Central Queensland Coal Project

Chapter 13 – Noise and Vibration

Environmental Impact Statement

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Central Queensland Coal Mine Project

Chapter 13 – Noise and Vibration

24 October 2017

CDM Smith Australia Pty Ltd
ABN 88 152 082 936
Level 4, 51 Alfred Street
Fortitude Valley
QLD 4006
Tel: +61 7 3828 6900
Fax: +61 7 3828 6999

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13 Noise and Vibration

Noise and vibration emissions attributable to activities undertaken during the construction and operation of the Central Queensland Coal Project (herein referred to as the Project) have the potential to impact the surrounding environment, particularly sensitive locations within the area. This chapter addresses the relevant legislation and policies, the assessment method, the existing noise environment and identifies potential impacts and proposes mitigation measures for the construction and operation of the Project. The technical noise and vibration assessment was conducted by Vipac Engineers and Scientists Ltd (Vipac) and is found in Appendix A8 - Noise and Vibration Technical Report. Note that Appendix A8 –Noise and Vibration Technical Report references the original proponent; Styx Coal Pty Ltd, and the original Project name, Styx Coal Mine Project; however, the Central Queensland Coal Pty Ltd is the new Proponent for the Project and the Project has been renamed as Central Queensland Coal Project to better reflect the change of Proponent. This proponent and title change does not affect the technical studies.

13.1 Project Overview

The Project is located 130 km northwest of Rockhampton in the Styx Coal Basin in Central Queensland. The Project will be located within Mining Lease (ML) 80187 and ML 700022, which are adjacent to Mineral Development Licence (MDL) 468 and Exploration Permit for Coal (EPC) 1029, both of which are held by the Proponent.

The Project will involve mining a maximum combined tonnage of up to 10 million tonnes per annum (Mtpa) of semi-soft coking coal (SSCC) and high grade thermal coal (HGTC). Development of the Project is expected to commence in 2018 and extend for approximately 20 years until the current reserve is depleted.

The Project consists of three open cut operations that will be mined using a truck and shovel methodology. The run-of-mine (ROM) coal will ramp up to approximately 2 Mtpa during Stage 1 (Year 1-4), where coal will be crushed, screened and washed to SSCC grade with an estimate 80% yield. Stage 2 of the Project (Year 4-20) will include further processing of up to an additional 4 Mtpa ROM coal within another coal handling and preparation plant (CHPP) to SSCC and up to 4 Mtpa of HGTC with an estimated 95% yield. At full production two CHPPs, one servicing Open Cut 1 and the other servicing Open Cut 2 and 4, will be in operation.

A new train loadout facility (TLF) will be developed to connect into the existing Queensland Rail 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 Project is located within the Livingstone Shire Council (LSC) Local Government Area (LGA). The Project is generally located on the “Mamelon” property, described as real property Lot 11 on MC23, Lot 10 on MC493 and Lot 9 on MC496. The TLF is located on the “Strathmuir” property, described as real property Lot 9 on MC230. A small section of the haul road to the TLF is located on the “Brussels” property described as real property Lot 85 on SP164785.

13.2 Legislative Framework

The following legislation, policy, guidelines and standards relate to the Project and are relevant for identifying values and mitigating and managing impacts. The policies and guidelines consider the existing acoustic environment and inform the proposed noise and vibration criteria for the Project. Refer to Chapter 1 – Introduction for further details on the Project's legislative framework.

13.2.1 State

13.2.1.1 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) provides the key legislative framework for environmental management and protection in Queensland. The EP Act utilises several mechanisms to achieve its objectives including: Environmental Protection Policies (EPPs) for water use, noise and air.

With particular regard to the control of noise, however, section 440R of the EP Act restricts a person from carrying out building works in a way that makes an audible noise on a business day or Saturday, before 6:30am or after 6:30pm.

13.2.1.2 Environmental Protection (Noise) Policy 2008

The object of the EPP (Noise) is to 'achieve the object of the Act in relation to the acoustic environment' (Part 2(5) EPP (Noise)). The framework to achieve this includes:

- Identifying environmental values (EVs) to be enhanced or protected;
- Specifying acoustic quality indicators and goals to protect or enhance the EVs; and
- Providing a framework for making consistent, equitable and informed decisions about the acoustic environment.

The acoustic quality objectives defined in the EPP (Noise) provide guidance as to what ambient noise levels should be achieved to protect the receiving environment. The acoustic quality objectives for sensitive receptors are defined in Schedule 1 of the EPP (Noise). The acoustic quality objectives relevant to the Project are presented in Table 13-1. The values in brackets are the external values using a transmission loss of 7 decibels (dB) for a standard Queenslander home based on construction materials. This methodology is consistent with the EIS Guidelines - Noise and Vibration, which recommends 7 dB for this type of building.

Table 13-1 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)	Day time and evening	50	55	65	Health and wellbeing
Dwelling (indoors)	Day time and evening	35 (42)	40	45	Health and 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 EPP (Noise) 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 loss which is a conservative transmission loss for European building construction in Queensland and 15 dB for a commercial/retail building

13.2.1.3 Guideline Mining – Model Mining Conditions

Pursuant to the EP Act is the Model Mining Conditions (MMC), published by the Department of Environment and Heritage Protection (EHP). The purpose of the guideline is to provide a set of model conditions to form general environmental protection commitments for the mining activities and their environmental authority conditions. The Project is subject to the acoustic criteria outlined in this guideline, as presented in Table 13-2. The MMC also contains measurements and reporting requirements for low frequency noise following complaints. Low frequency noise involves a frequency range of 10 to 200 hertz (Hz). If a complaint is made regarding low frequency noise, under the MMC a one-third octave band measurement in the frequency range 10 to 200 Hz should be carried out.

Table 13-2 Model Mining Conditions noise criteria

Noise level dB(A) measured as:	Monday to Saturday			Sunday and Public Holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
Sensitive place						
$L_{Aeq,Adj,15min}$	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						
$L_{Aeq,Adj,15min}$	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 caculate noise limits:

- 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.

The MMC also provides noise and ground vibration criteria for blasting activities (see Section 13.6.4.2). Blasting will occur in accordance with MMC on Monday to Sunday between 7am and 6pm. Should blasting outside these hours be required, approval will be sought from the appropriate Authorities, and will be covered by a specific Blast Management Plan developed for each individual occurrence and will incorporate a notification procedure informing all related and impacted parties. Typically, vibration impacts are localised (within a 20 m radius) and only have the potential to affect sensitive receptors where these are very close to the source of vibration.

13.2.1.4 Application Requirements for Activities with Noise Impacts (EM962)

The Application Requirements for Activities with Noise Impacts (EM962) outlines the information required to support an EA application for activities with noise impacts. The guidelines require three key areas to be addressed:

- Identify the environmental values of the receiving acoustic environment including the identification of any nearby sensitive places (see Section 13.5.2.4);
- Identify the possible impacts due to the proposed activity and all associated risks to the EVs (see Section 13.7 and Section 13.8); and
- Identify the strategies to mitigate the identified risks to the EVs (see Section 13.9).

The EVs associated with noise include human health and wellbeing such as sleep quality, relaxation and recreation activities, community amenity and the health and biodiversity of ecosystems. There are a range of acoustic quality objectives prescribed to each EV in Schedule 1 of the EPP (Noise) (refer to Table 13-1 for those relevant to the Project).

13.2.1.5 EIS Information Guideline – Noise and Vibration

The EIS Information Guideline – Noise and Vibration provides guidance material for the preparation of an EIS Noise and Vibration chapter. The guideline supports the ToR by including comprehensive steps to address the noise and vibration impacts and management measures for the Project.

13.2.1.6 Guideline – Noise and Vibration from Blasting

The EHP Guideline – Noise and vibration from blasting provides criteria for Environmental Authorities issued under the EP Act.

The guideline specifies human comfort criteria for:

- Airblast overpressure level;
- Ground vibration peak particle velocity; and
- Times of blasting.

The vibration and blasting criteria as per this guideline is provided in Section 13.6.4.

13.3 Environmental Objectives and Performance Outcomes

13.3.1 Environmental Objectives

The environmental objective relevant to noise is provided in the *Environmental Protection Regulation 2008* (EP Regulation). In accordance with the EP Regulation, the Project acoustic objective is to operate in a way that protects the EVs of the acoustic environment.

13.3.2 Performance Outcomes

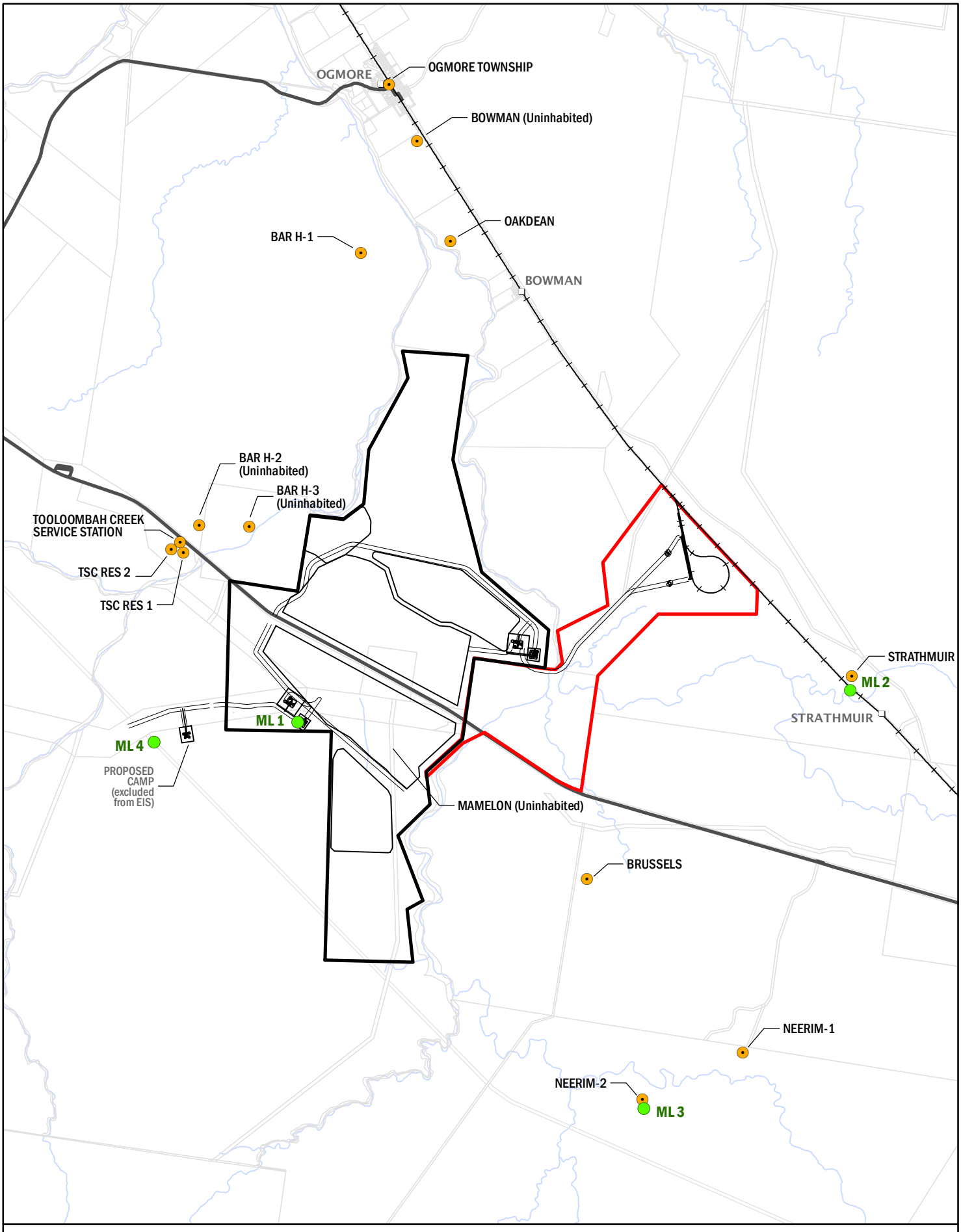
The acoustic performance outcomes include the following:

- The release of sound to the environment from the activity is managed so that adverse effects on EVs, including health and wellbeing, are prevented or minimised; and
- No noise or vibration complaints are received.

13.4 Assessment Method

13.4.1 Fieldwork

Noise monitoring was undertaken at four locations by Noise Measurement Services in 2011 as part of the baseline assessment for the Project. The assessment 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 have been referred to in this chapter and Appendix A8 – Noise and Vibration Technical Report. Further details of the noise monitoring assessment method by Noise Measurement Services is provided in Appendix A8 – Noise and Vibration Technical Report. The noise monitoring locations are shown on Figure 13-1.



N

0 1 2 km

Scale @ A4 1:80,000
Date: 21/07/17
Drawn: Gayle B.

Legend

- Noise monitoring location
- Sensitive receptor
- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Cadastral boundary
- Watercourse

Figure 13-1
Monitoring sites and sensitive receptors

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

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13.4.2 Noise Prediction Methodology

Noise level prediction have been assessed using the SoundPLAN noise modelling software using the CONCAWE noise prediction methodology. The CONCAWE methodology is suited for predicting noise propagation over large distances as it accounts for a range of atmospheric conditions that can significantly influence the propagation of noise. This method is supported by the *EIS Information Guideline – Noise and Vibration.* The SoundPLAN software and calculation methodology allows environmental parameters to be modelled. Further details on the noise prediction methodology is presented in Appendix A8 – Noise and Vibration Technical Report.

13.5 Existing Environment

13.5.1 Topography

Elevations across the Styx catchment range from 0 to 540 m above sea level. The area predominantly comprises flat or undulating lands, draining via several smaller creeks and tributaries to the Styx River and estuary, and into the Coral Sea. The land within the Project area can be described as gently undulating.

A LiDAR survey was conducted of the EPC 1029 area. Based on this data, elevations within the ML area vary between 4.5 and 155 m AHD, with the Project area located between 11.4 and 43.8 m AHD.

Based on the Capricornia Coastal Lands (CCL) program, the ML area contains the following geomorphological land units:

- Broad, level to gently undulating alluvial plains and fans on alluvium, including some areas of gilgai microrelief;
- Level to gently undulating plains and rises on sedimentary rocks and unconsolidated sediments, including some minor to severe gilgai microrelief;
- Undulating rises and low hills on deeply weathered sedimentary and metamorphic rocks;
- Narrow floodplains along the Styx River;
- Dissected low plateaus on gently dipping sedimentary rocks; and
- Rolling low hills and rises on hard sedimentary rocks.

13.5.2 Climatic Conditions

13.5.2.1 Temperature and Relative Humidity

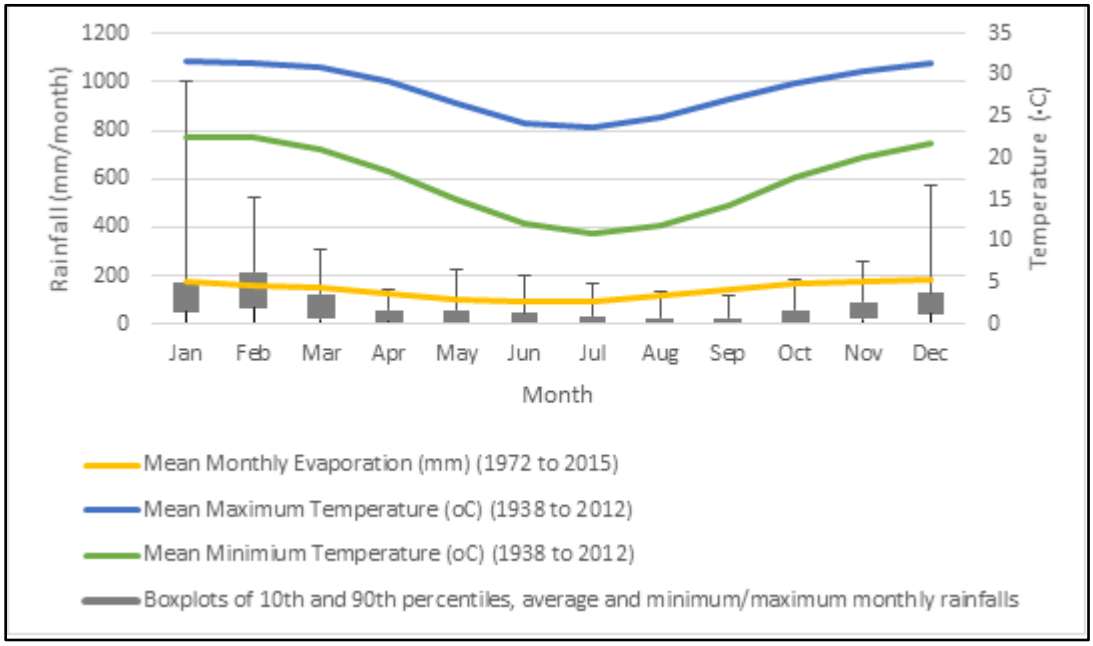
The annual average maximum temperature from the St Lawrence Post Office site (BoM station no. 033065) is 28.4°C, with a relatively small variation in average maximum temperatures across each month (23.8 to 31.7°C). Maximum temperatures above 40°C occur in the record in November to February, with the maximum of 44°C recorded on 5 January 1994. Mean minimum temperatures range from 10.9 to 22.5°C with a mean annual monthly minimum of 17.4°C. The minimum temperature was 2.2°C, which was recorded on 19 July 1963.

Average monthly relative humidity varies between 46% (3pm reading) and 74% (9am reading) throughout the year, with the highest values recorded at 9am between January and June, and the lowest between June and October at 3pm. These values reflect the dry conditions typical of the region.

13.5.2.2 Rainfall

Rainfall in the Styx catchment varies between 800 mm/year in the south to around 1,100 mm/year in the north (Melzer *et al*., 2008). A number of rainfall recording stations are located within the Styx catchment in the vicinity of the MLA area. These include Strathmuir and Tooloombah, St Lawrence Post Office and Mystery Park.

Monthly rainfall statistics from Strathmuir (BoM station no. 033189) for the period from 1941 through to 2016 is shown in Figure 13-2. These statistics show that generally November to March receives the most rain, with around 70% of the annual rainfall falling in this period. A larger variation is seen for the summer rainfall months, with January recording the largest variation (up to a maximum of 1,002 mm in January 1951).



Source: Rainfall from Strathmuir (BoM station no. 033189); Temperature and evaporation data from St Lawrence Post Office (BoM station no. 033065)

Figure 13-2 Rainfall, evaporation and temperature trends

The evapotranspiration Climatic Atlas of Australia (BoM, 2001) shows average annual evapotranspiration (areal potential) between 1,700 to 1,800 mm/yr, matched by recorded evaporation data in the area of 1,685 mm/yr (St Lawrence Post Office, BoM station no. 033065). Average evaporation exceeds average rainfall for all months as shown in Table 13-3 and Figure 13-2**.** However, as noted above, the large variation in rainfall means that 90th percentile rainfalls exceed evaporation during the January to March period.

Table 13-3 Monthly average evaporation and rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Monthly Evap. (mm)	174	158	152	129	105	90	96	115	140	167	177	183	1686
Mean Monthly Rainfall (mm)	138	145	82	36	39	31	26	19	16	40	64	104	740

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Difference (Evap. – Rainfall) (mm)	36	13	70	93	66	59	70	96	127	127	113	79	946

Source: Evaporation from St Lawrence Post Office (BoM station no. 033065), rainfall from Strathmuir (BoM station no. 033189)

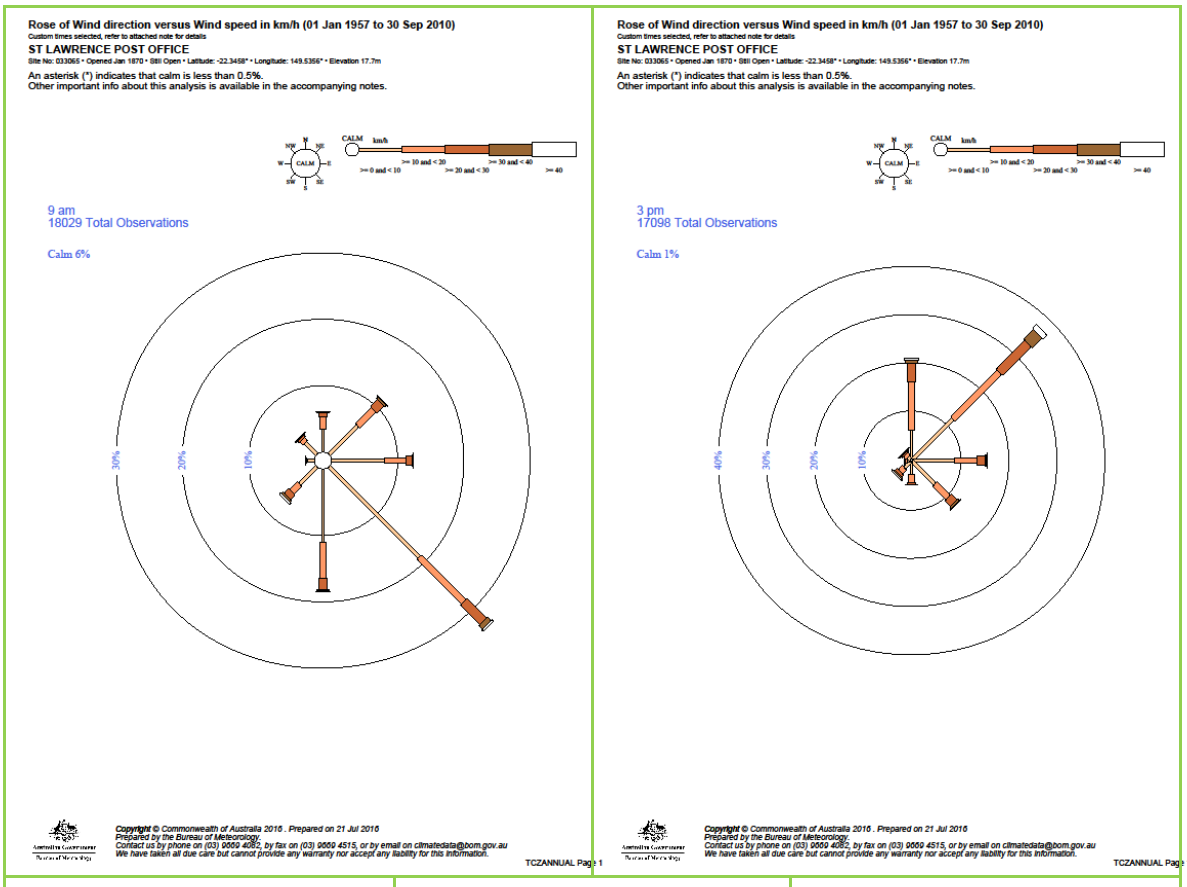
13.5.2.3 Wind Speed and Direction

Annual, seasonal and diurnal distributions of winds were predicted at the Project using The Air Pollution Model (TAPM) / CALMET meteorological modelling system for 2014.

The annual wind rose (Figure 13-3) shows the predominant wind directions at 9 am are from the southeast, and east to north east at 3 pm.

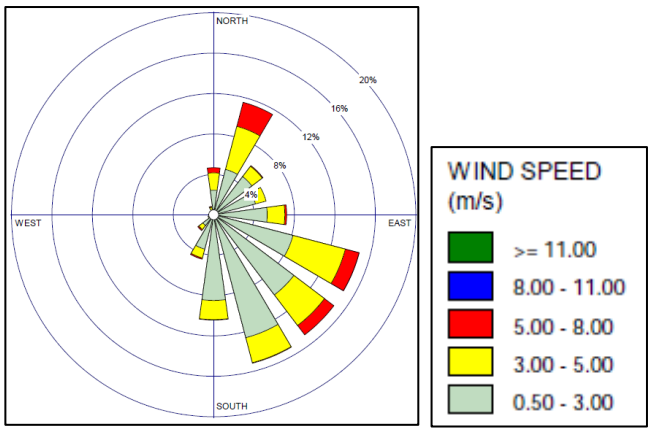
The seasonal wind rose (Figure 13-4) shows that the predominant wind directions are from the north northeast during spring, north northeast and southeast during summer. In autumn, the winds are primarily from the south easterly directions, southerly and south southeast winds are more frequent during the winter season.

The diurnal wind rose (Figure 13-5) shows the wind roses for the time of day during the year of 2014. The wind roses show that there are more frequent and stronger winds from the north northeast during the afternoon and evening periods.

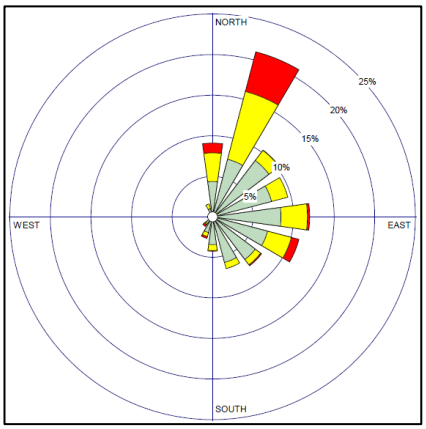


Location: St Lawrence	**Data Period:** 1957 to 2010	**Data Type:** Measured Data

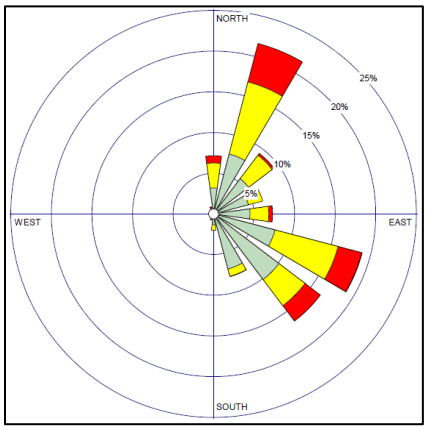
Figure 13-3 Annual wind rose



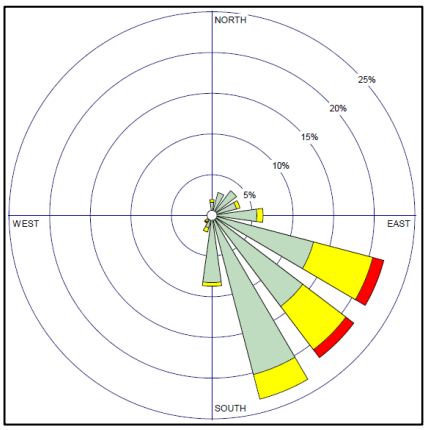
Annual (Calm – 0.97%)



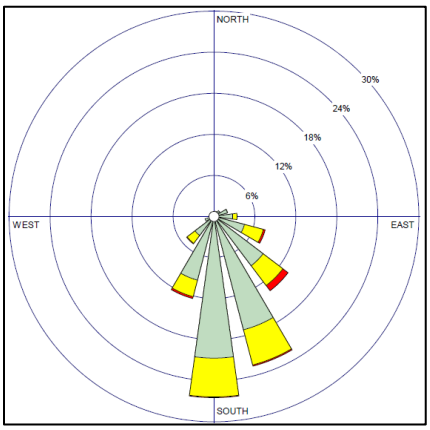
Spring (Calm – 1.10%)



Summer (Calm – 0.51%)



Autumn (Calm – 1.00%)



Winter (Calm – 1.27%)

Figure 13-4 Seasonal wind rose

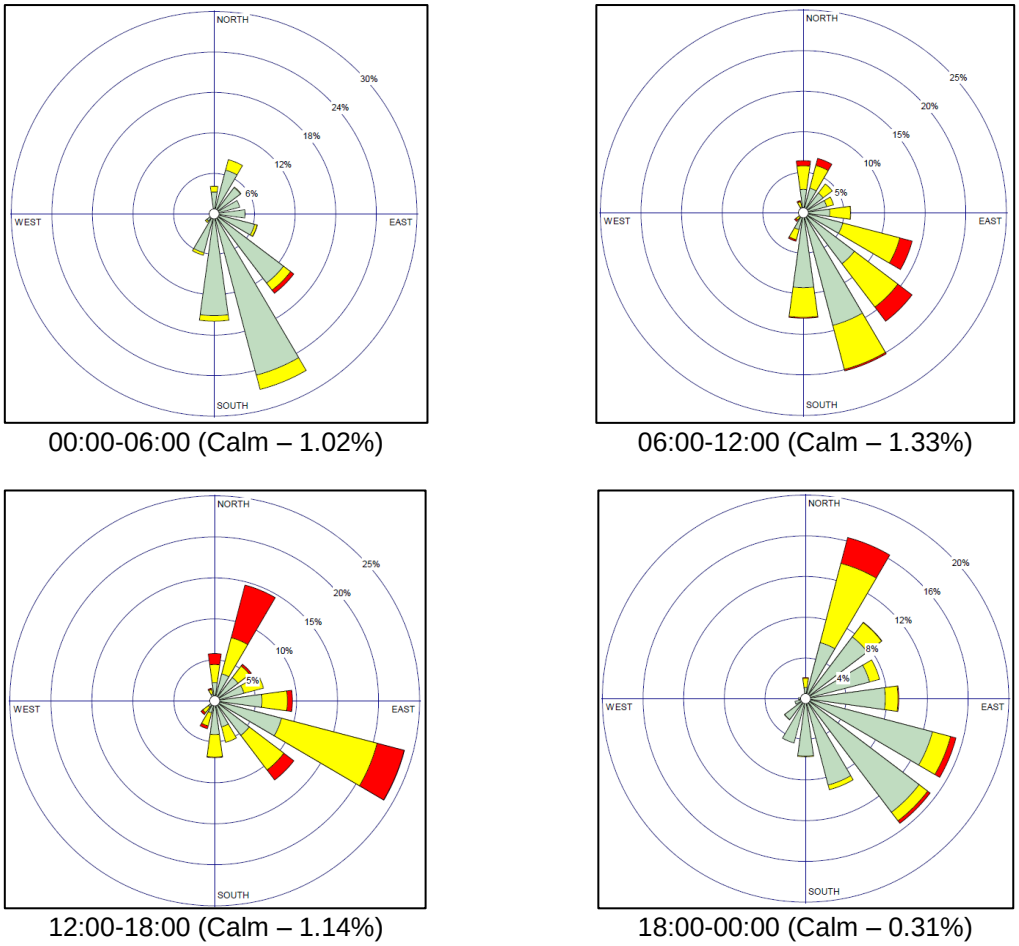


Figure 13-5 Diurnal wind rose

A comparison of the wind roses at 9 am and 3 pm for the TAPM derived dataset (Figure 13-3) at the Project site was also undertaken with the BoM long-term wind roses at St Lawrence. The 9 am wind roses from BoM and TAPM are very similar with slight differences in the percentage of time the wind blows from the southwest; 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% at 9 am. The 3 pm 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 from 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.

Key features of the winds are therefore:

- The winds were calm for 1% of the year;
- The winds were 0.5 - 3 m/s for 67% of the year;
- The winds were 3 - 5 m/s for 25% of the year;
- The winds were greater than 5 m/s for 7% of the year; and
- The 9 am and 3 pm wind roses for the TAPM modelled data are generally consistent with the measured data from the St Lawrence BoM Weather Station.

13.5.2.4 Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance the motion of noise. To determine which category is modelled, the Pasquill-Gifford stability classes need to be determined for the Project. 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 to F. 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.

For this assessment the weather conditions, including stability class frequencies at the proposed Project have been obtained from TAPM. TAPM is a three-dimensional prognostic model developed and verified by Commonwealth Scientific and Industrial Research Organisation (CSIRO). 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 13-4.

Table 13-4 Annual stability class distribution

Stability class	Description	Frequency of occurrence (%) and average wind speed (m/s)					
		Annual		Day (Annual)		Night (Winter)	
		Freq.	Wind speed	Freq.	Wind speed	Freq.	Wind speed
A	Very unstable low wind, clear skies, hot day time conditions	1.3%	2.1				
B	Unstable clear skies, day time conditions	10.8%	3				
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	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

During temperature inversions noise emissions from distant sources can be amplified. During the night time period (22:00 to 07:00 hours), Class F occurs 34.3% of the time.

13.5.3 Sensitive Receptors

Consistent with the EPP (Noise) a sensitive receptor is a place where noise can result in adverse impacts. As listed in Schedule 1 of the EPP (Noise) sensitive receptors include dwellings, libraries and educational institutions, childcare centres, medical institutions, commercial and retail activity centres, protected areas identified under the *Nature Conservation Act 1992* as a critical habitat or area of major interest, and public parks or gardens.

Using aerial imagery and on ground assessments, 10 sensitive receptors are located within the locality of the Project.

It is anticipated that the Project personnel will be accommodated locally; however, if this is not practicable an accommodation camp will be constructed outside the Mining Lease. The accommodation camp will be owned by the proponent to accommodate the Project workforce and visitors. Under the MMC, a camp associated with the Project is not considered a sensitive receptor and as such has not been assessed.

The receptor name and the location of each receptor is described in Table 13-5. Except for the Tooloombah Creek Service Station, all identified receptors are isolated homesteads. The nearest residential receptor, TSC Res1, is located approximately 2 km from the pit edge of Open Cut 1. Note that the modelling presented in Appendix A8 – Noise and Vibration Technical Report did not account for TSC Res 1 and TSC Res 2; however, given the proximity of these sensitive receptors to Tooloombah Creek Service Station the same results have been applied. The entire township of Ogmore has been counted as one sensitive receptor.

Sensitive receptor locations and monitoring locations in relation to the Project are shown in Table 13-5 and presented in Figure 13-1.

Overall, there a very few sensitive receptors surrounding the Project given the particularly rural nature of the area.

Table 13-5 Sensitive receptor locations within wider Project area

Receptor name	Location		Distance and direction to nearest open cut
	Latitude	Longitude	
BAR H-1	149.654152	-22.644752	4.1 km (N)
Brussels	149.69164	-22.736011	3.2 km (SE)
Neerim-1	149.716823	-22.761051	6.9 km (SE)
Neerim-2	149.701064	-22.768169	3.4 km (SE)
Oakdean	149.668225	-22.642817	4.5 km (NE)
Ogmore Township	149.658111	-22.619961	6.8 km (N)
Strathmuir	149.732975	-22.705505	6.3 km (E)
Tooloombah Creek Service Station	149.625007	-22.688686	2.2 km (W)
TSC Res 1	149.626891	-22.688964	1.9 km (NW)
TSC Res 2	149.626348	-22.687752	2.1 km (NW)

Environmentally Sensitive Area (ESA) mapping identified a category B ESA within the mining lease. This category B ESA is associated with remnant vegetation listed as Endangered under the *Vegetation Management Act 1999* (VM Act). The assessment of noise impacts on ecological receptors are addressed in Chapter 14 – Terrestrial Ecology.

13.5.4 Background Noise

The noise environment near 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 ML area and the North Coast Rail Line is located approximately 1.5 km from the northern boundary of the proposed ML 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.

Noise emitted from natural sources such as wind and fauna activity varies throughout the seasons. During the summer months, background noise is dominated by insect noise. Noise monitoring was undertaken in March 2011. Measurement results for this assessment have been supplemented by estimated background noise levels from Australian Standard AS1055.2 for a noise category R1 which is expected to be representative of a rural area with negligible transportation noise.

Type 2 environmental noise loggers were used to record L_{01}, L_{10}, L_{90} and L_{eq} levels in 15 minute intervals. 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 2 km 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

A summary of the noise monitoring results is presented in Table 13-6.

Table 13-6 Summary of noise monitoring results March 2011

Noise descriptor	Time period for all days	Overall noise levels dB(A) during monitoring period			
		ML1	ML2	ML3	ML4
$L_{eq, adj, 15 mins}$	Day (7am to 6pm)	40.3	49.8	41.3	39.7
	Evening (6pm to 10pm)	49.2	46.1	45.6	38.1
	Night (10pm to 7am)	45.3	50.9	39.5	37.4
$L_{01, adj, 15 mins}$	Day (7am to 6pm)	53.5	69.6	56.7	52.1
	Evening (6pm to 10pm)	56.3	53.1	57.8	50.4
	Night (10pm to 7am)	53.4	71.3	50.3	49.8
$L_{10, adj, 15 mins}$	Day (7am to 6pm)	40.5	45.6	42.2	39.6
	Evening (6pm to 10pm)	48.9	43.5	47.8	40.5
	Night (10pm to 7am)	46.3	44.1	42.2	40.0
$L_{90, adj, 15 mins}$	Day (7am to 6pm)	34.3	35.5	32.7	31.7
	Evening (6pm to 10pm)	44.7*	37.8	38.1	32.4
	Night (10pm to 7am)	39.5	38.2	32.6	28.1

* May be affected by seasonal insect or fauna noise

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, except for ML4.

13.6 Determining Background Noise Assessment Criteria

Background noise assessment criteria was based on the methods provided in the MMC (refer to Table 13-2). This is discussed in more detail below.

13.6.1 Construction Noise Criteria

In the absence of specific guidelines for the assessment of construction noise in the MMC, the potential construction noise impacts from the Project have been assessed against the EPP (Noise) objectives (see Table 13-1).

13.6.2 Operational Noise Criteria

The operational noise limits proposed for the Project, in accordance with the criteria set out in the MMC, are presented in Table 13-7. When determining the Project's specific noise criteria, the MMC calculations have been based on the lowest monitored noise levels for the day of the week classification (Monday to Saturday or Sunday and Public Holidays). This represents the most stringent criteria for the Project as the operations will be seven days, 24 hours per day a week. The operational criteria for the Project is presented in Table 13-7.

Table 13-7 Site specific noise criteria for sensitive places as per the MMC methodology

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

13.6.3 Low Frequency Noise Assessment

Low frequency noise is typically generated by machinery and plant and becomes more dominant within noise emissions over large distances as high and mid frequency sound dissipates. The assessment of low frequency noise was based on the Ecoaccess Draft Assessment of Low Frequency Noise Guideline (Roberts, 2004). This guideline does not provide a low frequency noise threshold relating to human health, but rather recommends a guideline level at which the likelihood of annoyance and complaints increases. This limit is 50 dB(Z) inside receptor buildings. Where the dB(Z) level exceeds the dB(A) measurement of 15 dB then additional monitoring is recommended.

13.6.4 Vibration and Blasting Criteria

The vibration and blasting as a result of the construction and operational phases have the potential to impact human comfort and create annoyance at sensitive receptor locations. There are no Australian standards for the impact of vibration on building structures or human comfort. However, British and German standards are often applied by the Australian industry for the assessment of construction and operation impacts from vibration.

13.6.4.1 Vibration

Vibration can result from a variety of sources, including industrial, construction and transportation activities. Vibration is generally classified according to time duration as follows:

- **Continuous vibration**: continues uninterrupted for a prolonged period (usually throughout day time and / or night time);
- **Impulsive vibration**: is an instantaneous build up to a peak followed by a damped decay that may or may not involve several cycles of vibration. It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is less than two seconds; and
- **Intermittent vibration**: can be defined as interrupted periods of continuous (for example a drill) or repeated periods of impulsive vibration (for example a pile driver), or continuous vibration that varies significantly in magnitude (Department of Environment and Conservation 2006).

Impacts of vibration during construction and operation can be summarised into two main categories:

- Human comfort and annoyance; and
- Damage to buildings.

Human Comfort and Annoyance Criteria

The guidelines for human comfort and annoyance are more stringent than the criteria to protect buildings from damage. The human comfort and annoyance criteria for residential receptors are described in Table 13-8. Root Mean Square (RMS) vibration velocity spectral bands below the preferred level represent a low risk for complaints and vibration below the trigger level represents a low risk of complaints.

There are no Queensland specific criteria for vibration. However, the New South Wales Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006) is recognised in the EIS Information Guideline – Noise and Vibration (EHP, 2014) as the applicable criteria. For this assessment, only continuous and impulsive vibration will be considered as intermittent vibration activities such as drills will be undertaken within the pits and these vibrations are localised (less than 20 m radius).

Table 13-8 Guideline for exposure to continuous and impulsive vibration

	Receptor	Time	RMS velocity (mm/s)	
			Preferred	Max
Continuous vibration	Residential	Day time	0.20	0.40
		Night time	0.14	0.28
Impulsive vibration	Residential	Day time	6.0	12.0
		Night time	2.0	4.0

Source: Department of Environment and Conservation 2006

Building Damage Criteria

The guideline values for vibration velocity used for evaluating building damage differ due to the exposure period. German Standard DIN 4150-3 outlines the peak particle velocity vibration values for short-term and long-term exposure that will not cause damage (Table 13-9). DIN 4150-3 defines short-term exposure as vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated and long term exposure as all types of vibration not covered by the definition of 'short-term vibration'.

The British Standard (BS) 7385.2-1993 'Evaluation and Measurement for Vibration in Buildings' outlines the peak particle velocity vibration values for transient vibration as a function of frequency, as shown in Table 13-10. DIN 4150-3 guideline values for the maximal value below which damage is unlikely to occur when measured in the top floor for two horizontal vibration components are described in Table 13-11.

Table 13-9 Short term vibration on structures (DIN 4150-3)

Structure type	Guideline values for velocity (mm/s)			
	Vibration at the foundation			Horizontal plane (All frequencies)
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	
Buildings used for commercial, industrial and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design	5	5 to 15	15 to 20	15
Other buildings	3	3 to 8	8 to 10	8

Table 13-10 Transient vibration guide values for cosmetic damage (BS 7385-2)

Structure type	Peak particle velocity in frequency range of predominant pulse	
	14 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/sec	
Unreinforced or light framed structures residential or light commercial type buildings	15 mm/sec at 4 Hz increasing to 20 mm/sec at 15 Hz	20 mm/sec at 15 Hz increasing to 50 mm/sec at 40 Hz and above

Table 13-11 Long-term vibration on structures (DIN 4150-3)

Type of structure	Guideline values for velocity (mm/s)
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	10
Dwellings and buildings of similar design and/or occupancy	5
Structures that, because of their sensitivity to vibration, cannot be classified in the other two categories and are of great intrinsic value (such as listed buildings under preservation order	2.5

13.6.4.2 Blasting Criteria

The noise and vibration impact of blasting and air-blast overpressure can be assessed in accordance with the MMC. The Project criteria for blasting, based on the methods prescribed in the MMC, are described in Table 13-12.

Table 13-12 Blasting noise and ground vibration limits

Blasting noise 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	No blasting
Ground vibration peak particle velocity	5 mm/second peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/second peak particle velocity at any time	No blasting

* Should blasting during these hours be required, approval will be sought from the appropriate Authorities, and will be covered by a specific Blast Management Plan.

13.7 Noise Modelling

Noise propagation over long distances can be significantly affected by the weather conditions, in particular winds and temperature inversions, as both these conditions can increase noise levels at sensitive receptors. They may also reduce noise levels in certain situations.

The EIS Information Guideline for Noise and Vibration requires the prediction of noise for 'different times of under both average and adverse climatic conditions'. Adverse climatic conditions with respect to noise modelling relates to those atmospheric conditions that enhance the motion of noise, that is calm and clear conditions during the evening and night time periods. Six meteorological categories are captured using the CONCAWE methodology. This assessment is based on the average and worst climatic conditions.

The average climatic conditions include:

- 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.

The worst climatic conditions include:

- 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.

13.7.1 Modelling Scenarios

Two different scenarios were modelled for the mining activities and were chosen to represent the main activity phases of the Project. The activity phases that were modelled are:

- Construction Phase (Year 1 to 3): the Project will use standard construction equipment, general trade equipment and specialised equipment as required (refer to Section 13.7.1.1); and
- Operational Phase – Year 12: mining activities will be at the peak during this year (refer to Section 13.7.1.2).

13.7.1.1 Construction Phase

The construction equipment modelled and the location of this equipment, for modelling purposes, is provided in Table 13-13 and Figure 13-6.

Table 13-13 Construction equipment modelled

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

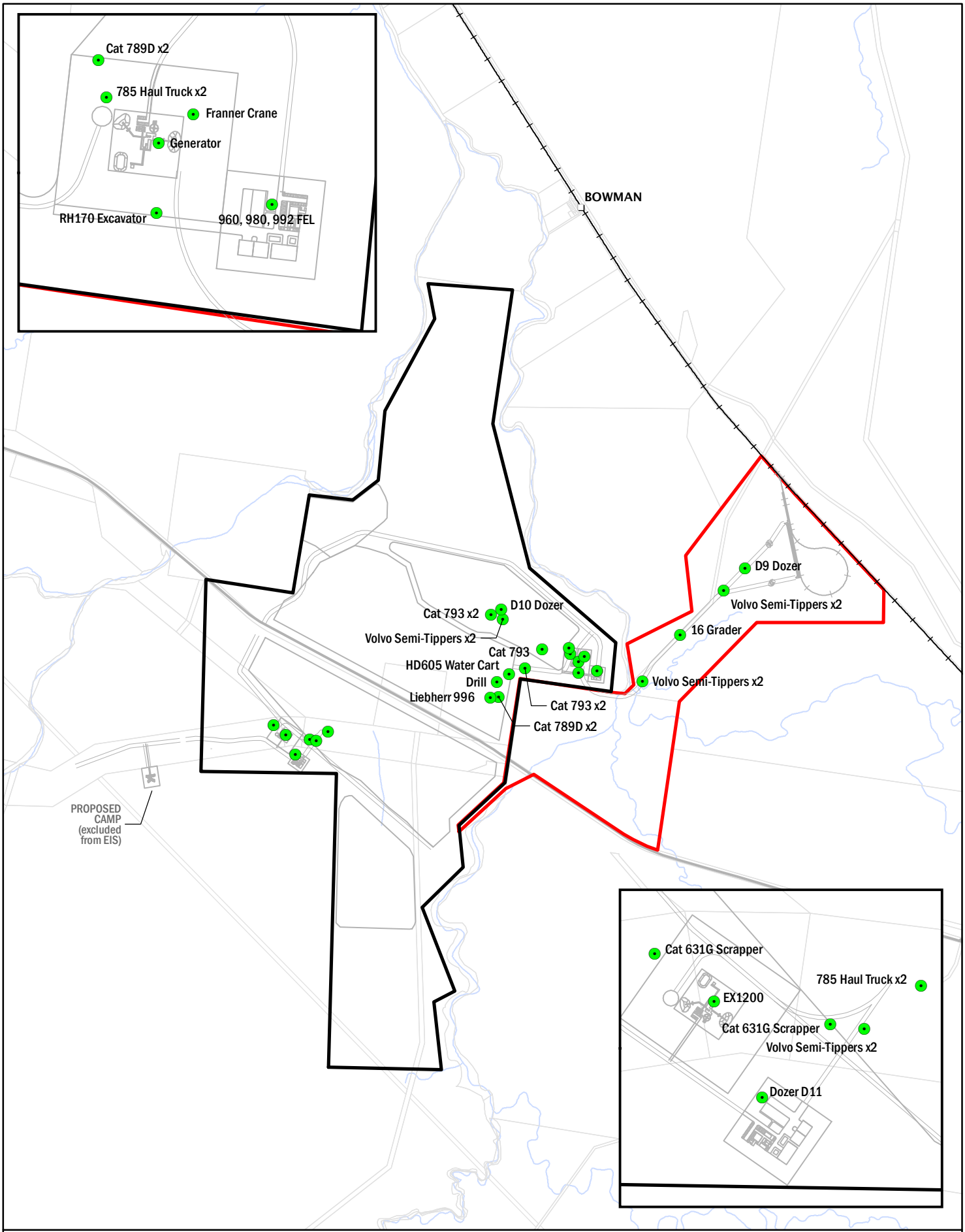


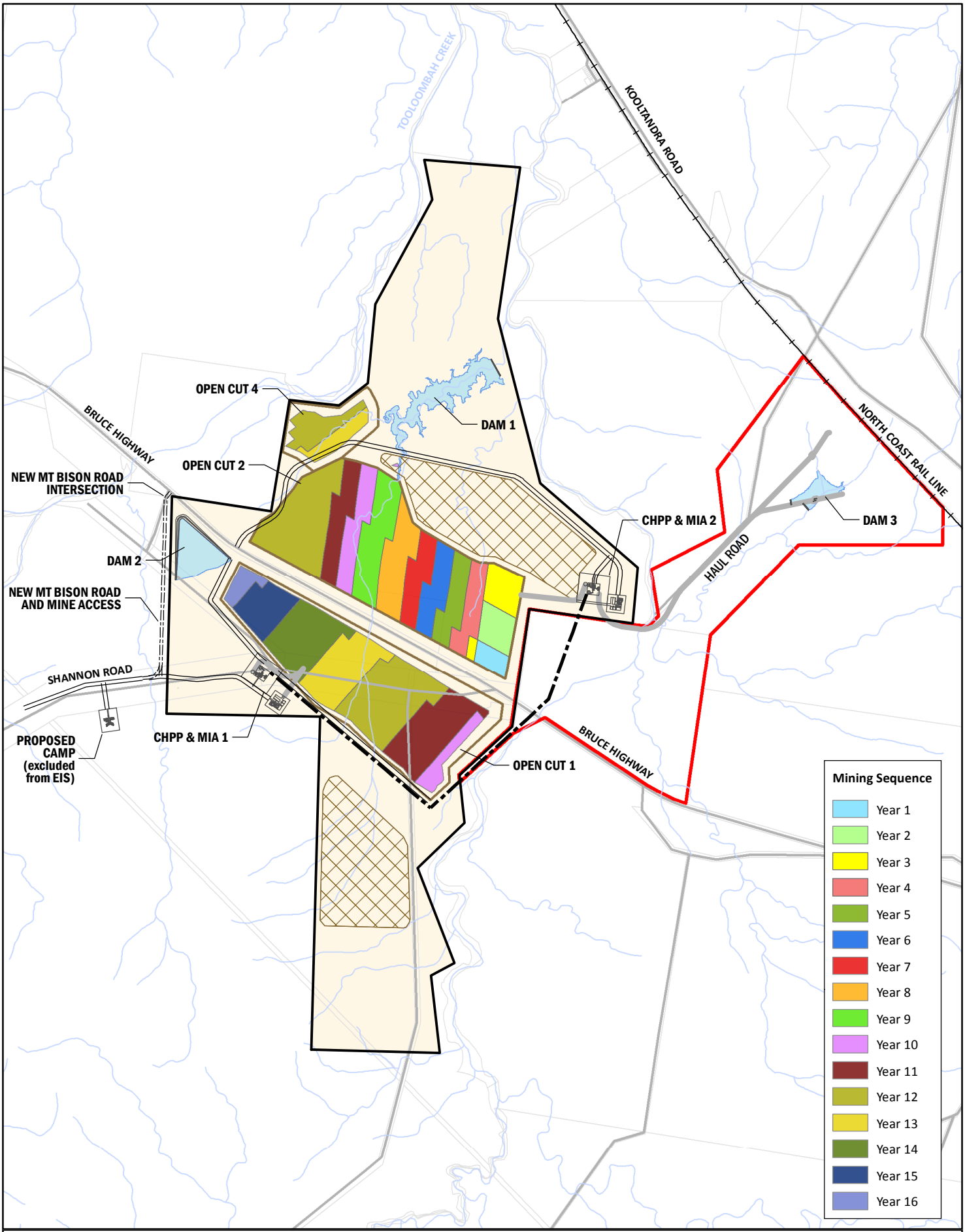
Figure 13-6
Construction sources as modelled

13.7.1.2 Operational Phase

The mining equipment sequence for the Project operations is presented Table 13-14 and the location of stationary equipment is presented in Figure 13-8. Based on the equipment schedule, noise modelling has been conducted for Year 12 of mining when mining activities are expected to be the highest (Figure 13-7). The operational phase modelled scenario was based on a 24 hour day, 365 day operation.

Table 13-14 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



N

0 0.5 1 km

Scale @ A4 1:55,000
Date: 19/07/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Open-cut Mine Pit
- Dam Catchment
- Waste Dump Area
- Overland Conveyor
- North Coast Rail Line
- Haul roads
- Proposed mine infrastructure
- Watercourse
- Main road
- Cadastral boundary

DATA SOURCE
QLD Open Source Data, 2017

Figure 13-7
Mining sequence

CDM Smith

BRUGGEMANNGD B:\BES150160 Styx Coal\GIS\DATA\MXD\FINAL\.03 EIS Preparation\BES150160.03-061 R2 Mine Schedule.mxd 7/19/2017

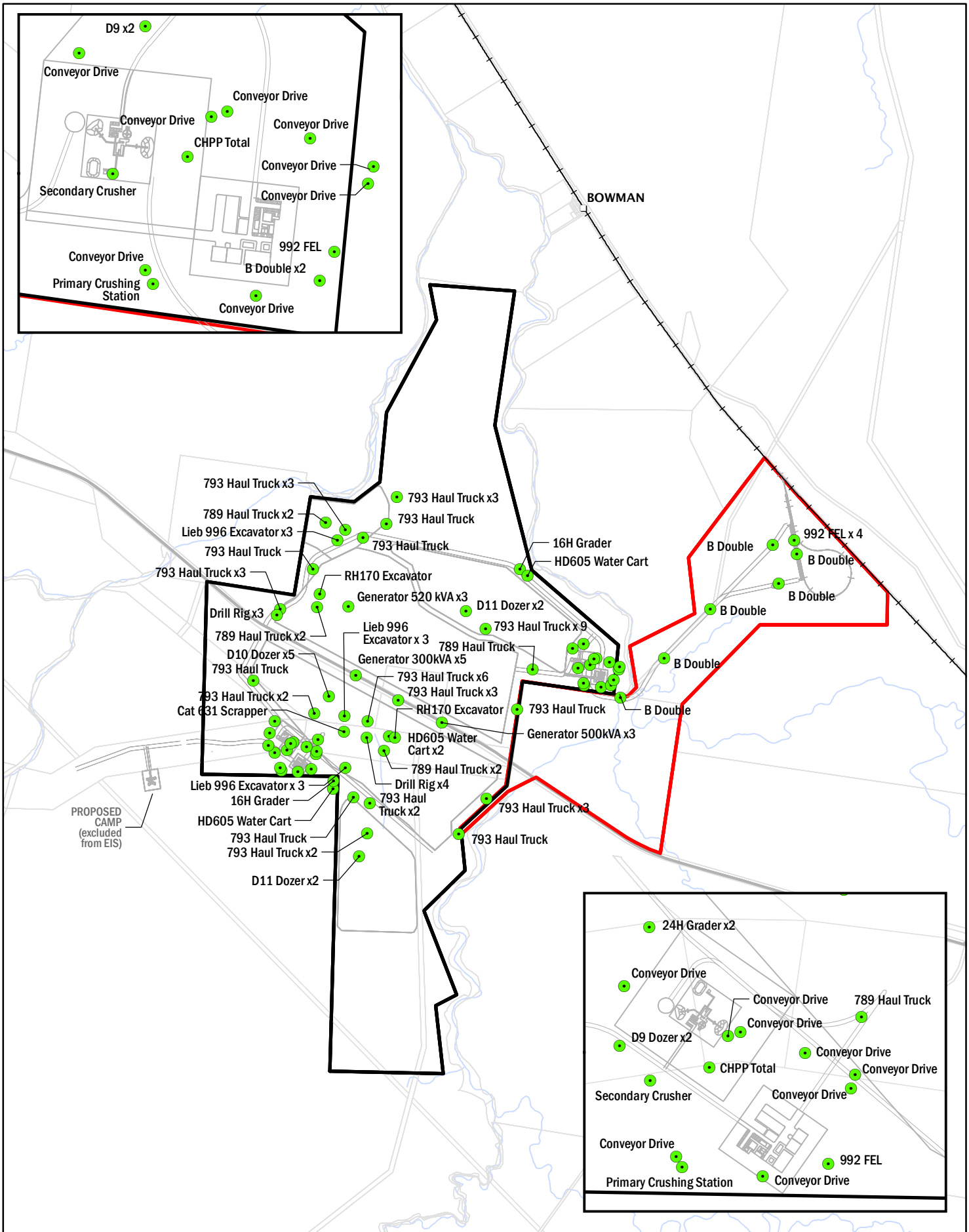


Figure 13-8

Location of stationary noise sources

N

0 0.5 1 km

Scale @ A4 1:62,500
Date: 21/07/17
Drawn: Gayle B.

Legend

- Operation sources
- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Cadastral boundary
- Watercourse

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

13.7.2 Sound Power Levels

Typical noise sources and levels were obtained from:

- Vipac's database, which includes noise measurements of plant equipment measured at numerous mine sites in Central Queensland;
- AS 2436 – 2010 'Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Site'; and
- BS 5228 - 2009 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' which provides a comprehensive list and associated noise emissions data of equipment used on construction sites globally.

The indicative equipment to be used and their corresponding sound power levels (noise) during the construction phase are outlined in Table 13-15 and operations in Table 13-16.

Table 13-15 Sound power levels for significant noise sources - construction phase

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}
Construction											
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 13-16 Sound power levels for significant noise sources - operational phase

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		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

13.7.3 Predicted Noise Levels During Construction

The predicted noise levels at sensitive receptors for the construction phase during average and worst climatic conditions are shown in Table 13-17 and Table 13-18. Noise criteria for construction has adopted the EPP (Noise) objectives as identified in Table 13-1. 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 13-15 will be in operating simultaneously, whereas this is unlikely to occur in actual operations.

The results show the noise levels from the Project for the day time, evening and night time period during average and worst climatic conditions are predicted to be below the applicable criteria for L_{Aeq} and L_{A1} at all sensitive receptors with the exception of the Brussels location and the two residents within 100 m of the Tooloombah Creek Service Station (TSC Res 1 and TSC Res 2). Construction noise levels at Brussels exceed the criteria during worst climatic conditions and construction noise levels at TSC Res 1 and TSC Re 2 exceed the criteria during average and worst climatic conditions.

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

Table 13-17 Construction phase noise predictions (L_{Aeq})

Receptor	Criteria (EPP) (dB(A))			Predicted noise level (dB(A)) average climatic conditions			Predicted noise level (dB(A)) worst climatic conditions		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
BAR H-1	37	37	30	27	27	28	28	29	28
Brussels	37	37	30	25	25	27	39	39	39
Neerim-1	37	37	30	13	13	14	26	27	26
Neerim-2	37	37	30	13	13	14	26	27	26
Oakdean	37	37	30	28	28	28	28	29	28
Ogmore Township	37	37	30	19	20	22	19	20	22
Strathmuir	37	37	30	18	19	20	32	33	32
TSC Res 1	37	37	30	34	35	35	36	36	36
TSC Res 2	37	37	30	34	35	35	36	36	36
Tooloombah Creek Service Station*	42	42	NA	34	35	NA	36	36	NA

* 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.

Table 13-18 Construction phase noise predictions (L_{A1})

Receptor	Criteria (EPP) (dB(A))			Predicted noise level (dB(A)) average climatic conditions			Predicted noise level (dB(A)) worst climatic conditions		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
BAR H-1	42	42	35	32	32	33	33	34	33
Brussels	42	42	35	30	30	32	44	44	44
Neerim-1	42	42	35	18	18	19	31	32	31
Neerim-2	42	42	35	18	18	19	31	32	31
Oakdean	42	42	35	33	33	33	33	34	33
Ogmore Township	42	42	35	24	25	27	24	25	27
Strathmuir	42	42	35	23	24	25	37	38	37
TSC Res 1	42	42	35	39	40	40	41	41	41
TSC Res 2	42	42	35	39	40	40	41	41	41

* Note that L_{A1} at Tooloombah Creek Service Station has not been assessed as there is no specific criteria.

13.7.4 Predicted Noise Levels During Operations

The predicted noise levels at sensitive receptors for Year 12 of the Project during average and worst climatic conditions are shown in Table 13-19 and Table 13-20. Figure 13-9 and Figure 13-10 shows the noise levels propagating from the Project during average and worst climatic conditions. Noise criteria for operations has adopted the MMC criteria as identified in Table 13-2. 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 13-16 will be operating simultaneously, whereas this is unlikely to occur in actual operations.

For noise sensitive receptors, L_{Aeq} and L_{A1} noise levels are predicted to exceed at a number of the sensitive receptors by up to 14 dB(A) during the day and evening, and by up to 21 dB(A) at night time during worst climatic conditions. For the commercial receptor (Tooloombah Creek Service Station) L_{Aeq} 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.

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

Table 13-19 Year 12 operational noise predictions (L_{Aeq})

Receptor	Criteria (MMC) (dB(A))			Predicted noise level (dB(A)) average climatic conditions			Predicted noise level (dB(A)) worst climatic conditions		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
BAR H-1	37	37	30	38	38	38	39	39	39
Brussels	37	37	30	30	31	32	44	45	44
Neerim-1	37	37	30	18	18	19	32	33	32
Neerim-2	37	37	30	19	19	20	32	33	32
Oakdean	37	37	30	37	37	35	37	38	37
Ogmore Township	37	37	30	29	30	29	29	30	29
Strathmuir	37	37	30	23	23	24	29	30	29
TSC Res 1	37	37	30	50	50	50	51	51	51
TSC Res 2	37	37	30	50	50	50	51	51	51
Tooloombah Creek Service Station*	42	42	NA	50	50	NA	51	51	NA

* 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.

Table 13-20 Year 12 operational noise predictions (L_{A1})

Receptor	Criteria (MMC) (dB(A))			Predicted noise level (dB(A)) average climatic conditions			Predicted noise level (dB(A)) worst climatic conditions		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
BAR H-1	42	42	35	43	43	43	44	44	44
Brussels	42	42	35	35	36	37	49	50	49
Neerim-1	42	42	35	23	23	24	37	38	37
Neerim-2	42	42	35	24	24	25	37	38	37
Oakdean	42	42	35	42	42	40	42	43	42
Ogmore Township	42	42	35	34	35	34	34	35	34
Strathmuir	42	42	35	28	28	29	41	42	41
TSC Res 1	37	37	30	50	50	50	51	51	51
TSC Res 2	37	37	30	50	50	50	51	51	51

* Note that L_{A1} at Tooloombah Creek Service Station has not been assessed as there is no specific criteria.

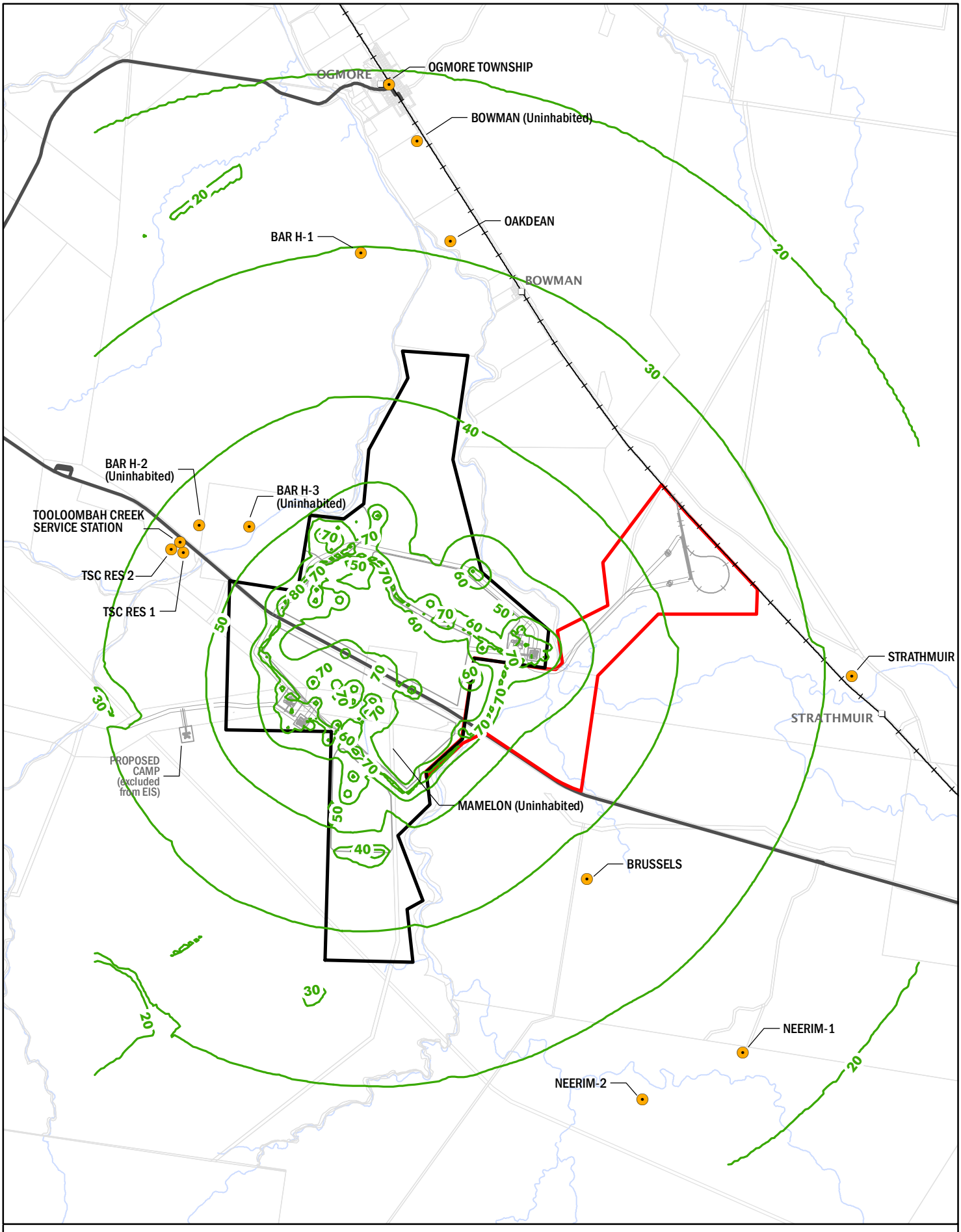
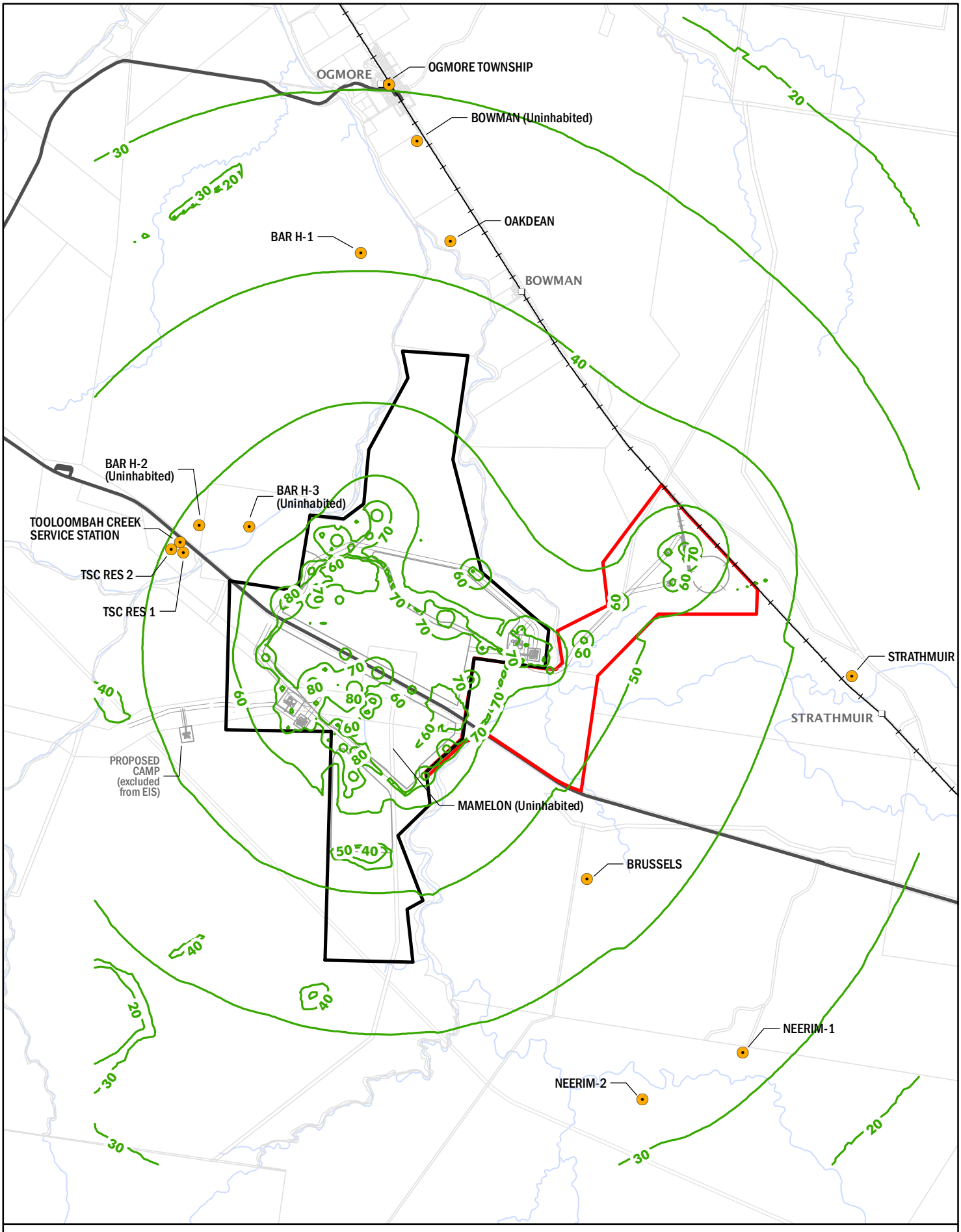


Figure 13-9
Operational noise predictions during average climatic conditions



N

0 1 2 km

Scale @ A4 1:80,000
Date: 21/07/17
Drawn: Gayle B.

Legend

- Operational noise predictions
- Sensitive receptor
- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Watercourse
- Cadastral boundary

Figure 13-10
Operational noise predictions during worst climatic conditions

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

13.7.5 Low Frequency Noise 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 in Table 13-21 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. Low frequency noise from mining activities are predicted to comply with Low Frequency Noise criteria and low frequency noise impacts are not predicted.

Table 13-21 Low frequency assessment

Receptor ID	Criteria	$L_{eq,\ 18:00\text{-}22:00\ hours}$ 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 (including TSC Res 1 and TSC Res 2)		58 dB(Lin), and dB(Lin)-dB(A) is 7dB

13.7.6 Vibration Assessment

The vibration assessment incorporated blasting (removal of overburden and extraction of coal from open cut pits) and mobile plant equipment. Blasting will be required to break and fragment the overburden and interburden horizons. The separation distances between the nearest pit edge and sensitive receptors is provided in Table 13-22.

Table 13-22 Separation distances for blasting assessment

Receptor	Distance to pit edge
Tooloombah Creek Service Station (including TSC Res 1 and TSC Res 2)	2 km
Brussels	3 km

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 13-23.

Table 13-23 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	1,000 kg / 250 kg

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

At 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. It is envisaged that an explosives contractor will provide the explosives for the site. The preferred option for storage and supply of bulk explosives is for the blasting contractor to store the chemicals in a remote location offsite, and then transport the shots to site in specially designed trucks for loading into the blast holes. The blasting contractor, through a specifically designed initiation system, connects each primed blast hole together with detonating cord. The speed at which each blast progresses is determined by the site Blast Engineer to minimise noise and vibration. Ground vibration and airblast overpressure from blasting will be managed to acceptable levels at the identified receptor locations in accordance with Australian Standard AS 2187 Explosives – Storage, Transport and Use.

Vibration from activities other than blasting are not expected to affect any sensitive receptors. Vibration from traffic on roads, for example, only affects areas within 20 m of the road. No receptors are located this close to the Project. Consequently, mobile plant equipment will not cause any disturbance to the sensitive receptors.

13.8 Potential Impacts

This section assesses the impacts of the modelled noise and vibration assessment results on the sensitive receptors shown in Figure 13-1.

13.8.1 Construction

Noise generation from the preparation of the open cut mining area and surface infrastructure areas will be the primary potential impact to the existing acoustic environment. This includes activities such as truck movements, blasting, constructing the TLF and power generation.

Based on the assessment presented in Section 13.7.3, noise levels from the Project's construction for the day time and evening periods are predicted to be below the applicable criteria for the L_{Aeq} and L_{A1} at all sensitive receptors during average climatic conditions apart from the TSC Res 1 and TSC Res 2 locations exceeding the night time criteria. During periods of modelled worst climatic conditions noise levels during day time and evening periods at all sensitive receptors except for at Brussels are predicted to be below the applicable criteria for the L_{Aeq} and L_{A1}. Noise levels at Brussels, exceed the criteria during worst climatic conditions with the highest predicted levels are L_{Aeq}, 39 dB and L_{A1}, 44 dB for day, evening and night time. Noise levels at TSC Res 1 and TSC Res 2 exceed the night time criteria during worst climatic conditions with the highest predicted levels being L_{Aeq}, 36 dB and L_{A1}, 41.

13.8.2 Operations

During operations, open cut mining will be the primary source of noise and vibration. Emissions will also occur during coal haulage and processing. The assessment has been based on Year 12 when peak operations will occur.

Based on the assessment presented in Section 13.7.4, and noting this is based on a maximum production rate of 10 Mtpa in Year 12 of operations, the day time and night time periods are predicted to exceed the applicable criteria for the L_{Aeq} and L_{A1} at a number of sensitive receptors by up to 14 dB(A) during the day and evening, and by up to 21 dB(A) at night time. During the night time period and based on a 10 Mtpa production scenario, exceedances are predicted at all sensitive receptors except for at the Ogmore Township.

13.9 Mitigation and Management Measures

The noise modelling results discussed in the aforementioned sections indicate that the noise levels from the Project are likely to exceed the Project criteria. General mitigation measures have been developed in accordance with the objectives of the EPP (Noise) to protect the ambient noise environment. In addition, specific mitigation measures are proposed for both the construction and operational activities to minimise the number of sensitive receptors impacted by the noise and to reduce the noise level.

13.9.1 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 hierarchy and mitigation measures:

- Undertaking ongoing monitoring at the Brussels, TSC Res 1 and TSC Res 2 sensitive receptors.

Should noise monitoring identify that noise level exceedances occur outside of "worst climatic conditions", and noting that these conditions (stability Class F) would typically occur on cold nights when windows are likely to be closed, the following mitigation measures will be implemented:

- Establish screens (i.e. vegetative, earthen mounds) between construction areas and the Brussels, TSC Res 1 and TSC Res 2 sensitive receptors; and then
- Limit construction works to the daytime periods near the Brussels, TSC Res 1 and TSC Res 2 receptors.

Should ongoing modelling identify ongoing exceedances and the above measures do not successfully reduce construction noise to acceptable levels at the Brussels, TSC Res 1 and TSC Res 2 sensitive receptors, internal and external noise mitigation such as double glazing on windows and wall insulation will be provided.

In implementing noise mitigation measures during the construction period, Central Queensland Coal will continue to liaise with the owners of Brussels, TSC Res 1 and TSC Res 2 and any other property to validate noise issues as they arise.

13.9.2 Mitigation for Operation

Noise modelling results indicate that CAT793D haul trucks are the major contributor of noise during operations. For receptors near the TLF, other major noise sources include CAT992 FEL's and B-Double Coal Haulage Units.

Leading up to achieving peak production of 10 Mtpa at year 12, Central Queensland Coal will as part of its approach to noise impact mitigation commence the 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). Predicted noise levels with CAT793 XQ are shown in Table 13-24 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. In all cases the use of CAT793 XQ trucks will see night period noise levels comply at all sensitive receptors, except at Brussels, Strathmuir, TSC Res 1 and TSC Res 2. Compliance with the noise criteria during this period would also result in compliance for day and evening.

Table 13-24 Predicted night time noise levels from operational activities – Year 12, 10 Mtpa scenario

Receptor ID	Criteria (L_{Aeq}/L_{A1})	$L_{Aeq,\ 2200\ -\ 07:00\ hours}$ dB(A)	$L_{A1,\ 22:00-07:00\ hours}$ dB(A)
		Worst Climatic	Worst Climatic
BAR H-1	30/35	30	35
Brussels	30/35	38	43
Neerim-1	30/35	25	30
Neerim-2	30/35	26	31
Oakdean	30/35	29	34
Ogmore Township	30/35	22	27
Strathmuir	30/35	32	37
TSC Res 1	30/35	42	47
TSC Res 2	30/35	42	47

With the replacement of CAT793D trucks with the quieter CAT793XQ trucks, noise levels are predicted to comply with the noise criteria at most receptors for both average and worst case climatic conditions. Noise exceedances of 8dB(A) are still predicted at Brussels for the night period and under worst case climatic conditions with the use of CAT793XQ trucks. Noise exceedance of 2 dB(A) are also predicted at Strathmuir for night period under worst climatic conditions. Noise exceedances of 12 dB(A) are predicted to occur at TSC Res 1 and TSC Res 2 with the use of CAT793XQ trucks. Note that Tooloombah Creek Service Station has not been included in the night time assessment as the service station does not currently operate at night. Should the Tooloombah Creek Service Station operate at night, the results associated with TSC Res 1 and TSC Res 2 will be applied given the proximity (approximately 100 m) of these residents to the service station. These results will be compared against the commercial criteria presented in Section 13.6. Notwithstanding, Tooloombah Creek Service Station marginally exceeds the evening criteria by 1 dB(A). This is exceedance is presented in Appendix A8 – Noise and Vibration Technical Report.

While noise levels are predicted to exceed under worst case climatic conditions at Brussels, Strathmuir, TSC Res 1 and TSC Res 2 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 EPP (Noise) for daytime, evening, and night time except for TSC Res 1 and TSC Res 2.

Should noise monitoring identify that noise level exceedances occur outside acoustic amenity levels recommended in the EPP (Noise) for daytime, evening, and night time, Central Queensland Coal Project will establish screens (i.e. vegetative, earthen mounds) between operational areas and the Brussels, Strathmuir, TSC Res 1 and TSC Res 2 sensitive receptors.

Should ongoing modelling identify exceedances despite the implementation of the above screening measures at the Brussels, Strathmuir, TSC Res 1 and TSC Res 2 sensitive receptors, internal and external noise mitigation such as double glazing on windows and wall insulation will be provided.

In implementing noise mitigation measures during the construction period, Central Queensland Coal Project will continue to liaise with the owners of Brussels, Strathmuir, TSC Res 1 and TSC Res 2 and any other property to validate noise issues as they arise. Central Queensland Coal Project will also consider shutting down specific operations when climatic conditions dictate.

13.9.3 General Noise Control Measures

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

- Providing appropriate training for 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.

13.9.4 Mitigation for Blasting

Mitigation measures to minimise the impacts of blasting include:

- Implement a Blast Management Plan;
- Blasting programs will be planned and safely executed to comply with the vibration standards;
- Blasting, overpressure and flyrock will be controlled to an acceptable level with the following control measures:
  - Blasting will occur on Monday to Sunday between 7am and 6pm only. No blasting will occur outside of these hours unless approval has been obtained from the relevant authorities and a specific Blast Management Plan has been prepared
  - Blasting activities will be carried out in accordance with the Project's EA so that ground vibration and airblast overpressure (the wave explosive energy released into the atmosphere) are within approved blasting limits and in accordance with AS 2187
  - Blasting activities will account for the direction the wind is blowing to reduce the risk of potential airblast overpressure impacts at noise sensitive receptors
  - Real time noise monitoring will be undertaken as outlined in the ACARP Live Noise Prediction Method for Australian Conditions (Sanderson, 2013)
- Consultation with surrounding landholders will be undertaken to develop protocols for notification of blasts including:
  - Residents and all workers will be notified prior to blasting activities
- An exclusion zone for people and livestock will be established around each blast site prior to firing a blast.

13.9.5 Complaint Management

Central Queensland Coal Project will develop a complaints procedure within its Standard Operating Procedures that will address issues raised by community members or stakeholders in regard to noise and vibration. Complaints will be further investigated, recorded and corrective actions will be implemented if required and where reasonable and actions taken will be communicated back to the complainant.

Where appropriate, further monitoring will be undertaken at the affected location. Monitoring will be conducted to provide feedback into the success of mitigation measures, to confirm modelling and determine if further corrective actions are required to protect sensitive receptors. Monitoring will be undertaken in accordance with the requirements of the EA conditions, the MMC and the EHP's Noise Measurement Manual.

Vibration and blasting monitoring will be undertaken as-needed during each blast event to provide feedback to control environmental impacts. Mitigation measures and blast design parameters may need to be revised if complaints or exceedances are recorded.

The complaints procedure will include:

- A site contact phone number will be established to allow a timely response to noise related complaints;
- A complaint register;

- A written response will be made within seven days;
- Additional monitoring (if appropriate) following a complaint, provided it is not vexatious or frivolous. If additional noise monitoring is required, it will be conducted at the affected location;
- If the applicable criteria or the EA conditions are exceeded corrective actions will be implemented; and
- Corrective actions will be reported to the affected persons and recorded in the complaints register or as required in the EA conditions.

13.10 Qualitative Risk Assessment

The risk of impacts arising from the Project is largely avoided by the very low number of sensitive receptors near the proposed mining activities. The nearest dwellings are TSC Res 1 and TSC Res 2 located within 100 m from the Tooloombah Creek Service Station, approximately 2 km to the northwest of Open Cut 1.

Potential impacts and risks to environment values within and surrounding the Project area have been assessed in accordance with the EnHealth Council's document The Health Effects of Environmental Noise – Other Than Hearing Loss (ENHealth Council 2004) and by utilising the risk assessment framework.

For the purposes of risk associated with noise and vibration, risk levels are defined as follows:

- Extreme – Works must not proceed until suitable mitigation measures have been adopted to minimise the risk;
- High – Works should not proceed until suitable mitigation measures have been adopted to minimise the risk;
- Medium – Acceptable with formal review. Documented action plan to manage risk is required; and
- Low - Acceptable with review.

A qualitative risk assessment that outlines the potential impacts, the initial risk, mitigation measures and the residual risk following the implementation of the mitigation measures is shown at Table 13-25.

Table 13-25 Qualitative risk assessment

Issue and associated Project phase	Potential impacts	Potential risk	Mitigation measures	Residual risk
Vibration and over blast pressure (construction and operation)	Blasting activities that occur during construction will generate ground vibration, overpressure and potentially flyrock. The vibration during blasts will be within a range of human comfort at sensitive receptor locations given the separation distances. Blasting procedures will keep flyrock to a minimum and contained within the pit. Unplanned blast events or accidents in the blasting processes can cause unanticipated noise and vibrational impacts. Such an event may occur in a year through human error or equipment failure.	Low	Blasting programs will be planned and safely executed to comply with the vibration standards. Blasting, overpressure and flyrock will be controlled to an acceptable level with the following control measures: ▪ Blasting will occur on Monday to Sunday between 7 am and 6 pm only. No blasting will occur outside of these hours; ▪ Blasting activities will be carried out in accordance with the Project's EA so that ground vibration and airblast overpressure (the wave explosive energy released into the atmosphere) are within approved blasting limits; ▪ Blasting activities will account for the direction the wind is blowing to reduce the risk of potential airblast overpressure impacts at noise sensitive receptors; ▪ Real time noise monitoring will be undertaken as outlined in the ACARP Live Noise Prediction Method for Australian Conditions (Sanderson, 2013); ▪ Consultation with surrounding landholders will be undertaken to develop protocols for notification of blasts including: – Residents and all workers will be notified prior to blasting activities – Onsite monitoring of noise and vibration will be undertaken ▪ An exclusion zone for people and livestock will be established around each blast site prior to firing a blast. The above blasting protocols will also be in place during for any operational blasting activities which are required.	Low
Noise disturbance to residents (construction)	Noise from the Project's construction has the potential to cause a nuisance to residential receptors.	Low	Noise sources from construction activities will be attenuated, where practicable and will involve: ▪ Scheduling mobile equipment so that it does not congregate during the night time period;	Low

			▪ Training staff to operate the equipment to minimise unnecessary noise emissions; ▪ Machines and plant will be switched off when not in use and not left running unnecessarily; and ▪ Plant will be used in accordance with manufacturers' instructions. Care will be taken to site equipment away from noise sensitive areas. Where possible, loading and unloading will also be carried out away from such areas.	
Disturbance to wildlife (construction and operation)	Refer to Chapter 14 – Terrestrial Ecology and Chapter 16 – Matters of National Environmental Significance for noise related impacts.	Low	Refer to Chapter 14 – Terrestrial Ecology and Chapter 16 – Matters of National Environmental Significance for noise related mitigation measures.	Low
Noise disturbance to residents (operation)	Low frequency noise from mining activities are predicted to comply with low frequency noise criteria and low frequency noise impacts are not predicted.	Low	Apply general noise attenuating measures and monitor noise at sensitive receptors to confirm noise modelling results and manage complaints. General noise attenuating measures include: ▪ Training for staff to operate the equipment to minimise unnecessary noise emissions; ▪ Internal roads will be kept well maintained; ▪ Machines and plant will be switched off when not in use and not left running unnecessarily; ▪ Rubber linings will be used where practicable in, for example, chutes and dumpers to reduce impact noise; ▪ The drop heights of materials will be minimised, where practicable; ▪ As far as reasonably practicable, sources of significant noise will be enclosed. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements; ▪ Plant will be used in accordance with manufacturers' instructions. Care will be taken to site equipment away from noise sensitive areas. Where possible, loading and unloading will also be carried out away from such areas; and ▪ When purchasing new equipment or machinery, noise emissions will be considered as part of the procurement process.	Low

Low frequency noise (operation)	As the mid to high frequency components dissipate over distance low frequency noise becomes more dominant and can result in human discomfort resulting in annoyance. The continuous use of machinery can contribute to low frequency noise. Low frequency noise from mining activities are predicted to comply with low frequency noise criteria and low frequency noise impacts are not predicted.	Medium	Upon receiving a complaint noise monitoring will be undertaken, corrective actions will be implemented where required and general noise attenuating measures will be applied. General noise attenuating measures include: ▪ Training staff to operate the equipment to minimise unnecessary noise emissions; ▪ Internal roads will be kept well maintained; ▪ Machines and plant will be switched off when not in use and not left running unnecessarily; ▪ Rubber linings will be used where practicable in, for example, chutes and dumpers to reduce impact noise; ▪ As far as reasonably practicable, sources of significant noise will be enclosed. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements; ▪ Plant will be used in accordance with manufacturers' instructions. Care will be taken to site equipment away from noise sensitive areas. Where possible, loading and unloading will also be carried out away from such areas; and ▪ When purchasing new equipment or machinery, noise emissions will be considered as part of the procurement process.	Low

13.11 Conclusion

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 thus noise mitigation is required. Noise impacts will be managed through a Noise Management Plan and for blasting outside of MMC stipulations, a Blast Management Plan. A complaints procedure will allow for all complaint regarding the Project's noise to be documented, investigated and reported, with corrective actions provided as appropriate. The main noise reduction measure during operations is the replacement of CAT793D trucks with CAT793 XQ haul trucks leading up to achieving peak production of 10 Mtpa.

The Noise Management Plan will be developed in consultation and engagement with potentially affected receptors to achieve alternative arrangements, in particular at Brussels, Strathmuir and TSC Res 1 and TSC Res 2.

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.

13.12 Commitments

In relation to managing potential noise impacts, Central Queensland Coal's commitments are provided in Table 13-26.

Table 13-26 Commitments – noise and vibration

Commitment
Continue to liaise with the owners of Brussels, Strathmuir, TSC Res 1 and TSC Res 2 and any other properties to validate noise issues if they arise.
Commence the replacement of CAT793D trucks with CAT793 XQ haul trucks prior to peak operations (year 12) or earlier if production reaches 10 Mtpa.
Develop a complaints procedure within the Standard Operating Procedures that will address issues raised by community members or stakeholders regarding noise and vibration.
Develop and implement a Noise Management Plan.
Should noise monitoring identify that noise level exceedances occur outside acoustic amenity levels recommended in the EPP (Noise) for daytime, evening, and night time, Central Queensland Coal Project will establish screens (i.e. vegetative, earthen mounds) between operational areas and the Brussels, Strathmuir, TSC Res 1 and TSC Res 2 sensitive receptors.

13.13 ToR Cross-reference Table

Table 13-27 ToR cross-reference

Terms of reference	Section of the EIS
8.11 Noise and Vibration	
Describe and illustrate the locations of any sensitive receptors that are listed in Schedule 1 of the Environmental Protection (Noise) Policy 2008.	Section 13.5.3
Also describe any other environmental values that could be impacted by emissions from the proposed project.	Section 13.2.1.2
Fully describe the sources and characteristics of noise and vibration that would be emitted during the construction, commissioning, operation, upset conditions, and closure of the project.	Section 13.7
Conduct noise and vibration impact assessment in accordance with the EHP's EIS *information guideline—Noise and vibration*. The assessment must address low-frequency (<200Hz) noise emissions and potential cumulative impact of the project with other emissions of noise from any existing developments and known possible future development in the area.	Sections 13.7.5, 13.7.6 and 13.10 and Chapter 3 – Project Description
Describe how the proposed activity would be managed to be consistent with best practice environmental management.	Section 13.9 and 13.10
The EIS must address the compatibility of the project's noise emissions with existing or potential land uses in surrounding areas. Potential land uses might be gauged from the zonings of local planning schemes, or State Development Areas, etc.	Chapter 3 – Project Description
Describe how the achievement of the environmental management objectives would be monitored, audited and reported, and how corrective actions would be managed.	Sections 13.9 and 13.10