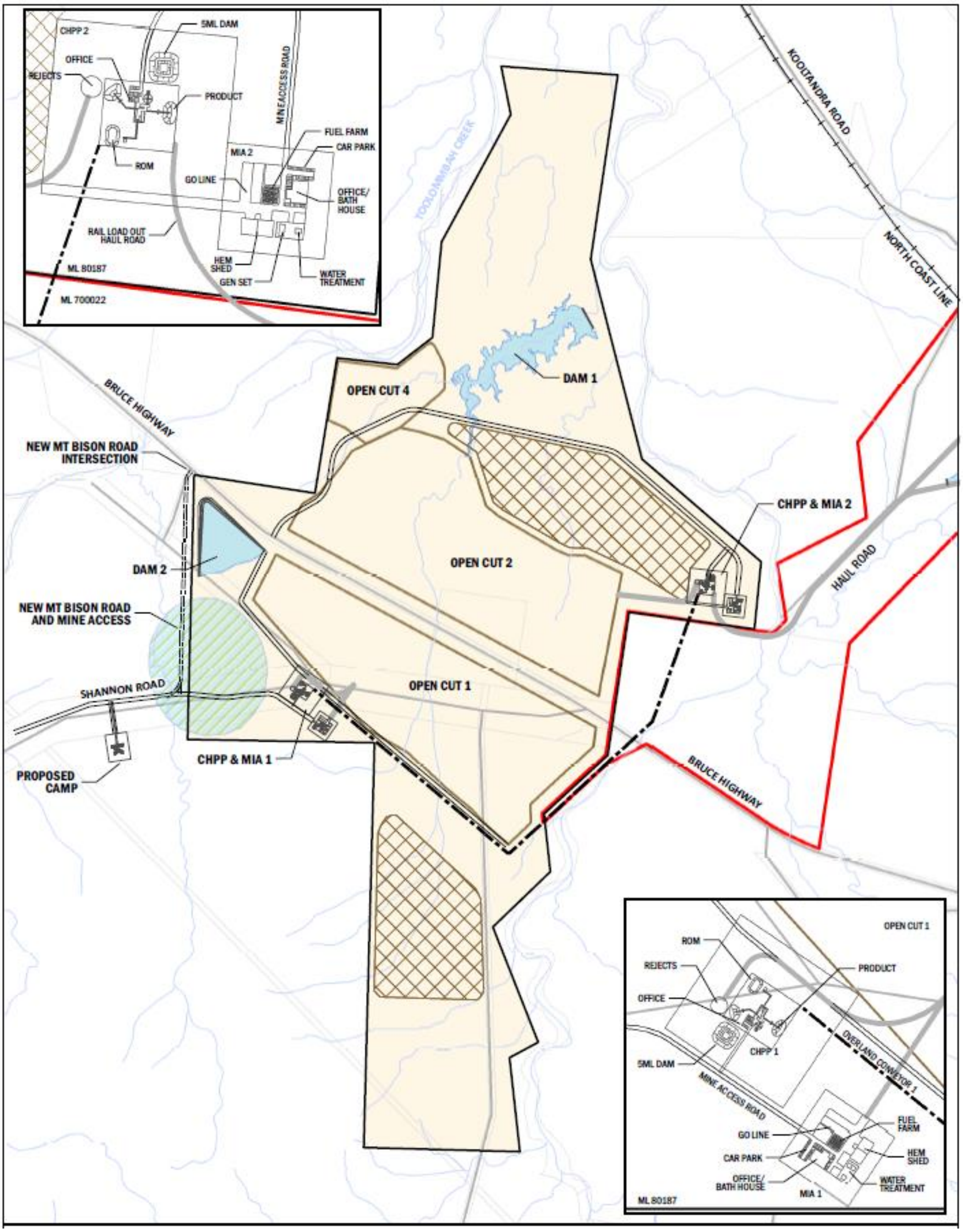


Figure B-1 Mine Arrangement [CDM Smith, July 2017]

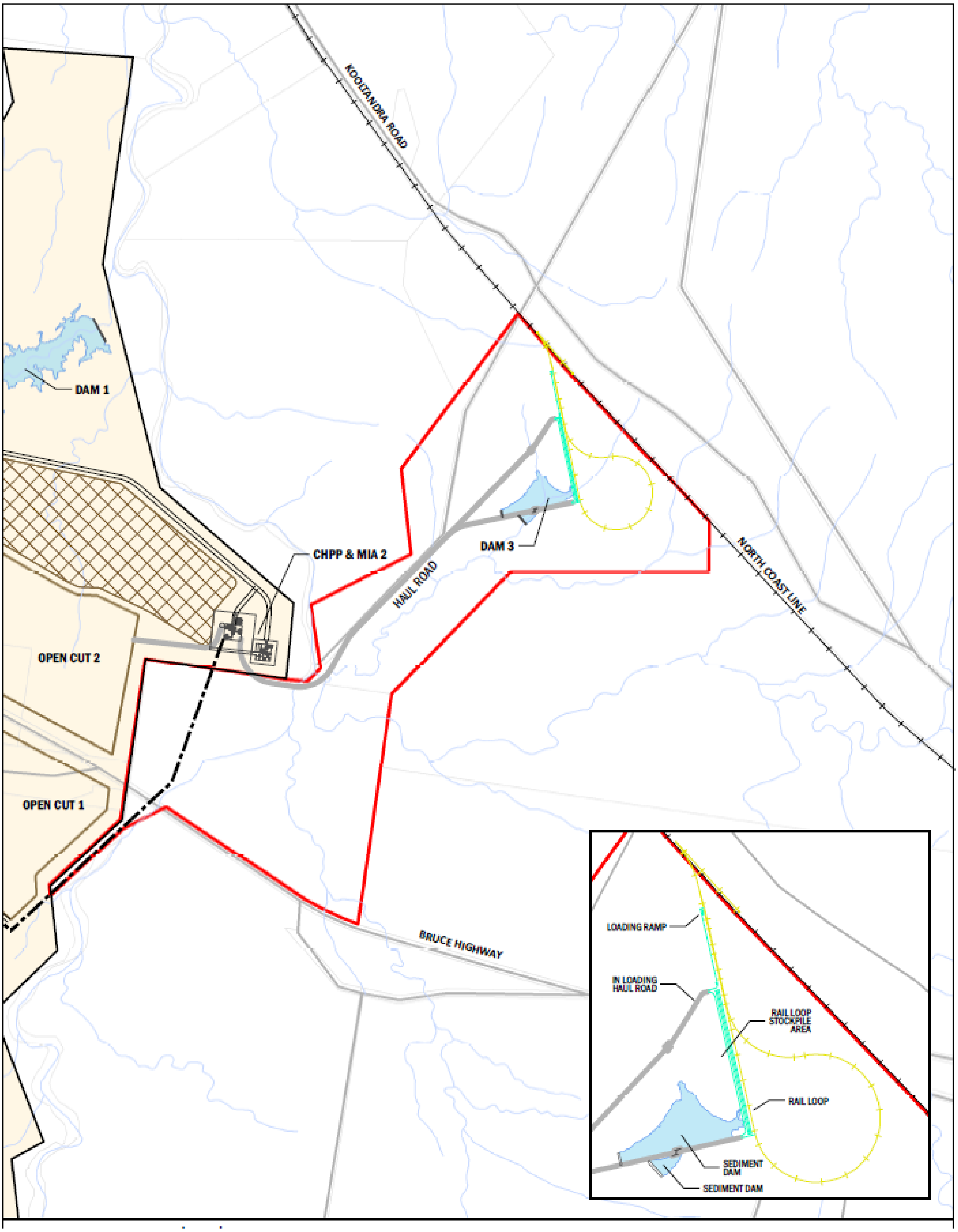


Figure B-2 TLF Arrangement [CDM Smith, July 2017]

Appendix C YEARLY MINING SEQUENCE

The mining sequence for years 1 to 16 is shown below. This assessment is based on year 12 of mining when the mining activities are expected to be the most intense.

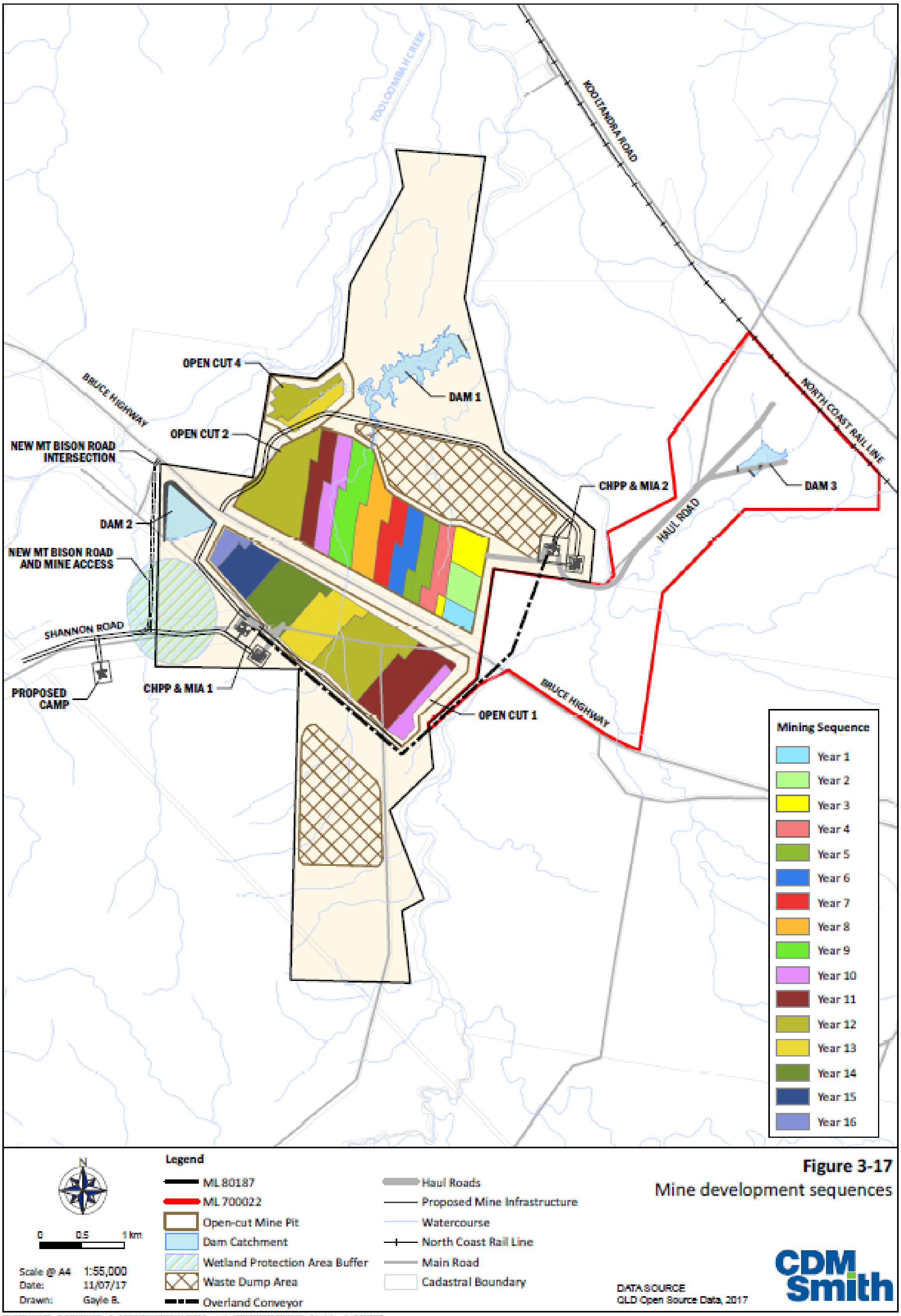
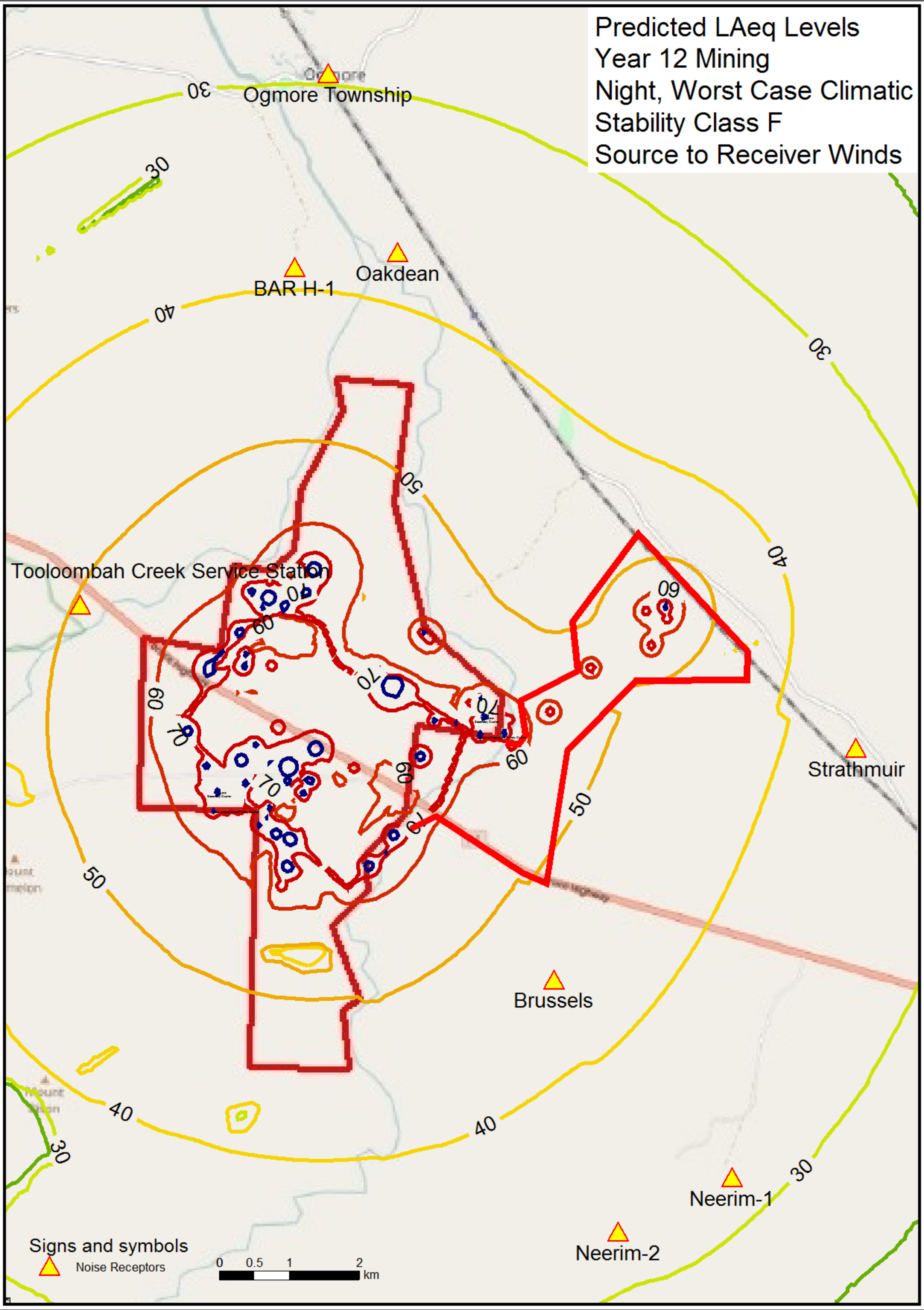


Figure C-1 Mine Development Sequences [CDM Smith, July 2017]

Appendix D NOISE PREDICTION CONTOURS

L_{Aeq} noise contour plots have been included for the following operational scenarios:

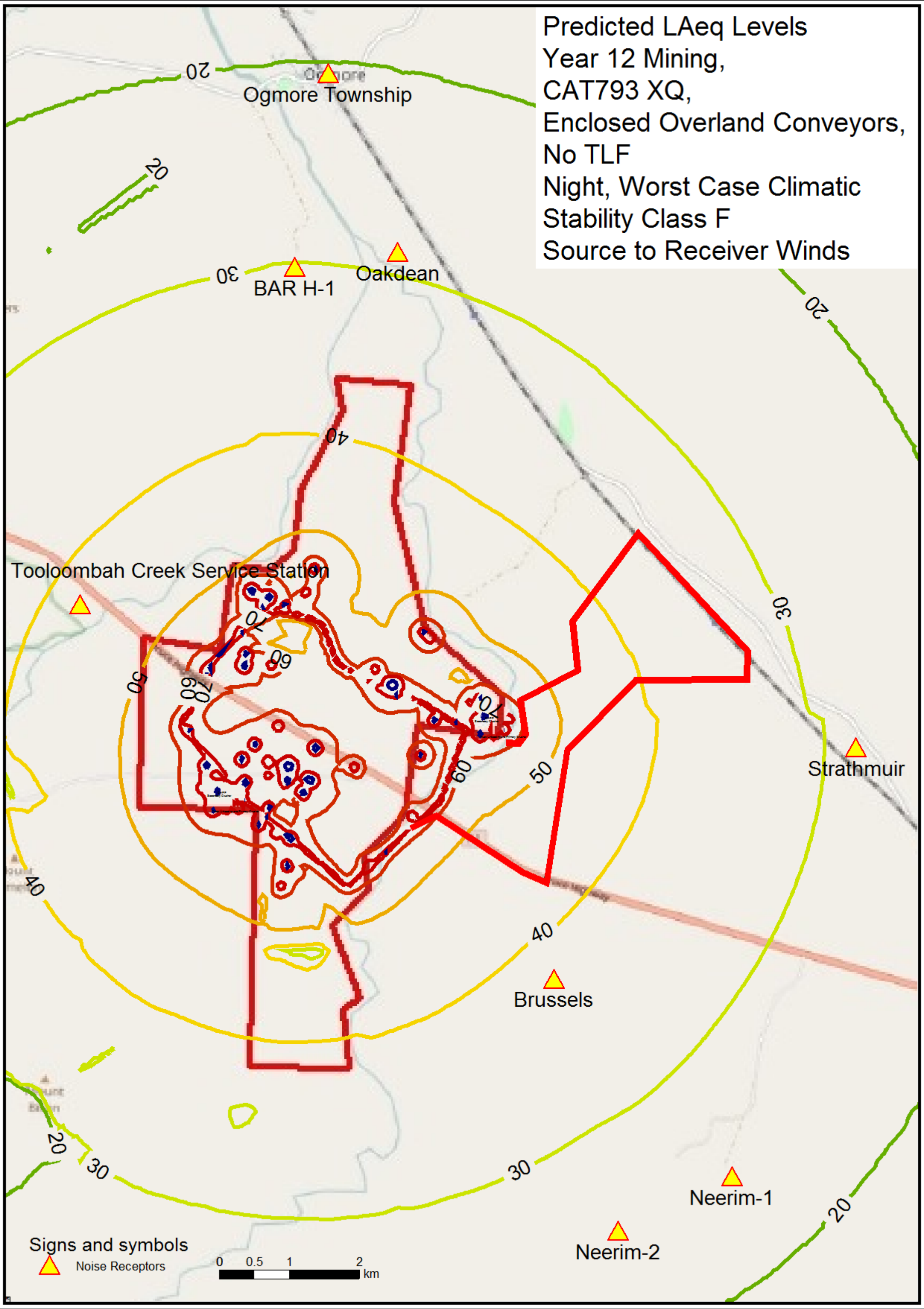
- Year 12 operations for the night time with worst case climatic conditions;
- Year 12 operations for the night time with worst case climatic conditions, CAT793 XQ trucks, covered overland conveyors, and no TRF operating at night time.



Parameter	Assessment Period:	Assessment Type:	Criteria:
L_{Aeq}	Night	Worst Case Conditions	30 dB(A)

Comment:
Year 12 with no noise mitigation

Figure D-1 Year 12 Noise Map with No Noise Mitigation



Parameter L_{Aeq}	Assessment Period: Night	Assessment Type: Worst Case Conditions	Criteria: 30 dB(A)

Comment:
Year 12 with Cat793 XQ trucks, enclosed overland conveyors, no TLF at night

Figure D-2 Year 12 Noise Map with Noise Mitigation