HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

Noise and Vibration

CLIENTS | PEOPLE | PERFORMANCE

Hancock Prospecting Pty Ltd

Alpha Coal Project (Rail)

Noise and Vibration Assessment

September 2010

Revision 0

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Glossary

dB	Unit of measurement for Sound Pressure Level.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels.
L_N	Statistical sound measurement recorded on the linear scale.
L_{AN}	Statistical sound measurement recorded on the "A" weighted scale.
$L_{A10\ (Time)}$	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
$L_{A10\ (1\ hour)}$	The L_{A10} level measured over a 1-hour period.
$L_{A10\ (18\ hour)}$	The arithmetic average of the L_{A10} levels for the 18-hour period between 0600 and 2400 hours on a normal working day. It is a common traffic noise descriptor.
$L_{Aeq\ (Time)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring. This is considered to represent ambient noise.
$L_{Aeq\ (15\ hr)}$	The L_{Aeq} noise level for the period 7 am to 10 pm. (Day and Evening)
$L_{Aeq\ (9\ hr)}$	The L_{Aeq} noise level for the period 10 pm to 7 am. (Night)
$L_{Aeq\ (1\ hr)}$	The L_{Aeq} noise level for a one-hour period. It represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7 am to 10 pm, or 10 pm to 7 am, (whichever is relevant).
$L_{A90\ (Time)}$	The A-weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90\ (15\ min)}$
$L_{AMax\ (Time)}$	The maximum sound level recorded during a specified time interval.
$L_{AMin\ (Time)}$	The minimum sound level recorded during a specified time interval.
Noise Sensitive Place	*Noise sensitive place* means any of the following places: (a) a dwelling; (b) a library, childcare centre, kindergarten, school, college, university or other educational institution; (c) a hospital, surgery or other medical institution; (d) a protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest, under the *Nature Conservation Act 1992*; (e) a marine park under the *Marine Parks Act 1982*; (f) a park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment.

Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24 hour period used for the assessment background level). This is the level used for assessment purposes. It is defined as the median value of: ◗ All the day assessment background levels over the monitoring period for the day (7 am to 6 pm). ◗ All the evening assessment background levels over the monitoring period for the evening; (6 pm to 10 pm). ◗ All the night assessment background levels over the monitoring period for the night. (10 pm to 7 am).
RTN	Road Traffic Noise
Sound Pressure Level (SPL)	20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level of 20 micropascals.

1. Introduction

1.1 Overview

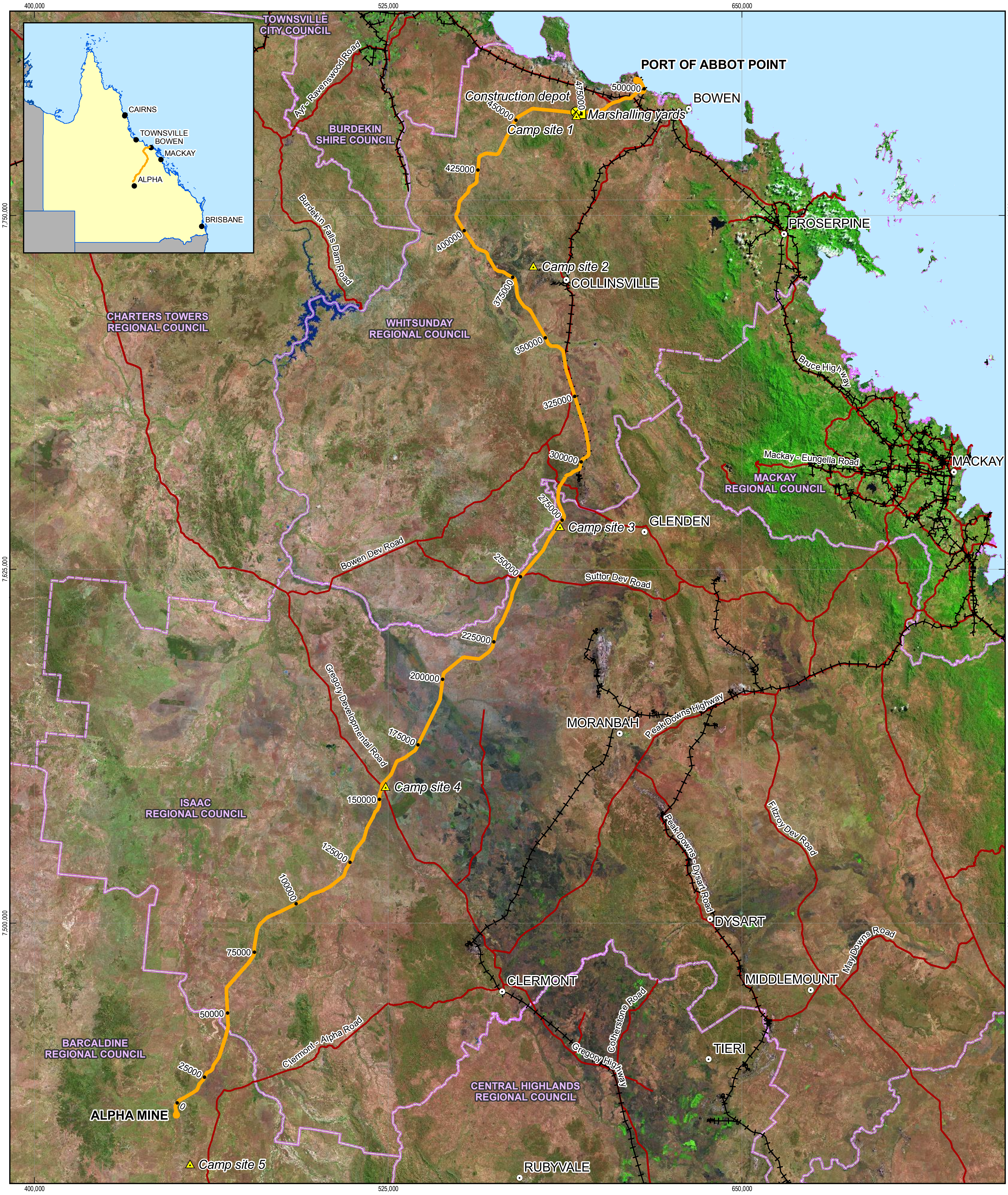
Hancock Prospecting Pty Ltd (HPPL) (the Proponent) has commissioned GHD Pty Ltd (GHD) to assess the potential noise and vibration impacts resulting from the construction and operation of the Alpha Coal Project (Rail) (herein referred to as the Project). This assessment has been undertaken with consideration to the following authority and regulatory publications:

- *Environmental Protection Act 1994* (EP Act);
- Environmental Protection (Noise) Policy 2008 (EPP (Noise)); and
- Department of Environment and Resource Management (DERM) Guideline – *Planning for Noise Control Guideline 2004.*

1.2 Description of Project

HPPL is proposing to construct a standard gauge, 495 km long railway line for the purposes of transporting processed coal from the Alpha Coal Mine to the Port of Abbot Point (refer to Figure 1-1). The Project corridor is a vital piece of infrastructure that will enable export of 60 Mtpa quality thermal coal to overseas markets from both the Alpha Coal Mine and the Kevin's Corner Mine.

In September 2009, GHD was commissioned by HPPL to undertake an Environmental Impact Statement (EIS) for the Project. The proposed alignment will link the Alpha Coal Mine with the Abbot Point Coal Export Terminal (see Figure 1-1). A component of the EIS involves assessing the air quality impacts associated with the construction and operation of the Project. For a full description of the Project refer to Volume 3, Section 1 of this EIS.



LEGEND

- Town
- Camp
- Marshalling Yards
- Depot
- Proposed Alignment
- State Road
- Existing Railway
- Local Government Area

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1:1,250,000 (at A3)

0 5 10 20 30 40 50

Kilometres

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

N

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Environmental Impact Statement

STUDY AREA

Job Number	41-22090
Revision	A
Date	04-08-2010

Figure: 1-1

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1.3 The Study Area

The Project stretches between the Alpha Coal Mine, 38 km northwest of the Alpha Township and the Abbot Point Coal Export Terminal, 25 km north of Bowen. The alignment of the Project has been selected on the basis of several factors, primarily environmental, economic and geotechnical grounds. The rail corridor proceeds in a generally north-easterly direction from the Alpha Coal Mine, crossing the Belyando River and several of its tributaries in the first 100 km. The Project corridor crosses relatively flat lowlands before commencing a gentle climb from near Eaglefield adjacent to the Suttor River, to a point near the existing Newlands mine. This is the highest point on the railway at approximately 300 metres above sea level. In the vicinity of the Newlands mine, the Project corridor runs parallel to the Queensland Rail (QR) Northern Missing Link (NML) railway for approximately 70 km through a pass in the Leichhardt Range and parallel to the Newlands Railway to a point near the Bowen River. The Project corridor then travels in a north westerly direction on crossing the Bowen River, then passing down the Bowen River valley through mostly grazing land toward Mt Herbert. The railway passes to the west of Mt Herbert through a pass in the Clarke Range. From this point, the railway travels north-easterly crossing the Bogie River, then finally in an easterly direction entering the Abbot Point State Development Area (APSDA) area on its western boundary.

The railway passes approximately 70 km to the northeast of the town of Clermont, 55 km to the northeast of the town of Moranbah, 35 km to the east of Mt Coolon, 20 km to the west of Collinsville, and enters the Abbot Point area 25 km west of Bowen.

From Eaglefield through to Abbot Point, a revised alignment was proposed which avoided the town of Collinsville, the Suttor State Forest and the Clarke Range completely. The alignment as currently presented avoids all Reserves, National Parks and State Forests.

The project footprint considered in this assessment comprised:

- an easement of approximately 500 km long and 60 m wide;
- a series of laydown areas and construction nodes;
- local construction access tracks (that will be used during construction only); and
- local maintenance access tracks (that will be used and maintained through the operational phase).

For the purposes of this assessment, the study area refers to land along and up to 1 km adjacent to the Project corridor. Extending the width of the study area was necessary to maximise opportunities for assessment in representative vegetation communities and habitats, given the lack of vehicle access to all parts of the corridor and prudent to consider possible regional impacts on habitats external to the corridor.

1.4 Scope of Work

The scope of work for the noise and vibration assessment comprised of:

- Desk-top review to identify key environmental noise catchment areas and noise sensitive receptors from aerial and terrestrial photography;
- Establish Project specific noise goals for the operational phase component of the rail line with consideration to relevant regulatory requirements and publications, such as:
    I. Australian Standard AS 1055.2:1997 – Acoustics – Description and measurement of environmental noise (AS1055);
    II. Environmental Protection (Noise) Policy 2008; and
    III. Queensland Department of Transport and Main Roads (DTMR) Interest in Planning Scheme – Planning for Rail Noise (updated March 2010).
- Based on information provided by HPPL detailing predicted train volumes and pass-bys, undertake one noise modelling scenario using Computer Aided Noise Abatement (Cadna-A) software to predict sound pressure levels of rail traffic emanations in the corridor for transport of 60 Mtpa and to provide an indication of areas of land likely to be impacted by the Project corridor;
- Conduct a desktop construction noise, vibration and blasting assessment based on distance from the Project corridor to the sensitive receivers; and
- Comment on expected impacts to noise sensitive receptors.

1.5 Limitations

This report has been prepared for HPPL with the purpose of providing an independent preliminary rail noise assessment for the Project.

It is not the intention of the assessment to cover every element of the noise environment, but rather to conduct the assessment with consideration to the prescribed work scope.

The findings of this assessment represent the findings apparent at the time of the assessment. It is the nature of environmental assessments that all variations in environmental conditions cannot be accessed and all uncertainty concerning the conditions of the ambient noise environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

In conducting this assessment and preparing the report, current guidelines for noise were referred to. This work has been conducted in good faith with GHD's understanding of HPPL's brief and the generally accepted consulting practice.

No other warranty, expressed or implied, is made as to the information and professional advice included in this report. It is not intended for other parties or other uses.

2. Noise and Vibration Goals

2.1 Environmental Protection (Noise) Policy 2008 (EPP (Noise))

The key environmental values for the acoustic environment are outlined within Section 7 of the *Environmental Protection (Noise) Policy 2008* as below:

> *The environmental values to be enhanced or protected under this policy are-*
>
> *a) The qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and*
>
> *b) The qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following –*
>
> *(i) Sleep;*
>
> *(ii) Study or learn;*
>
> *(iii) Be involved in recreation, including relaxation and conversation; and*
>
> *(iv) The qualities of the acoustic environment that are conducive to protecting the amenity of the community.*

2.1.1 Planning Levels

The EPP (Noise) 2008 nominates 'Planning Levels' for assets such railways. The Planning Levels are as follows:

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

This assessment is based on the above rail noise limits.

2.2 DTMR Interest in Planning Scheme – Planning for Rail Noise

The purpose of Department of Transport and Main Roads Interest in Planning Schemes is to advise local governments on how the *Sustainable Planning Act 2009* local government planning schemes can manage new development close to rail corridors. Planning schemes should encourage development in close proximity to rail corridors to be compatible with rail activities. Noise-sensitive uses should either be discouraged from areas affected by rail noise, or use appropriate measures to reduce noise impacts to an acceptable level. This would only apply to new material change of use or allotment reconfiguration applications, and applications for building works assessable under planning schemes.

The DTMR Interest in Planning Scheme also states *'It is recommended that local governments use an indicative figure of 100 metres from the rail corridor boundary to trigger sites requiring noise assessment for proposed development. This indicative distance has been devised in consultation with railway operators as it will capture areas potentially affected by rail noise. This indicative distance might be increased or decreased based on local knowledge of the area and* *information provided by relevant councils during the state interest review of local government planning schemes.'*

2.3 Construction Noise Criteria

In Queensland, construction activities should be in accordance with general building work hours as described under Section 440K – "Building Work" of the QLD *Environmental Protection Act 1994.* Under the regulation, no audible noise is permitted:

- 6.30 pm to 6.30 am – Monday to Saturday.
- Sundays and public holidays.

The time restrictions are designed to strike a balance between protecting noise amenity and the need to start construction activities early in the morning.

2.4 Human Comfort Vibration Criteria

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the continuous vibration level categories given in DIN 4150 Part 2 as shown below in Table 2-1.

Table 2-1 Vibration Levels and Human Perception of Motion

Approximate Vibration Level	Degree of Perception
0.1 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barley noticeable
1.0 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration values (in floors of buildings) are for vibration having frequency content in the range 1 to 80 Hz.

Vibration criteria have been set with consideration to the 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” for residential building types. The standard defines vibration limits in terms of Peak Particle Velocity (PPV) (mm/s). The BS 6472 human comfort peak vibration limits are shown in Table 2-2 for the frequency range of 8 Hz to 80 Hz which is applicable to construction works. These values are limits that may cause loss of amenity to the occupant. BS 6472 also recognises that higher vibration levels are tolerable for short term construction projects as undue restriction on vibration levels can significantly prolong construction works and result in greater annoyance.

Table 2-2 BS 6772 Human Comfort Vibration Limits from 8 Hz to 80 Hz (mm/s PPV[1])

Receiver Type	Period[2]	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

2.5 Structural Vibration Criteria

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

[1] Based on sinusoidal vibration sources

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

German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures.*

Short-term vibration guideline values are presented in Table 2-3.

Table 2-3 Guideline Values for Vibration Velocity to be Used When Evaluating the Effects of Short-Term Vibration on 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 v_i 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 vibration criteria presented in this Standard exceed the Human Comfort criteria presented above. Therefore, as indicated above, the human comfort criteria should be the over-riding criteria for the assessment of any vibration.

2.6 Blasting Criteria

Typically, when dealing with potential blasting noise and vibration, DECCW refers to Australian and New Zealand Environment Council (ANZEC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (1990). This guideline recommends the following noise and vibration limits.

Table 2-4 Recommended ANZEC 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.

3. Existing Environment

3.1 Existing Acoustic and Vibration Environment

Acoustic environments are often characterised by the Background ($L_{Abg,T}$) sound pressure level, defined to be equivalent to the A-weighted sound pressure level exceeded for more than 90% of a stated measurement period, T. ($L_{A90,T}$).

The current version of AS1055.2 refers to two methods of estimating background noise - by measurement, or by reference to a table of typical values dependent on land use and time of day.

Appendix B of AS1055.2 contains the table 'Estimated Average Background A-weighted Sound Pressure Levels ($L_{Abg,T}$) for Different Areas Containing Residences' that can be used to indicate the existing acoustic environment.

The table refers to 'Noise Area Categories', designated R1 to R6, which describe the neighbourhood in terms of transportation and industrial noise influences. The categories should be selected irrespective of metropolitan or country zoning.

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

The use of these categories may in fact be more meaningful in some cases than the determination of background sound levels based on measurement of ambient levels. For example, measured noise levels can vary substantially over time due to meteorological and source-related factors such as wildlife, and a limited sampling of noise levels may not obtain a truly representative picture of background levels. There may also be situations where the planning intentions for the area include more intensive development of a kind that generates noise, and this may need to be taken into account for a more appropriate medium to long term perspective on noise impacts.

Adopting this approach, the background noise levels from Appendix B of AS1055.2 are estimated to be as shown in Table 3-1.

In terms of vibration, it is important to note that there are no current activities near the project area that may cause background level of ground vibration.

Table 3-1 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	40
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

3.2 Land Use and Noise Receivers

The land use immediately surrounding the proposed site is primarily rural in nature. Table 3-2 lists potential sensitive receptors identified within 500 metres of the Project corridor (refer to Figure A-1 in Appendix A).

Table 3-2 Sensitive Receptors

Receiver	Easting	Northing	Distance from Proposed Track (m)	Description
Receiver 1*	587080	7701148	113	Potential dwelling
Receiver 2*	549392	7748051	260	Potential dwelling

- Note, the nature of this building is unknown, therefore this receiver has been conservatively estimated to be a fully occupied dwelling (sensitive receiver).

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 and vibration. The wetland provides habitat for migratory birds, particularly during the wet season. As the Project will be constructed during the dry season, the Project is likely to generate low impacts upon any breeding activities within/surrounding the wetland and upon migratory birds inhabiting areas within or adjacent to the Project corridor. During the operations phase of the Project, noise may interfere with the communication or mask predation of fauna. It may also startle some fauna species and displace them into adjacent habitats. 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 undertaken 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 Project operation will have an impact on the existing birds of the Caley Valley Wetland.

4. Rail Noise Impact Assessment

4.1 Noise Model Configuration

Acoustic modelling was undertaken using Computer Aided Noise Abatement (CadnaA) to predict the effects of rail traffic noise from the Project corridor.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors. Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

Rail traffic noise modelling was conducted using the Nordic Rail Traffic Noise Prediction Method (Kilde 1984), since it is capable of efficiently calculating both the L_{Amax} and L_{Aeq} noise levels.

The proposed development has been modelled based on available data at the time of the assessment, and as such, should be used for comparison purposes only. In particular, the model reflects the status of the design at the time of the assessment.

4.1.1 Ground Contours and Rail Alignment

Digital terrain contours, cadastral data and rail alignment were sourced from the GIS database of the project.

Earthworks details were not available at the time of modelling, therefore it was assumed that the land will be level with the rail alignment extending 15 metres on each side of the track.

4.1.2 Model Configuration

The following assumptions were made with regard to the model configuration:

- A general ground absorption coefficient of 0.5 was used throughout the model.
- Atmospheric conditions of 20°C and 70% humidity were used.
- Neutral weather conditions.

4.1.3 Modelling Scenarios

The following modeling scenarios were undertaken:

- 60 MTPA scenario.

4.1.4 Rail Traffic Assumptions

Current design calls for 32 tonne axle loads for rollingstock, consistent with other heavy haul coal railways around the world. It is desired to use proven diesel locomotives similar to those in use in the Pilbara iron ore system in Western Australia.

Hancock Prospecting has selected the same ruling grade based on current practice from the Pilbara heavy haul railways. The 1 in 320 grade allows for 24,000 tonne payloads to be hauled by 3 locomotives with a total traction power of 13,500 hp (one train). Current designing plans for the transportation of up to 60 mtpa of coal, thus equating to seven trains to be required on average, one way (14, two ways, each day).

Hancock Prospecting has chosen to use proven diesel locomotives either from GE Transportation Systems such as the GE ES44AC model or the EMD SD73ACe. However, due to more stringent emissions requirements that came into effect in the United States on January 1, 2005, the Dash 9-44CW has been replaced in production by the GE ES44DC, and a photograph of this example locomotive is displayed in Figure 4-1. Relevant specifications include:

- Builder: GE Transportation Systems.
- Model: GE ES44DC.
- Gauge: 1435 mm (standard).
- Wheel diameter: 1.07 m.
- Length: 22.3 m.
- Width: 3.12 m.
- Height: 4.7 m.
- Weight: 212 tonnes.
- Engine type: Gevo-12 turbocharged ('clean diesel').
- Generator: EMD AR10-JJD-D18 (Some units converted to AR10-CA5).
- Traction Motors: GE 5GE752AH.
- Transmission: Alternator, silicon diode rectifiers, DC traction motors.
- Power Output: 3,300 kW (4,400 hp).
- Top Speed: varies between 113 km/h – 121 km/h.
- Fuel Capacity: 18,900 Litres.

Figure 4-1 Example GE Locomotive

The following assumptions were made with regard to the modelled rail movements and configuration:

- Based on standard coal wagons each of 106 tonne capacity, about 234 wagons will be needed to be attached to each locomotive 3-unit set to carry the proposed 24,000 tonnes of coal per train, resulting in a total length of 4 km;
- The expected coal train movements per day for peak production and transportation in 2016 (train movements spread out evenly over a 24-hour period) are 7 trains in each direction (14 train movements over a 24 hour period for transport of coal from both the Alpha Coal Mine and the Kevin's Corner Mine);
- The design speed was assumed to be 80 km/h;
- This assessment looks at the worst case scenario of maximum operations (60 Mtpa transported) occurring, in 2016; and
- This leads to the daily volumes shown in Table 4-1 below.

Table 4-1 Rail Volumes (One Way)

Line Capacity	60 Mtpa
Number of tonnes per train (tonnes)	24000
Number of trains per day (one way)	7
Number of locomotives per day (one way)	21
Number of wagons per day (one way)	1638

The above volumes were doubled up in the model to simulate return train trips on the single line.

Trains were modelled using United Group Rail Noise Measurement Data and adapted to the Nordic train input data. The sound power level per linear metre used in the model is shown below in Table 4-2.

Table 4-2 GE Locomotive Sound Power Level, L_w dB(A) Per Linear metre

Source	Octave Band Centre Frequency (Hz)							L_W Per Linear Metre
	63	125	250	500	1k	2k	4k	
GE Locomotive ES44DC	86	89	91	93	88	86	80	94

4.1.5 Validation

As the corridor is new, it is not possible to undertake a model validation. However, the Nordic model has been used in a vast number of projects in Australia and is widely accepted by government authorities. As such, the model is expected to provide a reasonable level of accuracy.

4.2 Noise Model Results

Noise modelling contours are provided in Appendix B for the proposed 60 MTPA Scenario.

All existing residences in the vicinity of the proposed rail corridor are outside the 65dB(A) $L_{Aeq,24hrs}$, which implies that the Code of Practice noise target will be met with the corridor in operation.

Table 4-3 shows predicted rail noise levels at noise sensitive locations within 500 m of the rail corridor.

Table 4-3 Comparison of Predicted Noise Levels at Identified Sensitive Receivers

Receiver	Noise Criteria $L_{Aeq,24hr}$ dB(A)	Predicted Noise Levels 60MTPA $L_{Aeq,24hr}$ dB(A)	Noise Criteria L_{max} dB(A)	Predicted Noise Levels 60MTPA L_{max} dB(A)
Receptor 1	65	60.7	87	75.9
Receptor 2		64.7		80.0

Table 4-3 above shows that predicted rail operational noise levels are under the 65 $L_{Aeq,24hr}$ dB(A)and 87 L_{max} dB(A) criteria at all existing identified sensitive receivers.

4.3 Rail Vibration

Given the nearest sensitive receive is over 100 m from the rail corridor, it is highly unlikely there would be adverse comment regarding operational vibration impacts. Furthermore, recent vibration testing of coal trains in the Hunter Valley have indicated there is low probability of adverse impact upon the human comfort for receivers located more than 40 metres from the rail line (Author, Year).

5. Construction Phase

5.1 Construction Methodology

The following construction activities are likely to be undertaken on the project:

Civil Works including:

- earthworks construction;.
- drainage construction; and
- bridgework construction.

Track Construction including:

- track laying.
- signalling installation. and
- communications installation.

For the purposes of this EIS, it has been assumed that construction of the civil works for the rail alignment will be undertaken in a number construction fronts, with progressive handover to enable track construction to follow closely behind without any delay.

A maintenance access track has also been allowed for to run parallel adjacent to the rail alignment. The final design, location and standard of the maintenance access track will be determined as part of the detail design.

A rail corridor with of 60 – 100 m has been nominated, which is considered sufficient to accommodate majority of the permanent infrastructure. At the detail design stage and following land owner consultation, the precise rail corridor will be defined.

Construction material such as borrow material, capping material, ballast and construction water may have to be sourced from outside the 60 -100m rail corridor. This will be determined from the ground breaking investigations for geology and hydrogeology which is planned to be undertaken as part of the detail design.

5.2 Construction Equipment

The following construction equipments are likely to be required for the project:

- For Civil Works: dozers, graders, excavators, scrapers, dump trucks, rollers, backhoes, water carts, cranes and piling rigs.
- For Track Works: sleeper layer, track layer, ballast wagons, rail welding machine, tamper, water carts, excavators and backhoes.

It should be noted that these are estimates only and the actual type and number of vehicles is to be determined by the construction contractors.

The bulk earthworks will be undertaken using scrapers for the short hauls, and with excavators and dump trucks used for long distance earthmoving. It is intended that the majority of the general fill will be obtained from the cutting excavations. The design of the alignment has been done such that it maximises the balanced between cut to fill. The design will be optimised during detail design to account for likely quantities of unsuitable material obtained from detailed geotechnical investigations.

Track laying is likely to be undertaken using a track layer. It is envisaged track laying will commence from the port end and head towards the mine in one construction front. The civil works are required to be completed and handed over such that there is no delay to the track laying.

5.2.1 Construction Equipment and Indicative Sound Power Levels

Typical noise levels produced by construction equipment anticipated to be used on site were sourced from the following:

- BS5228-1:2009 *Code of Practice for Noise and Vibration on Construction and Open Sites Part 1: Noise.*
- AS2436: 1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*.
- United States Department of Transportation Federal Highway Administration – Construction Equipment Noise Levels and Ranges.
- GHD's internal database.

An indicative list of construction equipment/plant that would be used during construction and corresponding sound power levels is provided in Table 5-1.

Table 5-1 Indicative Construction Plant / Equipment

Task	Equipment	Estimated Sound Power Level L_{Aeq} dB
Civil Works	Dozer	114
	Grader	105
	20t excavator	107
	Scraper 20t	108
	Dump trucks and articulated dump trucks	109
	Rollers 18t	101
	Backhoe	96
	Water cart	109
	Mobile cranes	99
	Auger Piling Rig	110
	Impact Piling Rig	133

Task	Equipment	Estimated Sound Power Level L_{Aeq} dB
Track Works	Sleeper/Track Layer Plant	114[1]
	Ballast Regulator	114
	Rail Welding Machine (Generator)	107
	Ballast Tamper	115
	Water Cart	109
	20t excavator	107
	Backhoe	96

[1] No noise data available for sleeper/track laying plant, therefore the sound power level has been conservatively estimated.

5.2.2 Construction Noise Sources

Construction noise at the sensitive receivers was calculated based on distance loss from the source to the receiver. The calculations do not take into consideration the mitigating or enhancing effects of terrain, screening or meteorological conditions, therefore providing a measure of conservatism.

The magnitude of noise impacts associated with construction would be dependent upon a number of factors including:

- The intensity of construction activities.
- The location of construction activities.
- The type of equipment used.
- Existing local noise sources.
- Intervening terrain.
- The prevailing weather conditions.

In addition, mobile machinery would likely move about, variously altering the directivity of the noise source with respect to individual receivers. During any given period the machinery items to be used on site would operate at maximum sound power levels for only brief stages. At other times the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Finally, certain types of construction machinery would be present on site for only brief periods during construction.

5.2.3 Assessment of Impacts

The predicted construction noise for each item of plant has been calculated for different distances and is shown in Table 5-2. Predicted construction noise levels at the nearest sensitive receivers are also provided in Table 5-3.

Table 5-2 Predicted Construction Noise for Different Distances, dB(A)

Construction Stage	Construction Noise Source	Distance (m)						
		50	100	250	500	1000	2000	3000
Civil Works	Dozer D9	72	66	58	52	46	40	36
	Grader	63	57	49	43	37	31	27
	20t excavator	65	59	51	45	39	33	29
	Scraper 20t	66	60	52	46	40	34	30
	Dump trucks and articulated dump trucks	67	61	53	47	41	35	31
	Rollers 18t	59	53	45	39	33	27	23
	Backhoe	54	48	40	34	28	22	18
	Water cart	67	61	53	47	41	35	31
	Mobile cranes	57	51	43	37	31	25	21
	Auger Piling Rig	68	62	54	48	42	36	32
	Impact Piling Rig	91	85	77	71	65	59	55
Track Works	Sleeper/Track Layer Plant	72	66	58	52	46	40	36
	Ballast Regulator	72	66	58	52	46	40	36
	Rail Welding Machine (Generator)	65	59	51	45	39	33	29
	Tamper	73	67	59	53	47	41	37
	Water Cart	67	61	53	47	41	35	31
	20t excavator	65	59	51	45	39	33	29
	Backhoe	54	48	40	34	28	22	18

Table 5-3 Predicted Construction Noise for Sensitive Receivers dB(A)

Construction Stage	Construction Noise Source		
		Receiver 1	Receiver 2
Civil Works	Dozer D9	65	58
	Grader	56	49
	65t excavator	58	51

Construction Stage	Construction Noise Source		
		Receiver 1	Receiver 2
	Scraper 20t	59	52
	Dump trucks and articulated dump trucks	60	53
	Rollers 18t	52	45
	Backhoe	47	40
	Water cart	60	53
	Mobile cranes	50	43
	Auger Piling Rig	61	54
	Impact Piling Rig	84	77
Track Works	Sleeper/Track Layer Plant	65	58
	Ballast Regulator	65	58
	Rail Welding Machine (Generator)	58	51
	Tamper	66	59
	Water Cart	60	53
	65t excavator	58	51
	Backhoe	47	40

Table 5-2 indicates construction activities such as impact piling generate the highest sound pressure levels at distance. Table 5-3 indicates the highest predicted construction noise levels are expected to occur at Receiver 1 which is located approximately 110 metres from the rail corridor. All other receivers are located greater than 200 metres from the corridor and hence noise levels are somewhat lower at these locations.

It should be highlighted that due to the intermittent and mobile nature of construction noise, the estimates are conservative. Essentially, they represent the maximum possible distances over which an acoustic impact may be observable during quiet ambient conditions. If such impacts were to occur, they would likely be intermittent and infrequent. Furthermore, the construction of the rail track is transient in nature and noise impacts would reduce as the rail construction progresses along the route away from receivers.

However, it is recommended the mitigation measures outlined in Section 5.2.4 are considered and implemented if high noise generating activities such as impact piling are conducted outside standard day-time working hours.

As such, it is recommended the Queensland Rail Code of Practice for Railway Noise Management is employed to assist with managing construction noise impacts. The following section describes reasonable and practical measures that should be considered in developing ways to minimise the potential of unreasonable noise.

5.2.4 Construction Noise Mitigation Measures

In cases where it is necessary for such activities to be carried out outside standard day-time working hours, a community notification program (e.g. letter-drop) shall be carried out in advance of the activities (at least, 2 days before). The purpose of the community notification program to nearby affected noise sensitive places (within a minimum distance of 150 metres) shall be to outline the following:

- The schedule of construction and maintenance activities (the proposed times).
- The reasons for construction and maintenance activities being carried out outside standard day-time working hours.
- Likely timeframes of construction and maintenance activities (the proposed dates).
- Nature of construction and maintenance activities.

Construction activities generating noise that affects neighbouring noise-sensitive places should, wherever possible and practicable, be confined to “standard day-time working hours”. These are as follows:

- 07:00 – 18:00 hours, Monday to Friday.
- 07:00 – 13:00 hours, Saturday.

Having due consideration to operational requirements and safety constraints, construction activities outside these hours can be minimised as far as practical. The following can be implemented to assist in the reduction of noise from construction activities:

- Locate mobile plant (compressors, generators, etc) as far as practicable away from neighbouring noise-sensitive places.
- Direct principal noise sources (e.g. exhausts) away from noise-sensitive places as far as possible.
- Fitting of equipment with effective and properly maintained noise suppression equipment consistent with the requirements of the activity, where possible.
- Ensure equipment utilised is maintained and operated as per manufacturers’ specifications.
- Minimise the use of warning devices to within operational health and safety constraints.
- Co-ordination of loading/unloading of material activities to be within standard day-time working hours wherever practicably possible.
- encourage construction operators to have equipment that include noise performance as a selection criterion at the time of purchase.

5.3 Construction Vibration

Blasting normally generates the highest levels of ground vibration, however construction equipment such as pile driving can also lead to high vibration levels and therefore needs to be assessed to minimize potential adverse impacts on the surrounding residential receivers. Ground vibration caused by blasting is covered in Section 5.4.

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- The efficiency of the energy transfer mechanism of the equipment (i.e impulsive; reciprocating, rolling or rotating equipment).
- The frequency content.
- The impact medium stiffness.
- The type of wave (surface or body).
- The ground type and topography.

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data. The NSW RTA Environmental Noise Management Manual provides typical construction equipment ground vibration levels at 10 m. The rate of vibration attenuation can be calculated from the following regression analysis formula:

$$V = kD^{-n}$$

where

V = PPV;

D = Distance; and

n = attenuation exponent. The value of n generally lies between 1 and 2 with a relatively common value of 1.5[3] .

The predicted ground vibrations at various distances are shown in Table 5-4 for typical construction equipment.

Table 5-4 Predicted Construction Equipment Vibration Levels (mm/s PPV)

Plant Item[4]	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

[3] Construction Vibrations: State of the Art, John Wiss, 1981

[4] NSW RTA Environment noise management manual

Plant Item[4]	Human Perception Preferred Criteria *(Maximum Criteria)*		Predicted Ground Vibration				
	Day	Night	10 m	30 m	50 m	100 m	300 m
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

Table 5-4 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 receiver is located at 110 metres from the rail corridor.

Based on typical vibration levels shown in Table 5-4, the majority of construction activities along the rail corridor are not expected to produce perceptible levels of vibration due to the distance from the receivers. Pile driving may produce vibration levels which are barely noticeable to receivers at approximately 110 metres.

Furthermore, vibration levels produced by rail corridor construction activities are expected to be well below the most stringent structural damage criteria of 3 mm/s at receivers located at distances greater than 50 metres.

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 5-5 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 5-5 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

5.4 Construction Blasting

Blasting may be required for excavations of sections of the rail corridor. Blasting may potentially be used in areas where hydraulic excavators with hammer attachments are ineffective due to large formations of hard rock.

A general assessment of construction blasting has been undertaken to assess potential adverse impacts on the surrounding residential receivers. Blasting estimations have been undertaken with consideration to AS2187 and have been based on available information. Blasting is non-linear in nature and variability in ground type and meteorological conditions makes it difficult to accurately predict ground vibration and airblast overpressure without site specific measurement data therefore the blasting predictions should only be used as a guide.

Blasting should only occur from 9 am to 5 pm (Monday to Friday) and 9 am to 1 pm (Saturday).

5.4.1 Estimation of Airblast Overpressure

Airblast overpressure can be estimated using the following equation:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

Where:

P is the pressure (kPa)

R is the distance from charge(m)

Q is the charge mass (kg)

Ka is the site constant. AS2187.2 recommends for confined blasthole charges values are commonly in the range of 10 to 100. A value of 50 has been adopted for this assessment.

a site exponent. AS2187.2 recommends for confined blasthole charges a good estimate of a = -1.45.

Airblast overpressure propagation can be increased with unfavourable meteorological conditions and decreased with topographic shielding. Unconfined surface charges would considerably increase the airblast overpressure propagation.

5.4.2 Estimation of Ground Vibration

Ground vibration has been estimated using the following equation:

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

Where:

V is the peak vector sum ground vibration ppv (mm/s)

R is the distance from charge (m)

Q	is the maximum instantaneous charge (MIC) (kg)

K_G	is the ground constant AS2187.2 gives a site constant for a free face in average field conditions of 1140 which has been used for the predictions. This value can vary from 1/5 times – 4 times depending on ground conditions and other factors.

5.4.3 Blasting Predictions

Reducing the charge mass or increasing the distance reduces the airblast overpressure and ground vibration. Airblast overpressure and ground vibration has been predicted for a range of charge masses and are shown in Figure 5-1 and Figure 5-2 for varying distances and assuming average conditions.

Charge mass estimates to achieve the construction airblast overpressure criteria of 120 dB(L) and ground vibration criteria of and 10 mm/s PPV are shown in Table 5-6.

No details of the blast configuration and design have been supplied. A MIC of greater than 100 kg should not be required and a charge of 50 kg or less is likely to be appropriate. Therefore blasting at distance greater than 200 metres would not be restricted with consideration to ground vibration. However ground vibration generally attenuates faster than airblast overpressure, hence airblast overpressure is generally the critical factor which controls the distance in which blasting can occur. Therefore blasting at distances to receivers of less than 800m would be restricted by the MIC.

The exact location and details of blasting is not known at this stage.

Once the exact location of blasting is known the distance to the receiver should be used for the charge mass estimate. Blast monitoring should be undertaken to assess compliance, determine the site constants and confirm the predictions.

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods, therefore should not effect blasting during the recommended standard hours.

It is recommended that all residential receivers be informed when blasting is to be undertaken. Reducing charge mass and increasing distance is the most effective way of reducing blasting impacts. The most likely impact of blasting is airblast overpressure. Methods to reduce the impact of airblast overpressure are detailed in mitigation Section 5.4.4 though the blast contractor would determine their effectiveness and practicability.

GHD acknowledge that the design of blast would be up the blast contractor and that the above information has been assumed for this assessment only, in the absence of specific information regarding blasting along the rail corridor route.

Table 5-6 Charge mass Estimates

Distance to Receiver (m)	MIC (kg) to Meet 120 dB(L)	MIC to Meet 10 mm/s PPV
1000	93	>100
900	68	>100

Distance to Receiver (m)	MIC (kg) to Meet 120 dB(L)	MIC to Meet 10 mm/s PPV
800	48	>100
700	32	>100
600	20	>100
500	12	>100
400	6	>100
300	3	>100
200	1	>100
100	<1	25

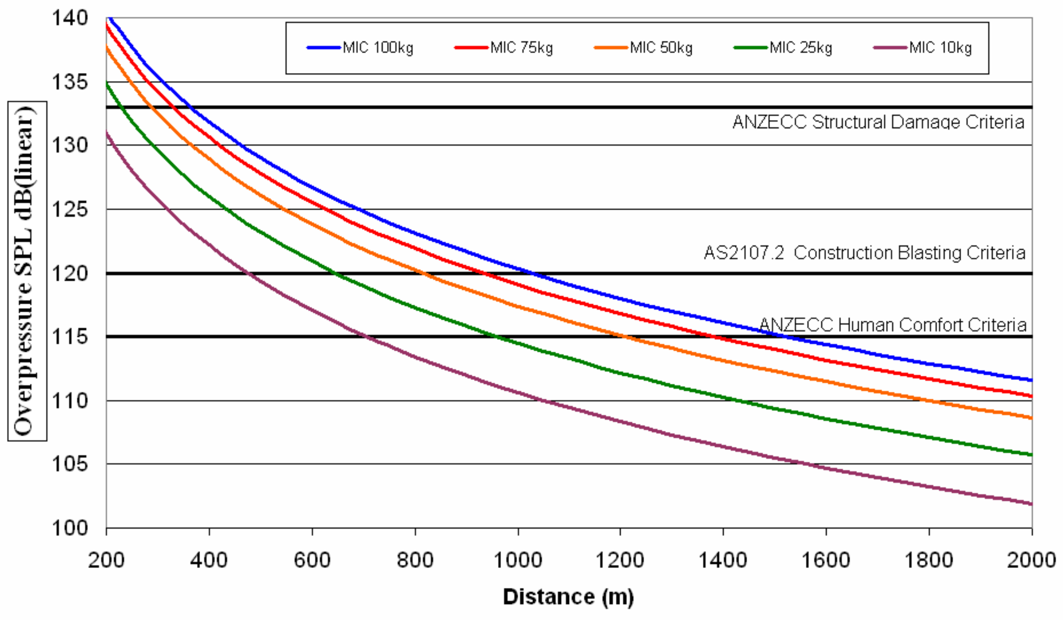


Figure 5-1 Airblast Overpressure Predictions for Different Charge Masses and Distances

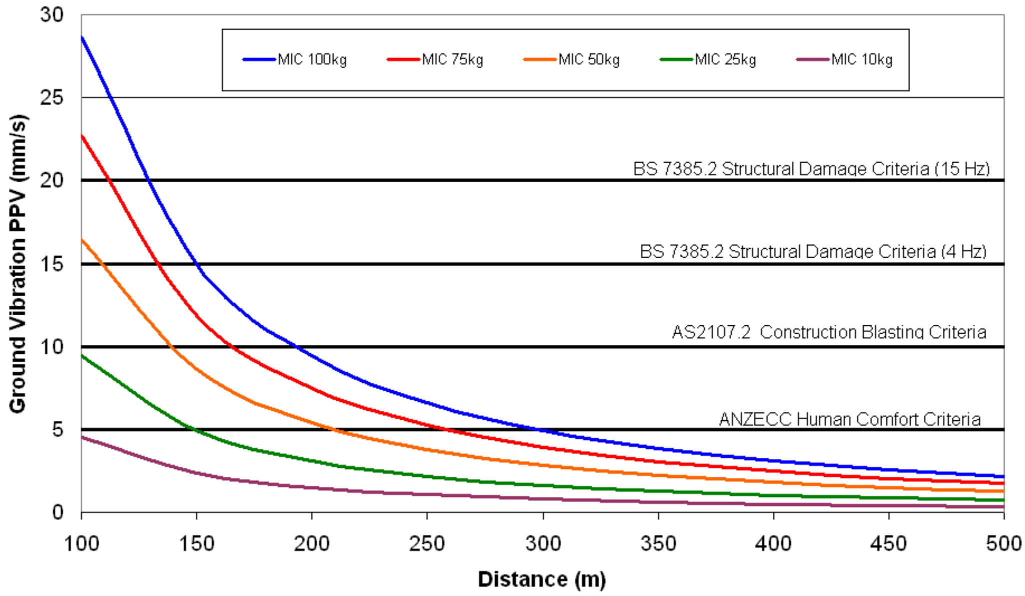


Figure 5-2 Ground Vibration Predictions for Different Charge Masses and Distances

5.4.4 Construction Blasting Mitigation Measures

If required, blasting noise and vibration levels may be reduced by application of the following:

- Reducing the maximum instantaneous charge (MIC by using delays, reduced hole diameter and/or deck loading.
- Changing the burden and spacing by altering the drilling pattern and/or delay layout, or altering the hole inclination.
- Exercise strict control over spacing and orienting all blast drill holes.
- Use minimum practicable sub-drilling which gives satisfactory toe conditions.
- Investigate alternative rockbreaking techniques.
- Establish times of blasting to suit local conditions.
- Direction of detonator initiation away from near residences.
- Building condition surveys would be undertaken at all potentially impacted dwellings prior to commencement of vibration generating works (such as blasting). These would be repeated at works completion.

6. Conclusion

GHD was commissioned by Hancock Consulting to assess the potential noise and vibration impacts resulting from the construction and operation of the proposed Alpha Rail Corridor Project, running from the Galilee Basin to Abbot Point, QLD.

Operational Noise and Vibration

This assessment indicates that rail noise levels from the proposed corridor are expected to meet the 65dB(A) $L_{Aeq,24hrs}$ and 87dB(A) L_{max} noise targets at all identified sensitive receivers.

Given the nearest sensitive receive is over 100 metres from the rail corridor, it is highly unlikely there would be adverse comment regarding operational vibration impacts. Furthermore, recent ground vibration testing from coal trains in the Hunter Valley have indicated there is low probability of adverse comment for human comfort for receivers located more than 40 metres from the rail line.

Construction Noise and Vibration

Calculations indicate construction activities such as impact piling generate the highest sound pressure levels at distance. The highest predicted construction noise levels are expected to occur at Receiver 1 which is located approximately 110 metres from the rail corridor. All other receivers are located greater than 200 metres from the corridor and hence noise levels are somewhat lower at these locations.

It should be highlighted that due to the intermittent and mobile nature of construction noise, the estimates are conservative. Essentially, they represent the maximum possible distances over which an acoustic impact may be observable during quiet ambient conditions. If such impacts were to occur, they would likely be intermittent and infrequent. Furthermore, the construction of the rail track is transient in nature and noise impacts would reduce as the rail construction progresses along the route away from receivers.

However, it is recommended the mitigation measures outlined in Section 5.2.4 are considered and implemented if high noise generating activities such as impact piling are conducted outside standard day-time working hours.

Based on typical vibration levels shown in Table 5-4, the majority of construction activities along the rail corridor are not expected to produce perceptible levels of vibration due to the distance from the receivers. Pile driving may produce vibration levels which are barely noticeable to receivers at approximately 110 metres.

Furthermore, vibration levels produced by rail corridor construction activities are expected to be well below the most stringent structural damage criteria of 3 mm/s at receivers located at distances greater than 50 metres.

Blasting

Although the exact details regarding blasting are not known, it remains a possibility and as a consequence blasting mitigation techniques have been provided to reduce the magnitude of the noise and vibration levels as well as the perception of vibration at sensitive locations. It is recommended that blast monitoring be considered to assess compliance and confirm the predictions and all residential receivers be informed when blasting is to be undertaken.

7. References

Department of Environment and Resource Management. (2004). *Planning for Noise Control Guideline 2004.* Accessed on 22nd September 2010 from http://www.derm.qld.gov.au/register/p01369aa.pdf .

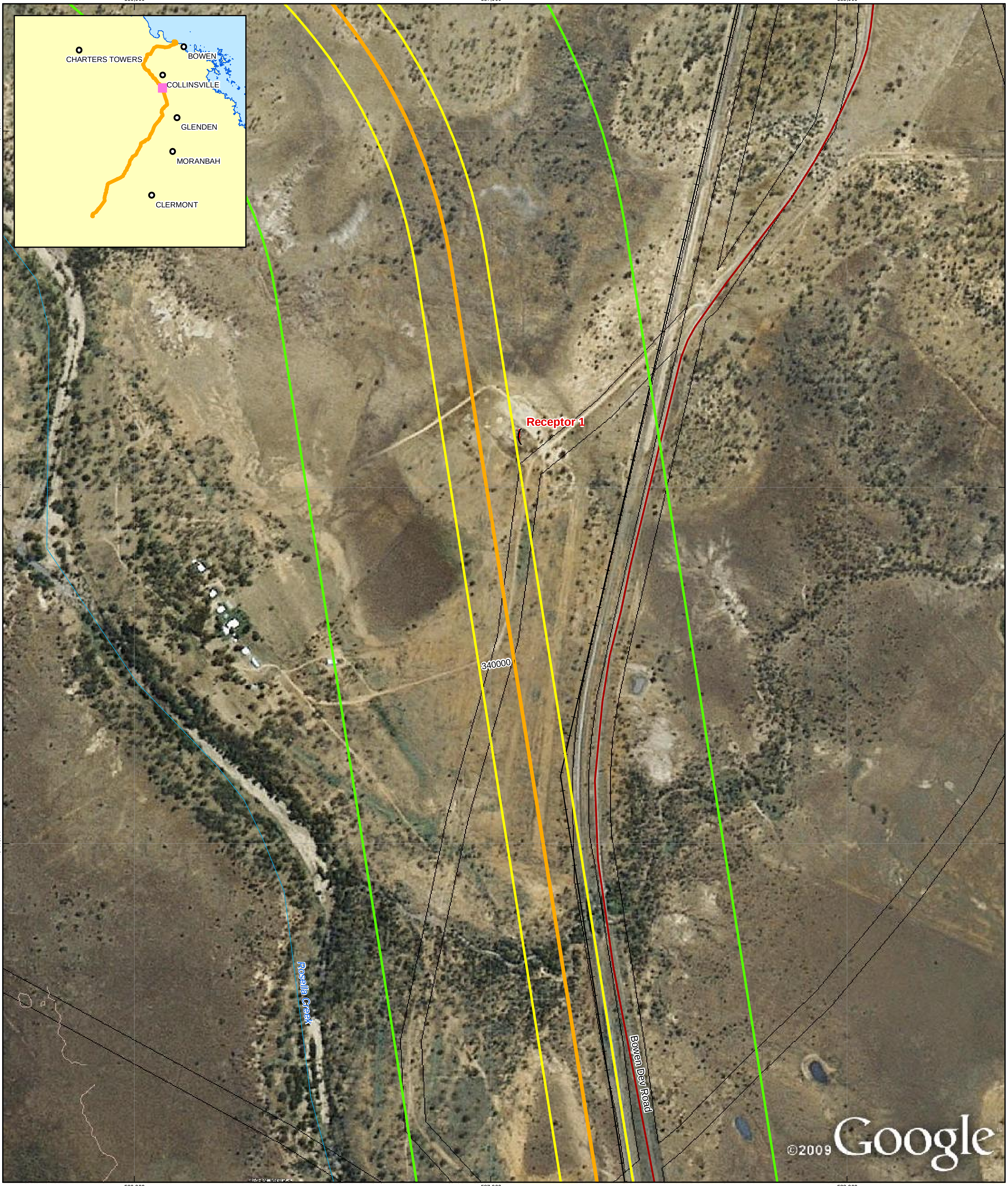
Queensland Parliamentary Counsel, *Environmental Protection (Noise) Policy 2008,* 1 January 2009.

Queensland Rail, *Code of Practice – Railway Noise Management Version 2*, November 2007.

ARTC Minimbah Third Track Environmental Assessment - Noise and Vibration Impact Assessment (GHD Report Ref: 22/13755/06/82578 R1).

Appendix A

Sensitive Receivers Locations



LEGEND

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

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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

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Date | 09-08-2010

SENSITIVE RECEPTORS

Figure: A-1
Sheet 1 of 2

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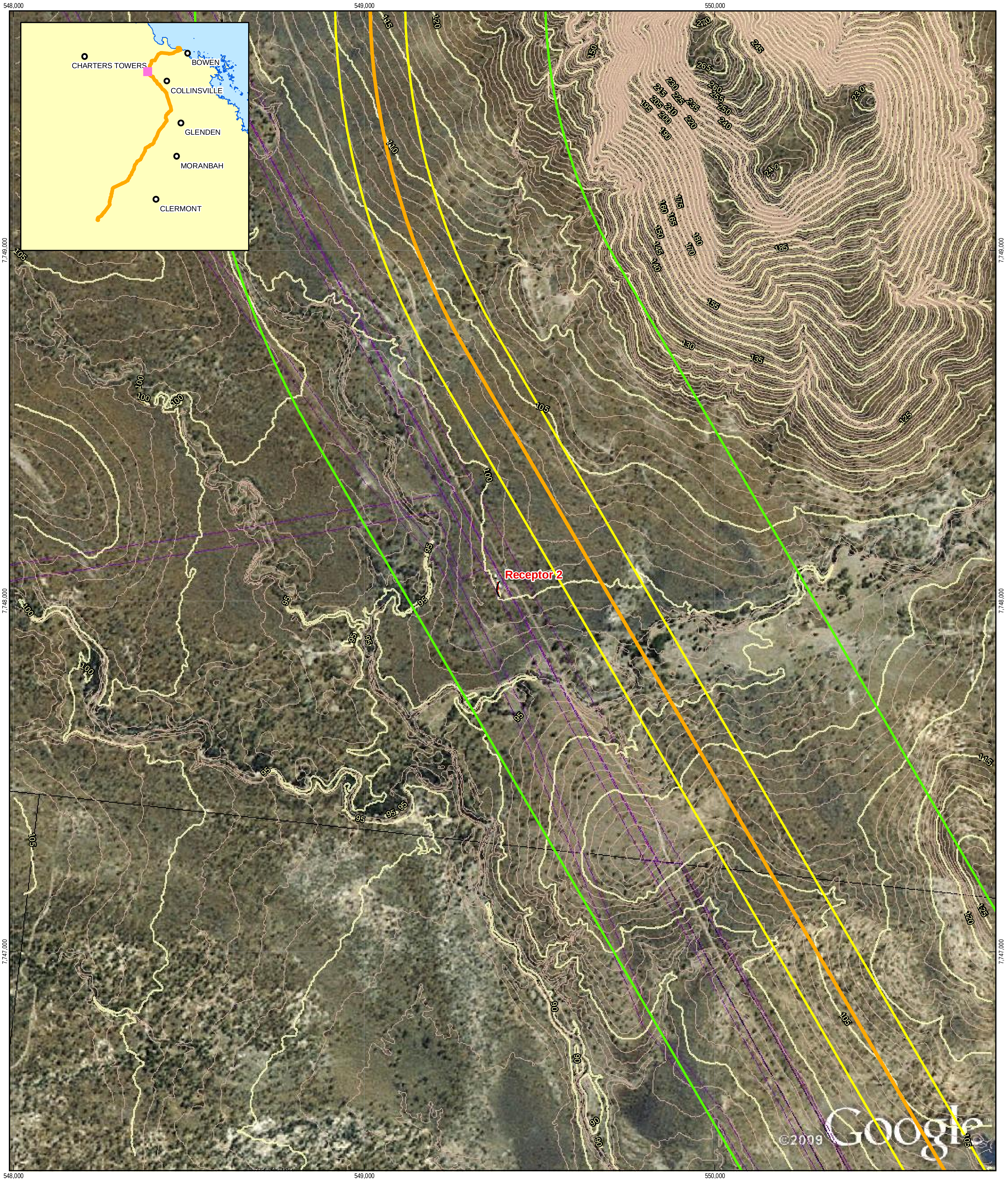

LEGEND

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

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1:10,000 (at A3)

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Kilometres

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

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SENSITIVE RECEPTORS

Figure: A-1
Sheet 2 of 2

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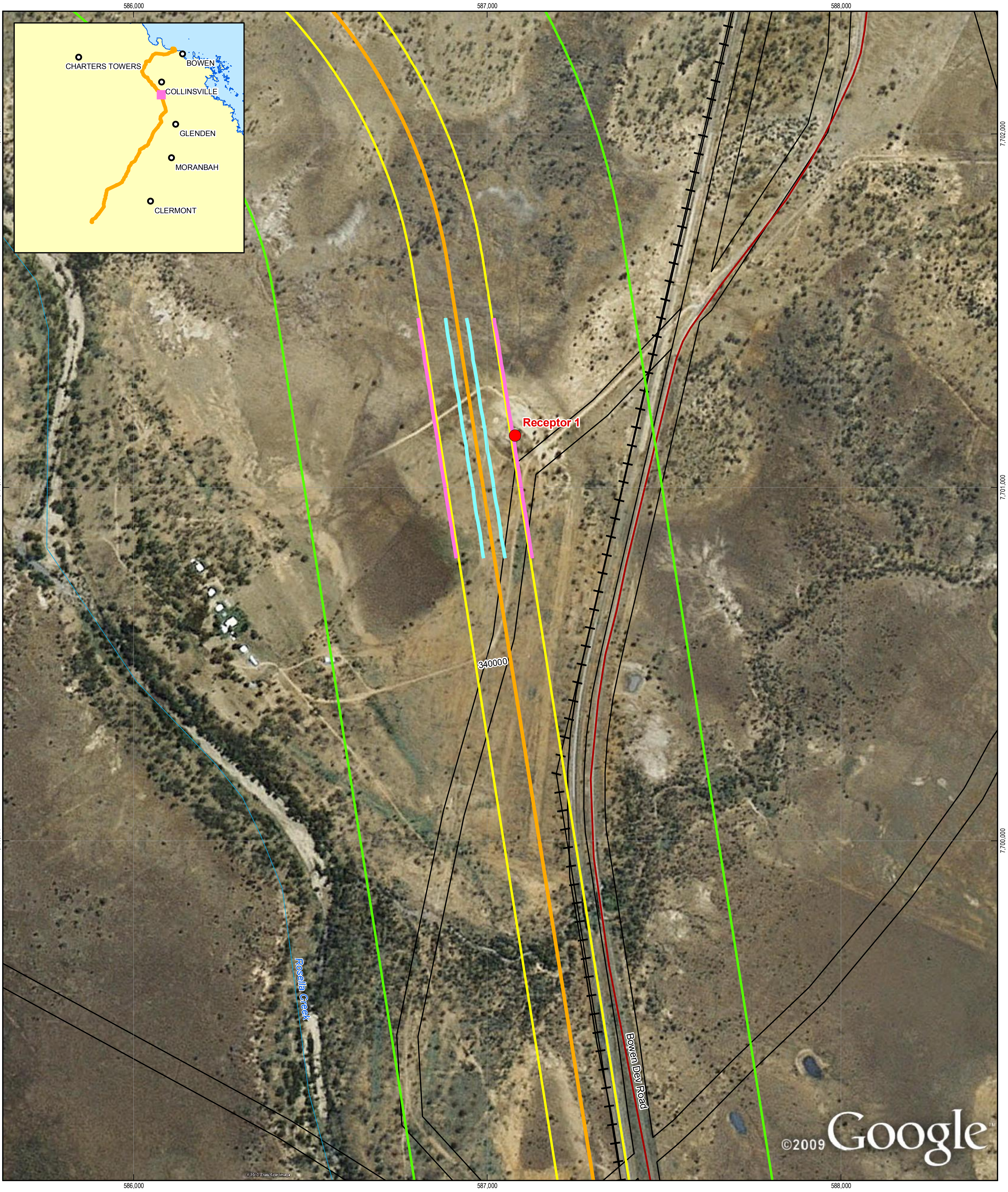
Appendix B

60MTPA Noise Contours



LEGEND

- Sensitive Receptor
- Proposed Alignment
- Existing Railway
- State Road
- Watercourse
- LAeq 24-hour criterion
- LAmax criterion
- Cadastre
- Easement
- 1000m Corridor
- 200m Corridor

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0 50 100 200 300 400 500

Meters

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

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Revision | A
Date | 09-08-2010

RECEPTOR 1

Figure: B-1

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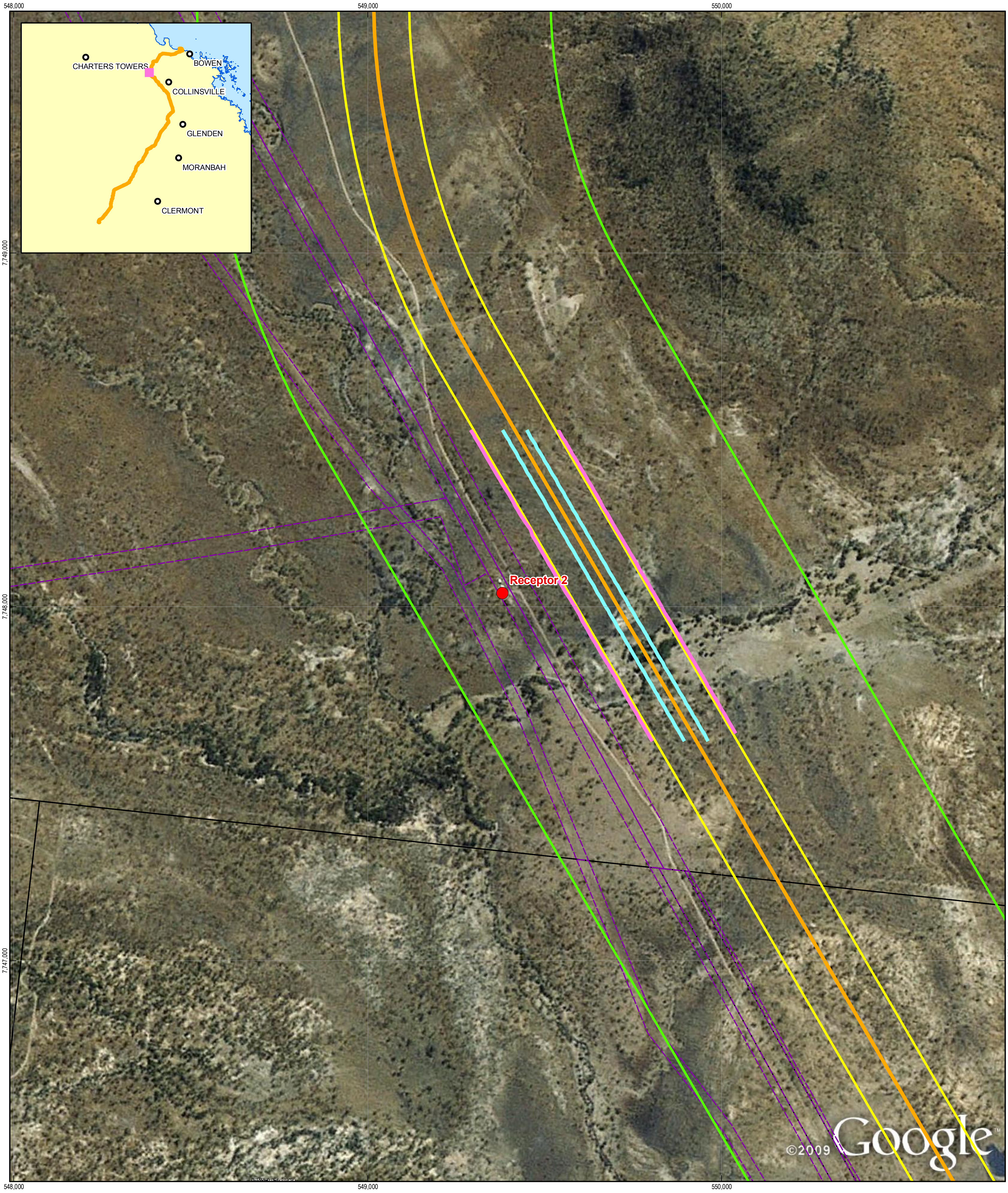

LEGEND

- Sensitive Receptor
- Proposed Alignment
- LAmax criterion
- LAeq 24-hour criterion
- Cadastre
- Easement
- 1000m Corridor
- 200m Corridor

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0 50 100 200 300 400 500

Meters

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

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Job Number | 41-22090
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RECEPTOR 2

Figure: B-2

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