15 Noise and Vibration

Section 15 Noise and Vibration

15.1 Introduction

This section provides an assessment of potential impacts associated with noise and vibration generated during the construction and operation phases of the Alpha Coal Project (Rail) (herein referred to as the Project).

The scope of work for the noise and vibration assessment comprises of the following:

- desktop review to identify key environmental noise catchment areas and noise sensitive receptors from aerial and terrestrial photography;
- establishment of Project specific noise goals for the operational phase of the Project with consideration to relevant regulatory requirements and publications, such as:
  - Australian Standard AS 1055.2 (1997) – Acoustics – Description and Measurement of Environmental Noise (AS1055);
  - Queensland Parliamentary Counsel (2008) - Environmental Protection (Noise) Policy 2008; and
  - Queensland Department of Transport and Main Roads (DTMR) Interest in Planning Scheme – Planning for Rail Noise (updated March 2010).
- noise modelling using Computer Aided Noise Abatement (Cadna-A) software to predict sound pressure levels of rail traffic emanations in the corridor for 60 Million Tonnes per Annum (Mtpa) and to provide an indication of areas of land likely to be impacted by the Project; and
- conduct a desktop construction noise, vibration and blasting assessment based on distance from the Project to the sensitive receptors.

15.2 Description of Environmental Values

15.2.1 Background Noise Levels

As the Project is located predominantly in rural areas, well away from most sensitive receptors, background noise monitoring was not undertaken. Instead, reference was made to AS1055.2 which provides typical values dependent on land use and time of day as a method of estimating background noise.

In AS 1055.2, 'Noise Area Categories', designated R1 to R6 are used to describe neighbourhoods in terms of transportation and industrial noise influences. The categories should be selected irrespective of metropolitan or country zoning. These categories have been used to determine the background sound levels for the Project.

For the nearest affected rural residential area to the Project, the appropriate description is considered to be R1. Category R1 refers to an area which is 'areas with negligible transportation'.

Adopting this approach, the background noise levels from Appendix B of AS1055.2 are estimated to be as shown in Table 15-1.

Table 15-1: Average Background A-Weighted Sound Pressure Level $L_{A90,T}$

Time of Day	Background Noise Level $L_{A90,T}$
Monday to Saturday	
7 am to 6 pm	0
6 pm to 10 pm	35
10 pm to 7 am	30
Sunday and Public Holidays	
7 am to 6 pm	40
6 pm to 10 pm	35
10 pm to 7 am	30

15.2.2 Land Use and Noise Sensitive Receptors

The land use immediately surrounding the Project is primarily rural in nature, in particular being cattle grazing. Table 15-2 lists potential sensitive receptors identified within 500 m of the Project (refer to Figure 15-1).

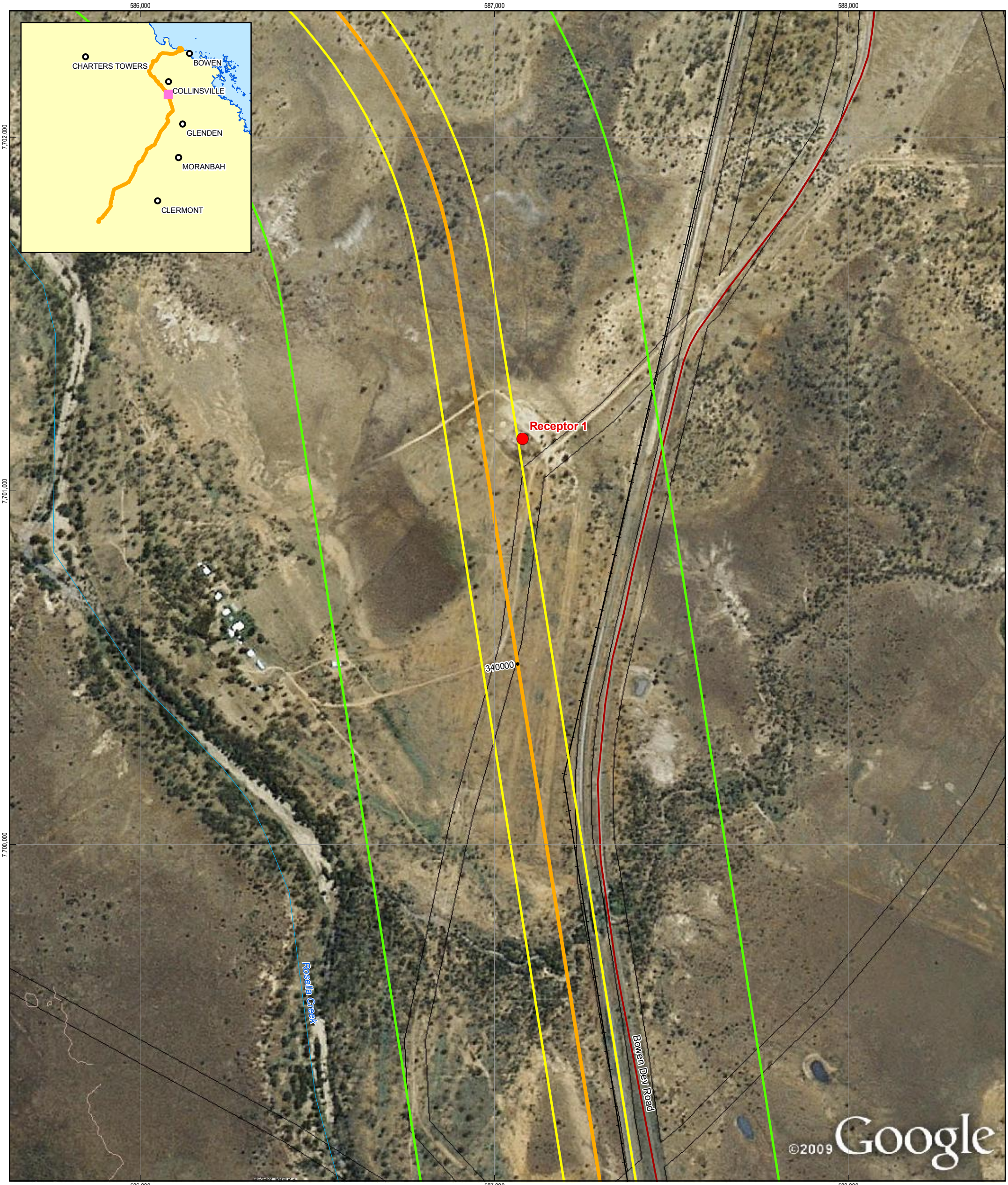
Table 15-2: Sensitive receptors

Receptor	Easting	Northing	Distance from proposed track in metres (m)	Description of receptor
R1*	587080	7701148	113	Occupied dwelling
R2	549392	7748051	260	Occupied dwelling

* Note, the nature of this building is unknown, therefore this receptor has been conservatively assumed to be an occupied dwelling (sensitive receptor).

With the exception of the Caley Valley Wetland, the Project does not pass through any areas of particular nature conservation significance that might be adversely affected by noise. The wetland provides habitat for migratory birds, particularly during the wet season.

The Social Impact Assessment, Volume 3, Section 20 of this EIS has identified that livestock in the vicinity of the rail corridor may be impacted by operational noise.



LEGEND

- Sensitive Receptor
- Proposed Alignment
- Existing Railway
- State Road
- Watercourse
- Contour (5m)
  - Major Contour
  - Minor Contour
- Cadastre
- Easement
- 1000m Corridor
- 200m Corridor

Source: See Copyright Details below and for full disclosure please refer to the EIS ***Volume 4 - References***

1:10,000 (at A3)

0 0.05 0.1 0.2 0.3 0.4 0.5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N W E S

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Alpha Coal Project
Environmental Impact Statement

SENSITIVE RECEPTORS

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Revision	A
Date	21-09-2010

Figure: 15-1
Sheet 1 of 2

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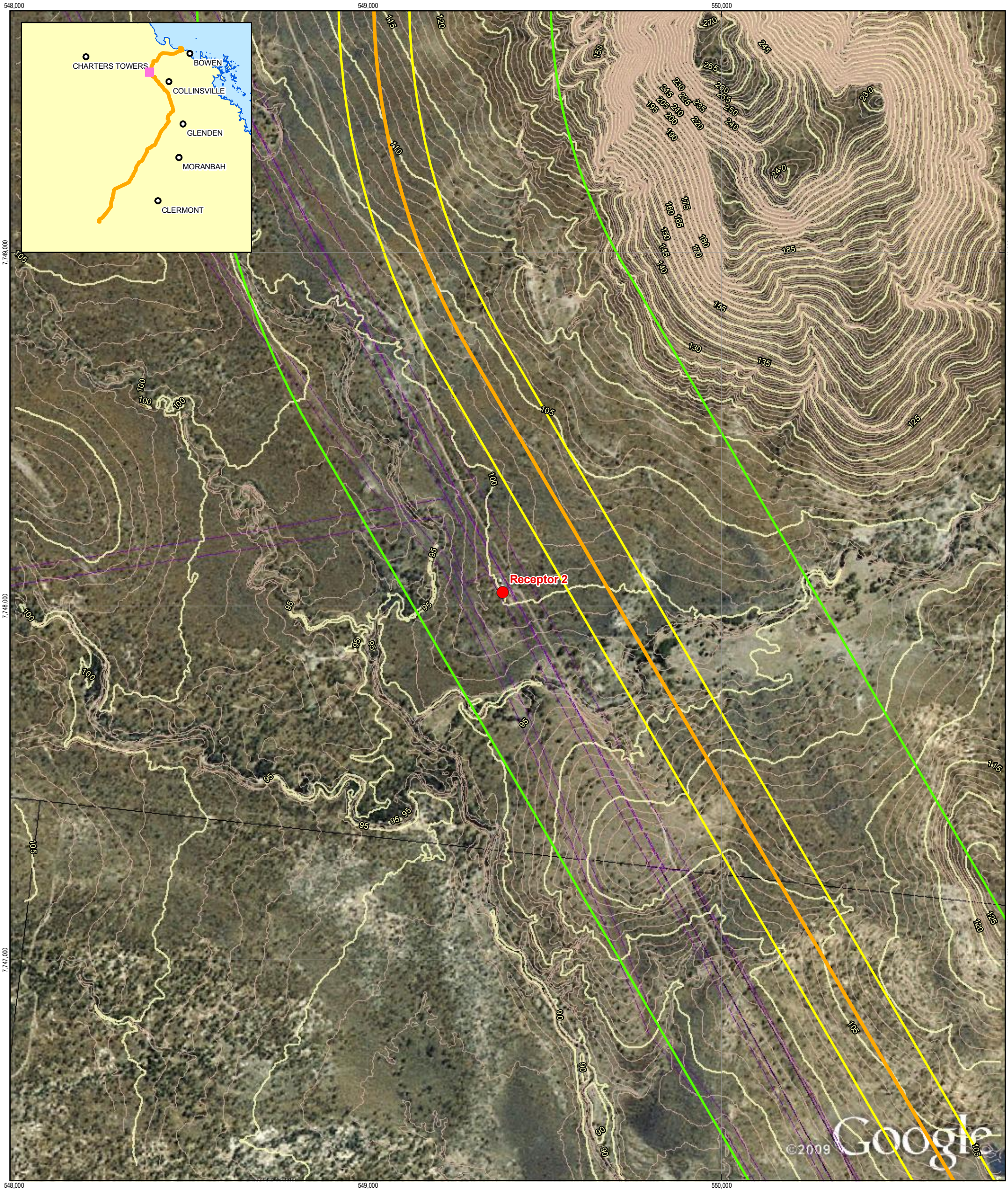

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Figure: 15-1
Sheet 2 of 2

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15.2.3 Environmental Values and Criteria

15.2.3.1 Noise Values

For Queensland, the key environmental values for the acoustic environment are outlined within Section 7 of the *Environmental Protection (Noise) Policy 2008* (EPP (Noise)). While the EPP (Noise) sets out acoustic quality objectives, Clause 8 (4) states that these do not apply to safety and transport, including rail, infrastructure. The EPP (Noise) nominates 'Planning Levels' (PL) for assets such as railways. The PLs are as follows:

- 65dB(A) $L_{eq, 24hr}$.
- 87dB(A) L_{Amax}.

This noise assessment is based on the abovementioned rail noise limits. Construction noise criteria are not addressed in Queensland laws or policies.

15.2.3.2 Low Frequency Noise

The Ecoaccess Queensland Environmental Protection Agency (EPA) Draft Guideline, Noise - Assessment of Low Frequency Noise (Roberts, 2004), provides guidance in assessing annoyance and discomfort to persons at noise sensitive places caused by low frequency noise comprised in the 10 Hz to 200 Hz range.

The Draft Guideline, Noise – Assessment of Low Frequency Noise (Roberts, 2004), separates the assessment of low frequency noise based on the frequency content of the noise and whether the noise is tonal or broadband. For non-tonal low frequency noise in the range of 10 Hz to 200 Hz, the Draft Guideline, Noise – Assessment of Low Frequency Noise (Roberts, 2004), suggests that the noise is considered to be acceptable if the contribution of low frequency noise within a room (LpA, LF) does not exceed the level shown in Table 15-3. It should be noted that these values are based on measurements conducted inside a dwelling.

Table 15-3: Recommended limits for non-tonal low frequency noise within a room (LpA,LF)

Type of Space	$L_{pA, LF}$ dB(A)[1,2]
Dwelling, evening and night	20
Dwelling, day	25
Classroom, office etc.	30
Rooms within commercial enterprises	35

Source: Jacobsen, 2001

15.2.3.3 Sleep Disturbance Criteria

Maximum noise levels over the night time period should be restricted to prevent sleep disturbance. Sleep disturbance criteria can be complex and vary from individual to individual, making it difficult to set firm criteria.

[1] Averaged over 10 minutes.

[2] If the noise has an impulsive character (e.g. drop forge, disco music), the limits are reduced by 5 dB.

The current Department of Environment and Resource Management (DERM) *Guideline – Planning for Noise Control Guideline 2004* provides guidelines on determining appropriate noise levels for minimising likelihood of sleep disturbance based on the likelihood of a person waking when exposed to a certain instantaneous noise level. This is then converted into the number of times per night that these instantaneous noise levels can be exceeded without waking individuals.

The guideline recommends that instantaneous internal sound pressure levels do not exceed in the order of 45 dB(A) L_{max} more than 10-15 times per night as a rule in planning for short-term or transient events.

On this basis, a "mid range" external noise level of 55 dB(A) L_{max} more than 10-15 times per night is considered appropriate for assessment purposes, as a 10 dB outside – inside reduction in noise level through a partially open window is typical.

15.2.3.4 Vibration

Vibration must be considered from a range of criteria:

- human comfort;
- building damage; and
- damage to buried pipelines and other infrastructure.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. Vibration levels of 1mm/s are readily noticeable by humans and levels of 14 mm/s will be very strongly felt. While vibration at these levels is not harmful to humans, it can significantly affect amenity.

BS 6472 – 1992, "Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)" is recognised as the preferred standard for assessing the "human comfort criteria". The BS 6472 human comfort peak vibration limits are shown in Table 15-4 for the frequency range of 8 Hz to 80 Hz which is applicable to construction works. There are no known existing uses in the immediate Project area which would contribute to existing vibration levels.

Table 15-4: BS 6772 Human Comfort Vibration Limits from 8 Hertz to 80 Hertz (millimetres per second peak particle velocity[3])

Receiver Type	Period[4]	Continuous Vibration		Intermittent and Impulsive Vibration	
		Preferred	Maximum	Preferred	Maximum
Residential	Day	0.28	0.56	8.6	17
	Night	0.2	0.4	2.8	5.6

Currently, there is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures.*

Short-term vibration guideline values for protection of structures are presented in Table 15-5.

[3] Based on sinusoidal vibration sources

[4] Day is between 7 am and 10 pm and night is between 10 pm and 7 am.

Table 15-5: Guideline Values for Protection of Structures

Guideline Values for Velocity, vi(t)[1] [mm/s]				
Line	Type of Structure	Vibration at the Foundation at a Frequency of		
		1Hz to 10 Hz	10Hz to 50Hz	50Hz to 100Hz[2]
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

Notes:

1 The term vi refers to vibration levels in any of the x, y or z axes.

2 At frequencies above 100Hz the values given in this column may be used as minimum values.

The Australian and New Zealand Environment and Conservation Council (ANZEC) *Technical Basis for Guidelines to Minimise* Annoyance *due to Blasting Overpressure and Ground Vibration* (1990) provides noise and vibration limits for blasting as shown in Table 15-6.

Table 15-6: Recommended ANZECC 1990 Blasting Limits

Airblast Overpressure	Ground Vibration
115 dB(lin) peak	5mm/s PPV
The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120 dB(lin) peak.	The level of 5mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10 mm/s.

Vibration due to the construction process also has the potential to affect services such as buried pipes, electrical and telecommunication cables. *German Standard DIN 4150-3: Structural Vibration – Part 3: Effects of Vibration on Structures (1999*) provides guidance on safe vibration levels for buried pipe work. Table 10 within DIN 4150-2 details the limits for short-term vibration. The levels apply on the wall of the pipe. For long-term vibration the guideline levels presented in Table 15-7 should be halved. Recommended vibration criteria for electrical cables and telecommunication services such as fibre optic cables range from between 50 mm/s and 100 mm/s.

Table 15-7: DIN 4150 Part 3 – Damage to buried pipes – Guidelines for Short-term Vibration

Pipe Material	Guideline values for velocity measured on the pipe (mm/s)
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, metal (with or without flange)	80
Masonry, plastic	50

15.3 Potential Impacts and Mitigation Measures

15.3.1 Overview

The following section identifies the potential impacts of noise and vibration on the nearest sensitive receptors during the construction and operation stages of the Project. Corresponding mitigation measures to effectively manage or eliminate such impacts are also prescribed.

15.3.2 Construction Noise

15.3.2.1 Potential Impact

Construction activities will generate noise associated with construction vehicles and equipment as well as pile driving and blasting if required. Noise levels from construction activities can vary significantly depending on the activities being undertaken. Construction noise is typically intermittent and, in the case of linear infrastructure where the construction activities move along the alignment, are generally short term.

Noise levels from construction have been predicted based on assumed construction equipment and activities. At the nearest sensitive receptor (assumed occupied dwelling) 113 m from the alignment, pile driving would result in levels of around 84 dB(A), if piling was required at this location. Otherwise, noise levels from various construction activities are predicted to range in the order of 50 – 60 dB(A). While these noise levels may cause some impact on residential amenity, elevated levels will be intermittent, and of short duration. Further, construction activities will not typically take place at night.

15.3.2.2 Mitigation Measures

Noise mitigation measures are not expected to be required during construction. HPPL will notify potentially affected residents and other community members in advance of construction. Should complaints arise HPPL will implement noise control measures, in accordance with the CEMP.

Construction activities will be limited to day light hours unless specific circumstances dictate a need for activities outside these times. In such case, potentially affected residents will be notified by HPPL.

15.3.3 Construction Vibration

Energy from construction equipment is transmitted into the ground and transformed into vibrations. The extent to which vibrations may be experienced depends on several factors:

- the type of equipment;
- the frequency of vibrations generated by the equipment;
- ground conditions, for example, soil type, moisture content and presence of rock; and
- topography.

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data. The New South Wales (NSW) Roads and Traffic Authority (RTA), Environmental Noise Management Manual (2001) provides typical construction equipment ground vibration levels at ten metres as well as a generic formula for calculation of the rate of vibration attenuation. Using this method, the predicted ground vibrations at various distances are shown in Table 15-8: for typical construction equipment. Table 15-8: indicates vibration levels range from less

than 0.1 mm/s to 0.7 mm/s at a distance of approximately 100 m. The nearest identified sensitive receptor – R1 is located 113 m from the Project.

Based on typical vibration levels shown in Table 15-8: , the majority of construction activities along the Project are not expected to produce perceptible levels of vibration at any identified sensitive receptors. Pile driving may produce vibration levels which will be barely noticeable to R1 but will be well below levels that might result in structural damage.

Table 15-8: Predicted construction equipment vibration levels (mm/s PPV)

Plant Item (RTA, 2007)	Human Perception Preferred Criteria *(Maximum Criteria*		Predicted Ground Vibration				
	Day	Night	10 m	30 m	50 m	100 m	300 m
Pile Driving (Impulsive)	8.6 *(17.0)*	2.8 *(5.6)*	21.0	4.0	1.9	0.7	0.1
15t Roller	0.28 *(0.56)*	0.2 *(0.4)*	7.5	1.4	0.7	0.2	<0.1
Dozer	0.28 *(0.56)*	0.2 *(0.4)*	3.3	0.6	0.3	0.1	<0.1
7t compactor	0.28 *(0.56)*	0.2 *(0.4)*	6.0	1.2	0.5	0.2	<0.1
Rock Breaking	0.28 *(0.56)*	0.2 *(0.4)*	7	1.3	0.6	0.2	<0.1
Backhoe	0.28 *(0.56)*	0.2 *(0.4)*	1	0.2	0.1	<0.1	<0.1

Blasting may be required for excavations of sections of the Project corridor. As locations where blasting may be required have not been determined, and as effects of blasting in terms of vibration are typically location specific, a detailed assessment of vibration from blasting has not been undertaken. Management and mitigation measures in relation to blasting will include:

- identifying sensitive receptors within the area potentially affected by blasting;
- contacting sensitive receptors prior to blasting;
- conducting a structural dilapidation assessment on any structures that might be affected by blasting;
- adhering to all required regulatory and good practice requirements in relation to excluding people from the potential effect area; and
- designing and placing charges to minimise impacts on any identified structures.

15.3.4 Rail Vibration

Given the nearest sensitive receptor is over 100 m from the Project; it is highly unlikely there would be adverse vibration impacts during the operation of the Project. Furthermore, recent vibration testing of coal trains in the Hunter Valley have indicated low probability of adverse impact on human comfort for receptors located more than 40 m from the rail line.

15.3.5 Operational Noise

15.3.5.1 Potential Impact

Acoustic modelling was undertaken using Cadna-A to predict the effects of rail traffic noise from the Project. Rail traffic noise modelling was conducted using the Nordic Rail Traffic Noise Prediction Method (Kilde, 1984), since this method is capable of efficiently calculating both the L_{Amax} and L_{Aeq} noise levels.

The methodology for undertaking the acoustic and rail traffic modelling is detailed further in Volume 6, Appendix I.

Noise modelling contours are provided in Volume 6, Appendix I for the proposed 60 Mtpa scenario. All existing residences in the vicinity of the Project are outside the 65 dB(A) $L_{Aeq,24hrs}$, which implies that the Planning Level for noise will be met with the Project in operation. Table 15-9 shows that predicted rail noise levels at noise sensitive locations are under the 65 $L_{Aeq,24hr}$ dB(A)and 87 L_{max} dB(A) criteria at all existing identified sensitive receptors.

As there are only 14 rail movements during each 24-hour period, it is unlikely that sleep disturbance will be an issue.

Table 15-9: Comparison of predicted noise levels at identified sensitive receptors

Receptor	Noise Criteria $L_{Aeq,24hr}$ dB(A)	Predicted Noise Levels 60 Mtpa $L_{Aeq,24hr}$ dB(A)	Noise Criteria L_{max} dB(A)	Predicted Noise Levels 60 Mtpa L_{max} dB(A)
R1	65	60.7	87	75.9
R2		64.7		80.0

The Caley Valley Wetland is subject to existing noise from the Abbot Point Coal Terminal operations and existing rail movements. Observations during the ecological field surveys undertake for the Project demonstrate that birds utilising this area are adapted to the existing noise levels. Birds utilise the areas of wetland adjacent to existing facilities. It is not expected that the increase in noise associated with the rail operation will have an impact on the existing utilise of the wetland by birds.

The intermittent nature of the rail operations, being only 14 rail movements per day, is not considered to represent a significant impact to livestock. It is expected that livestock will adapt to the noise and will not suffer stress from noise.

15.3.5.2 Mitigation Measures

The noise modelling results indicate that predicted noise levels at sensitive receptors are within relevant noise criteria. As such, no mitigation measures are proposed.

15.4 Conclusions

This assessment indicated that rail noise levels from the Project are expected to meet the 65dB(A) $L_{Aeq,24hrs}$ and 87dB(A) L_{max} noise targets at all identified sensitive receptors. Given that the nearest sensitive receptor is over 100 m from the Project; it is highly unlikely that any adverse vibration impacts will be experienced during operation.

Calculations indicate that noise from construction activities such as impact piling generate the highest sound pressure levels. The highest predicted construction noise levels are expected to occur at receptor R1 which is located approximately 113 m from the Project, while R2 is located more than 200 m from the Project and noise impacts are expected to be somewhat lower. Noise will be audible but not likely to have significant ongoing impacts due to the intermittent and short term nature of construction noise on linear projects, and as construction activities are not expected to occur at night.

Based on typical vibration levels shown in Table 15-8: , the majority of construction activities along the Project are not expected to produce perceptible levels of vibration due to the distance from the receptors. Vibration levels produced by Project construction activities are expected to be well below the most stringent structural damage criteria of 3 mm/s at receptors located at distances greater than 50 m.

Given the small number of sensitive receptors within 500 m of the alignment, blasting is not expected to cause problems. Regardless, once blasting locations are known, detailed assessments of community safety requirements and potential impacts on structures will be required.