Hera Project, via Nymagee

Noise and Vibration Assessment

Prepared by

Spectrum Acoustics Pty Limited

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EXECUTIVE SUMMARY

YTC Resources Limited is proposing to construct and operate the Hera Project (the Project), an underground gold and base metals operation at a location 4km south of Nymagee in western NSW (the Project Site).

An assessment of potential noise and vibration impacts from both the site establishment (construction) and operational phases has been conducted in accordance with relevant guidelines including the *NSW Industrial Noise Policy* (INP) and *Environmental Criteria for Road Traffic Noise* (ECRTN), both of which are Department of Environment, Climate Change and Water (DECCW) publications.

The assessment has found no exceedances of noise or blasting criteria at any assessed receiver. Worst case noise levels equal to the operational noise criterion (35 dB(A)) have been predicted at one of the four closest non-Project-related receivers assessed (labelled R3 in **Appendix B Figure B1** and **B2**) under adverse meteorological conditions (night time inversions). Noise monitoring at this receiver may become a requirement should the Project be approved.

In summary, the assessment has found that the Project would be able to operate within applicable noise and vibration criteria with the noise mitigation measures already incorporated in the mobile plant and vehicles, and that no additional operational safeguards and / or mitigation measures will be required.

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1. INTRODUCTION

YTC Resources Limited (the Proponent) is proposing to construct and operate the Hera Project (the Project), an underground gold and base metals operation at a location 4 km south of Nymagee in central NSW (the Project Site).

Spectrum Acoustics Pty Limited has been commissioned by R.W.Corkery & Co. Pty. Limited (RWC) on behalf of the Proponent to conduct a noise and vibration assessment to identify potential impacts of the Project and to recommend any potential mitigation measures.

1.1 AGENCY REQUIREMENTS

Table 1.1 summarises the Director-General's and other Government Department requirements for this noise and vibration assessment and indicates where these issues are addressed in this report.

Table 1.1
Noise Summary of Director-General's Requirements and other Government Departments in the *Environmental Assessment*

Government Agency	Paraphrased Requirement	Relevant Section(s)
	GENERAL	
DoP	• **Noise and Blasting** – including construction, operation and road traffic noise.	7.2, 7.3, 7.5
	NOISE AND VIBRATION	
DECCW 3/11/10	Potential impacts on the noise amenity of the surrounding area should be assessed in accordance with the NSW Government's Industrial Noise Policy (INP) accounting for all noise sources associated with the mine.	5.2
	The noise assessment must include (but not be limited to) an assessment of the C- Weighted noise (low frequency) as well as A- Weighted noise.	7.3.3
	The noise assessment should be based on adequate monitoring of pre-mine background noise which represents seasonal variations and the influence of weather factors such as temperature inversions and other unusual features which influence noise.	5.2
	Blasting and vibration impacts should also be assessed against the relevant guidelines.	5.3, 6.5

2. PROJECT OVERVIEW

2.1 PROJECT DESCRIPTION

As identified in Section 1.7 of the *Environmental Assessment*, a number of components of the Hera Project have been previously approved. These include the following (**Figure 1**).

- Construction and use of infrastructure required for an underground mine including a box cut, portal and decline, magazine and ventilation rises.
- Construction and use an integrated ore stockpile area and temporary Waste Rock Emplacement.
- Installation and use of one or more diesel generators within the power station and the associated Fuel Storage and Recycling Area.
- Construction and use of site offices, ablutions facilities, vehicle parking, workshop, laydown area and associated infrastructure.

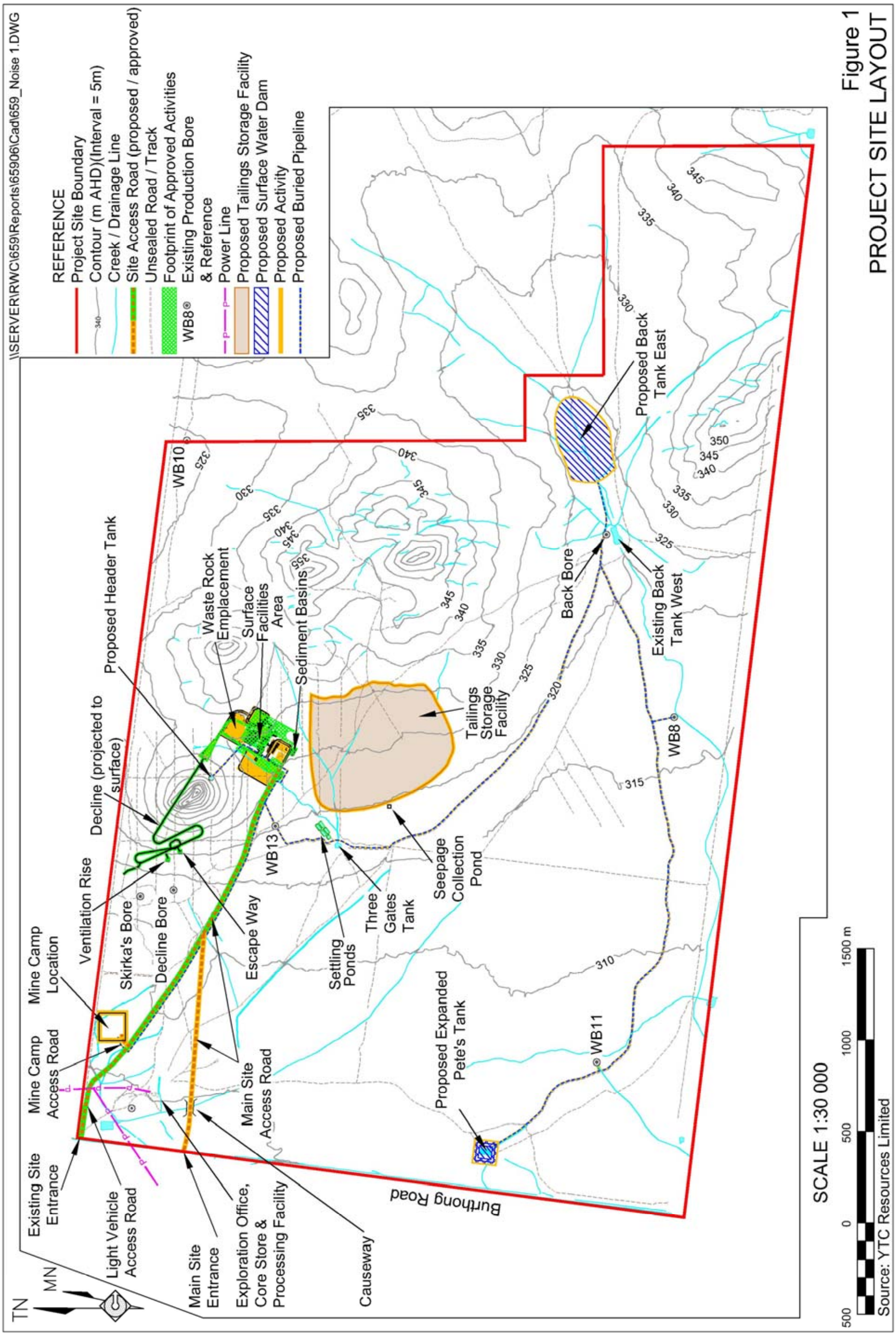
- Establishment of on-site communications facilities.
- Construction and use of water management structures.
- Construction and use of an access road (referred to in this document as the Light Vehicle Access Road). For the purposes of this application, the Light Vehicle Access Road would be used by light vehicles only.

The Project would include the following activities which would require approval (**Figure 1**).

- Road and the associated intersection to allow site access from Burthong Road Extraction of waste rock and ore material, using underground sublevel open-stope mining methods at the maximum rate of material would be approximately 350 000t per year for approximately 5.5 years.
- Construction and use of a Surface Facilities Area that would incorporate a range of approved infrastructure, including expanded site offices for the Proponent and Contractors, ablutions facilities, vehicle parking, power station, fuel storage, refuelling area, workshop and laydown areas.
- Construction and use of a Processing Plant within the Surface Facilities Area comprising crushing and grinding, gravity separation, flotation, leach and gold recovery circuits and ancillary infrastructure to produce approximately 33 000oz of gold, 74 000oz of silver, 10 000t of lead and 10 000t of zinc per year.
- Construction and use of a temporary Waste Rock Emplacement, incorporating an acid rock drainage encapsulation area and an associated Leachate Management Pond.
- Construction and use of a Tailings Storage Facility with the associated Seepage Collection Pond.
- Construction of a Mine Camp and Mine Camp Access Road for mine personnel.
- Construction and use of a surface water harvesting system, including expansion of Pete's Tank and construction of Back Tank East and associated water reticulation system.
- Construction and use of the Main Site Access by light and heavy vehicles.
- Transportation of concentrate from the Project Site to the Proponent's customers via public roads surrounding the Project Site.
- Construction and use of ancillary infrastructure, including soil stockpiles, core storage yards, internal roads and tracks, and sediment and erosion management structures not already approved.
- Construction and rehabilitation of a final landform that would be geotechnically stable and suitable for an end land use of agriculture or nature conservation.

2.2 PROJECT AREA, LAND USE AND TOPOGRAPHY

The Project Site is situated within the boundary of "The Peak" property (Lot 664, DP 761702), located approximately 4 km south of the township of Nymagee. The property covers an area of approximately 2,128 ha and the lease on the property is currently held by the Proponent (Western Land Lease No. 2455). Historically, the property has been used primarily for grazing purposes. The Project Site encompasses an area of 1,532 ha and existing land cover at the site is a mixture of cleared and forested areas.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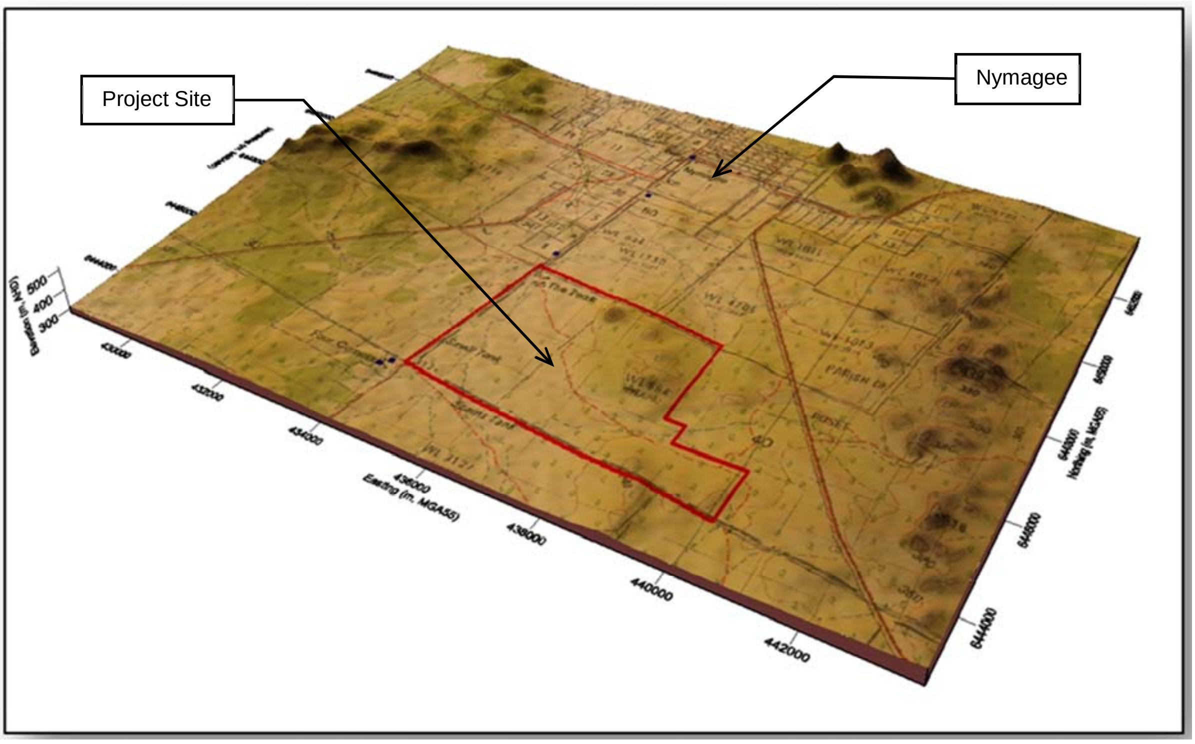
REFERENCE
Project Site Boundary
Contour (m AHD)(Interval = 5m)
Creek / Drainage Line
Site Access Road (proposed / approved)
Unsealed Road / Track
Footprint of Approved Activities
Existing Production Bore & Reference
Power Line
Proposed Tailings Storage Facility
Proposed Surface Water Dam
Proposed Activity
Proposed Buried Pipeline
Figure 1
PROJECT SITE LAYOUT
Proposed Back Tank East
Back Bore
Existing Back Tank West
WB8
WB10
WB11
WB13
Proposed Header Tank
Waste Rock Emplacement
Surface Facilities Area
Sediment Basins
Tailings Storage Facility
Decline (projected to surface)
Ventilation Rise
Mine Camp Location
Mine Camp Access Road
Skirka's Bore
Decline Bore
Escape Way
Settling Ponds
Three Gates Tank
Seepage Collection Pond
Main Site Access Road
Proposed Expanded Pete's Tank
Existing Site Entrance
Light Vehicle Access Road
Main Site Entrance
Exploration Office, Core Store & Processing Facility
Causeway
Burthong Road
TN
MN
SCALE 1:30 000
500 0 500 1000 1500 m
Source: YTC Resources Limited

The Project surface facilities are to be located to the central north of the Project Site at an altitude of approximately 335 m AHD. The Project Site is marked by reasonable flat terrain, increasing in elevation from approximately 305 m AHD along the western boundary to 345 m AHD at the southeastern corner. A series of hills, with elevations up to approximately 470 m AHD occur towards the northeast corner of the Project Site.

A three-dimensional representation of the topography of the region surrounding the Project Site extending north to Nymagee is presented in **Figure 2**.



Source: ENVIRON Australia Pty Ltd Note: Vertical Exaggeration of 4 applied to image

Figure 2 3-Dimensional Topography Surrounding the Project Site and Residences

The region surrounding the Project Site is sparsely populated. The four closest non-Project related sensitive receptors situated along Burthong Road have been selected as sensitive receptor locations for the assessment of noise and vibration emissions from the Project. The details of each of the selected assessment locations are presented in **Table 2.1**.

Table 2.1
Selected Non-Project Related Sensitive Receptors

Receptor ID	Location (m, MGA55)		Distance (km) / Direction from Processing Plant	Elevation (m, AHD)
	Easting	Northing		
R1	434054	6444176	3.9 / SW	320
R2	434182	6444316	3.7 / SW	320
R3	434871	6448174	2.6 / WNW	310
R4	435387	6450587	4.2 / NNW	310

3. DESCRIPTION OF TERMS

3.1 SCOPE

This section of the report aims to convey an understanding of several commonly used acoustical terms. Various terms are explained in plain language and the effects of certain atmospheric phenomena on noise propagation are discussed. Noise level percentiles are explained with the aid of a diagram of a hypothetical noise signal.

The descriptions in this section are not formal definitions of the terms. Formal definitions may be found in AS1633-1985 “Acoustics – Glossary of terms and related symbols”.

3.2 GENERAL TERMS

Sound Power Level

The amount of acoustic energy (per second) emitted by a noise source. Usually written as “Lw” or “SWL”, the Sound Power Level is expressed in decibels (dB) and cannot be directly measured. Lw is usually calculated from a measured sound pressure level.

Sound Pressure Level

The “noise level”, in decibels (dB), heard by our ears and/or measured with a sound level meter. Written as “SPL”, the sound pressure level generally decreases with increasing distance from a source. Noise levels are often written as dB(A) rather than dB. The “A-weighting” is a correction applied to the measured noise signal to account for the ear’s ability to hear sound differently at different frequencies. For example, 40 dB at 500Hz (speech frequency) is clearly audible but 40 dB at 50 Hz (very low bass) would be far less audible. The A-weighted sound pressure level therefore represents the measured (or predicted) noise level as it would be heard by the typical human ear.

Temperature Inversion

An atmospheric state in which the air temperature increases with altitude. Sound travels faster in warmer air than in cold air, so that during an inversion the top of a “sound wave” would move faster than the bottom. This bends (refracts) sound back towards the ground just as light bends upon entering and exiting a glass prism. The result is a “trapping” of sound energy near the ground and an increase in noise levels.

Wind Shear

A moving air mass would experience a “friction drag” at the ground in much the same way as a lava flow would flow quickly on top and “roll over” the lava beneath which must drag along the ground. This increasing wind speed with altitude is called “wind shear”.

For a sound wave travelling down wind, the top of the wave moves faster than the bottom and the wave bends towards the ground. However, for a wave travelling into the wind the top of the wave is slowed down more than the bottom is and the wave bends upwards. **Figure 3** shows several examples of how atmospheric effects can bend sound waves.

Figure 3 shows that sound rays can be refracted over a barrier (usually a bund wall or small hill) during a temperature inversion, increasing noise levels in the ‘shadow zone’.

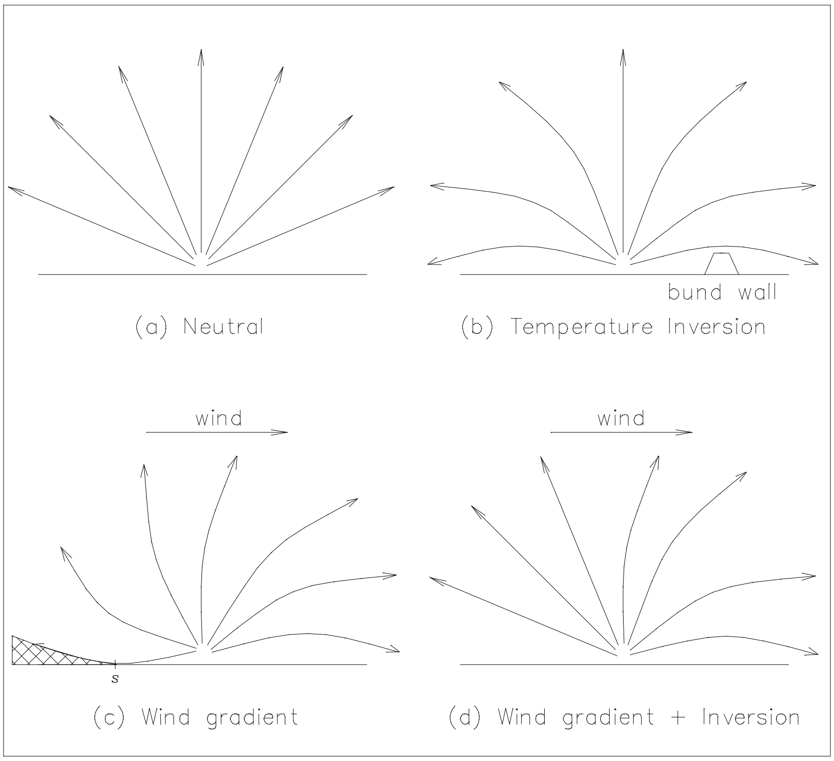


Figure 3 Sound Refraction under Temperature and Wind Gradients

Neutral Atmospheric Conditions

An atmosphere that is at a temperature of approximately 23^{o}C from ground level to an altitude of 200 m or more. There are no fluctuations in density or humidity and no wind. Such conditions rarely occur, as temperature would usually vary with altitude and there is always movement in various directions in different layers of the atmosphere.

Adverse Atmospheric Conditions

Atmospheric conditions (with regards to potential effects on noise propagation) which are characteristic of the study area. These would typically include seasonal wind directions and velocities (up to 3 m/s). Temperature inversions would be included as prevailing if they occur, on average, for more than 2 nights per week in winter.

3.3 NOISE LEVEL PERCENTILES

A noise level percentile (L_n) is the noise level (SPL) in decibels which is exceeded for “n”% of a given monitoring period. Several important L_n percentiles would be explained by considering the hypothetical time signal in **Figure 4**.

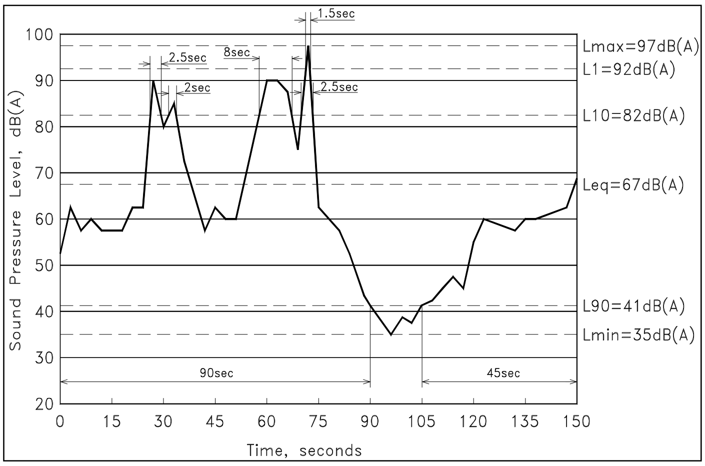


Figure 4 **Hypothetical Time-Trace of 150-second Sound Signal**

The signal in **Figure 4** has a duration of 2.5minutes (i.e. 150 seconds) with noises occurring as follows.

- The person holding the instrument is standing beside a road and hears crickets in nearby grass at a level of around 60 dB (A).
- At about the 30 second mark a motorcycle passes on the road, followed by a car.
- At 60 seconds a truck passes.
- After the truck passes it sounds its air horn at the 73 second mark.
- The crickets are frightened into silence and the truck fades into the distance.
- All is quiet until 105 seconds when the crickets slowly start to make noise, reaching full pitch by 120 seconds.
- The measurement stops at 150 seconds, just when an approaching car starts to become audible.

L_1 Noise Level

Near the top of **Figure 4**, there is a dashed line at 92 dB(A). A small spike of 1.5 seconds duration extends above this line at around 73 seconds. Since 1.5 seconds is 1% of the signal duration (150 seconds), the L_1 (or L_{A1} to signify A-weighting) noise level of this sample is 92 dB(A). The L_1 percentile is often called the *average peak noise level* and is used by the NSW Department of Environment Climate Change and Water[1] (DECCW) as a measure of potential disturbance to sleep.

L_{10} Noise Level

The dashed line at 82 dB(A) is exceeded for four periods of duration 2.5 seconds, 2 seconds, 8 seconds and 2.5 seconds, respectively. The total of these is 15 seconds, which is 10% of the total sample period. Therefore, the L_{A10} noise level of this sample is 82 dB(A). The L_{10}percentile is called the *average maximum noise level* and has been widely used as an indicator of annoyance caused by noise.

[1] Formerly Environment Protection Authority, EPA.

In similar fashion to L_1 and L_{10}, **Figure 5** shows that the noise level of 41 dB(A) is exceeded for 135 seconds (90 + 45 =135). As this is 90% of the total sample period, the L_{A90} noise level of this sample is 41 dB(A). The L_{90} percentile is called the *background noise level*.

L_{eq} Noise Level

Equivalent continuous noise level. As the name suggests, the $L_{eq}$of a fluctuating signal is the continuous noise level which, if occurring for the duration of the signal, would deliver equivalent acoustic energy to the actual signal. L_{eq} can be thought of as a kind of 'average' noise level. Recent research suggests that L_{eq} is the best indicator of annoyance caused by industrial noise and the DECCW *NSW Industrial Noise Policy* takes this into consideration.

L_{max} and L_{min} Noise Levels

These are the maximum and minimum SPL values occurring during the sample. Reference to **Figure 5** shows these values to be 97 dB(A) and 35 dB(A), respectively.

4. THE EXISTING ENVIRONMENT

4.1 INTRODUCTION

The existing meteorological and acoustic environments have been reviewed to determine appropriate noise criteria at assessed receivers and meteorological conditions relevant to the study area. A summary of the relevant information is included below.

4.2 METEOROLOGY

Meteorological data recorded at the Cobar MO AWS for the years 2005 – 2009 were analysed by the Air Quality and Greenhouse Gas Emissions Consultants ENVIRON Australia Pty Ltd (Environ, 2010) for the Hera Project. The following data are the most significant with respect to noise propagation within and surrounding the Project Site.

4.2.1 Relative Humidity

Atmospheric absorption of mid- to high-frequency sound is strongly dependent upon Relative Humidity (RH), with absorption generally inversely proportional to RH. Relative humidity typically varies around an average value of 50% under calm daytime conditions at 20^{o}Cin a semi-arid environment. Higher RH is experienced when the temperature drops and a value of 70% RH was adopted for modelling under cooler conditions.

4.2.2 Temperature Inversions

In accordance with the INP, temperature inversions are assessable if they occur for more than two nights per week during winter months. This corresponds to 4.1% of the total time in one year. Section E4 of the INP considers night-time to be from 6pm to 7am for the purposes of assessing inversions using the sigma-theta approach. Temperature inversions ranging from 1.5^{o}C/100m to 4^{o}C/100m correspond to a Pasquill-Gifford Stability Category (referred to as 'Category' hereafter) of F. Inversions stronger than 4^{o}C/100m correspond to Category G.

Analysis by ENVIRON (Environ, 2010) considered quantities such as boundary layer depth and stability parameters. Their analysis found that the atmospheric boundary layer was quite stable during the night time, suggesting the presence of temperature inversions when neither clouds nor appreciable winds are present.

Appendix E, Table E8, of the INP contains the default inversion strength of8^{o}C/100m (i.e., strong inversion under Category F stability) for arid and semi-arid areas which has been adopted in the noise modelling.

4.2.3 Winds

Distinct seasonal shifts in the wind field are evident in wind roses generated using CSIRO's The Air Pollution Model (Environ, 2010) based on wind roses measured at Cobar MO AWS in 2009. During summer and autumn, east to south-southwest airflow prevails, with a significantly lower incidence of westerly winds, particularly in summer. With the onset of winter, southwest to northeast winds become increasingly prevalent. Spring shows an increase in southerly and easterly airflow is dominated by westerly and west-northwesterly wind. The strongest winds typically occur from the northerly quadrant.

The INP requires assessment of winds from a given direction if the combined vector components up to 3 m/s from this direction occur for at least 30% of the time in any season and time period (day, evening or night). The Environ analysis shows that low speed (up to 3 m/s) winds do not occur this frequently and therefore winds have not been considered a feature of the area in this assessment.

Typical calm daytime conditions of no wind, 70% RH and -1^{o}C/100m vertical temperature gradient (i.e. dry adiabatic lapse rate, DALR) was also modelled to represent typical daytime noise levels.

5. NOISE AND VIBRATION CRITERIA

5.1 INTRODUCTION

This section of the report summarises the noise and vibration criteria for potentially affected non Project-related residences. Components of the Project for which criteria are derived include site activities (including on-site vehicle movements), blasting and off-site traffic on public roads.

In accordance with advice from DECCW on similar recent projects, an initial "construction" period during which elevated noise criteria may be applicable has not been considered for this Project. Consequently, all stages of the Project have been considered as operations in terms of setting noise emission criteria.

5.2 SITE NOISE CRITERIA

The INP specifies two noise criteria:

- an *intrusiveness criterion* which limits L_{Aeq} noise levels from the industrial source to a value of 'background plus 5 dB'; and
- an *amenity criterion* which aims to protect against excessive noise levels where an area is becoming increasingly developed.

Since there is no existing major industry dominating noise levels at any residences near the Project Site, and road traffic noise is not continuous, only the intrusiveness criteria were considered in setting a Project-specific operational noise limit of 35 dB(A),$L_{eq(15\text{-minute})}$ (day, evening and night) at all non-Project-related residences. This is the lowest intrusiveness criterion that can be established under the INP and assumes the default minimum background L_{90}noise level of 30 dB(A).

5.3 BLASTING CRITERIA

5.3.1 Annoyance Criteria

Noise and vibration levels from blasting are assessable against criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication *"Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990"*.

These criteria are summarised as follows.

- The recommended maximum overpressure level for blasting is 115 dB.
- The level of 115 dB may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120 dB at any time.
- The recommended maximum vibration velocity for blasting is 5 mm/s Peak Vector Sum (PVS).
- The PVS level of 5 mm/s may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 10 mm/s at any time.
- Blasting should generally only be permitted during the hours of 9 am to 5 pm Monday to Saturday, and should not take place on Sundays and Public Holidays.
- Blasting should generally take place no more than once per day.

These criteria are typically adopted by the DECCW when issuing Environment Protection Licences for projects involving blasting.

5.3.2 Building Damage Criteria

Building damage assessment criteria are nominated in AS 2187.2-1993 *"Explosives – Storage, Transport and Use Part 2: Use of Explosives"* and summarised in **Table 5.1.**

Table 5.1
Blasting Criteria to Limit Damage to Buildings (AS 2187)

Building Type	Vibration Level (mm/s)	Air Blast Level (dB re 20 μPa)
Sensitive (and Heritage)	5	133
Residential	10	133
Commercial/Industrial	25	133

The annoyance (ANZECC) criteria presented in Section 5.3.1 are more stringent than the building damage criteria (**Table 5.1**) and would be taken as the governing criteria for the Project.

5.4 SLEEP DISTURBANCE CRITERIA

To help protect against people waking from their sleep, the DECCW recommends that 1-minute (L_{A1}) noise levels (effectively, the maximum noise level from impacts – see Section 3.3 and **Figure 5**) should not exceed the background level by more than 15 dB when measured/computed at a point 1 m from a bedroom window. The "sleep disturbance" criterion is only applicable to night-time noise emissions.

The sleep disturbance criterion applicable for this Project at each non-Project-related residence is equal to the intrusiveness criterion (35 dB(A),$L_{eq(15\text{-minute})}$)plus 10 dB(A), that is, 45 dB(A),$L_{1(1\text{-minute})}$.

5.5 ROAD TRAFFIC NOISE CRITERIA

In NSW, noise from vehicle movements associated with an industrial source is assessed in terms of the INP if the vehicles are on the industrial site (the Project Site in this case). If the vehicles are on a public road, the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN) applies. The Project would produce a limited volume of heavy vehicle traffic which would access the Project Site from the west via Burthong Road, which is assumed to be a local road in this assessment due to the low traffic flow. **Table 5.2** below shows ECRTN traffic noise criteria for the case where a development creates additional traffic on a local road.

Table 5.2
Road Traffic Noise Criteria (ECRTN)

Type of Development	Recommended Criteria – dB(A)	
	Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 am)
11. Land use developments with potential to create additional traffic on existing local roads.	$L_{Aeq(1hr)}$= 55	$L_{Aeq(1hr)}$= 50

6. ASSESSMENT METHODOLOGY

6.1 SITE ESTABLISHMENT

The Project would require the following site establishment activities with the potential for noise impact on residential receivers.

1. Construction of surface infrastructure required for the underground mine, including a box cut, portal and decline, magazines, communication tower, fuel tank and refuelling area, ventilation rises, diesel generators for power, and water supply.
2. Construction of a processing plant and office area which would include:
    i. a Run-of-Mine (ROM) pad and temporary waste rock emplacement;
    ii. crushing and grinding, gravity separation and floatation circuits; and
    iii. Proponent and mining contractor site offices, workshops, laydown areas, ablutions facilities, stores, car parking, and associated infrastructure.
3. Construction of a Tailings Storage Facility.

4. Construction of a water management system, including construction of eight dams (comprising surface storage and sediment dams) and associated water reticulation system.
5. Construction of a site access road and new intersection with Burthong Road.
6. Construction of ancillary infrastructure, including soil stockpiles, core yards, internal roads and tracks and surface water management structures.

Assessment of noise was conducted using RTA Technology's *Environmental Noise Model* v3.06 (ENM).

Sound power levels of significant site establishment noise sources are shown in **Appendix A**. Noise source locations for this scenario are illustrated in **Figure B1** in **Appendix B.**

6.2 OPERATIONAL NOISE

6.2.1 Introduction

Assessment of operational noise was also conducted using the ENM software. The noise sources were modelled at their known (for stationary sources such as the crushing plant) or most exposed (for mobile sources such as trucks) positions and noise contours and/or point calculations were generated for the surrounding area.

6.2.2 Noise Sources

The Project would involve the following noise generating activities, the locations of which are illustrated in **Figure B2** in **Appendix B**.

1. Continuous operation of a front-end loader to manage stockpiles, blend the ore material and deliver it to the ROM pad.
2. Movement of haul trucks between the box cut and the ROM pad / temporary waste rock emplacement.
3. Processing operations including:
   - a crushing and screening circuit;
   - a primary ball mill for grinding; and
   - a gravity circuit (comprising a feed screen and centrifugal concentrator) and flotation circuit (where the concentrate and tail streams are separated and the concentrate is directed to a regrind circuit and the tails dewatered via a thickener prior to transfer to the Tailings Storage Facility).
4. Operation of equipment at the Tailings Storage Facility including water pumps, haul trucks and miscellaneous mobile equipment required to progressively lift and maintain the Tailings Storage Facility.
5. Transport of the bulk concentrate from the processing area to Burthong Road (via semi-trailer).
6. Miscellaneous operations on the Project Site, including:
   - equipment maintenance within laydown areas and workshops; and
   - light vehicles movements to / from, and around the Project Site.

6.2.3 Modelled Scenarios

As discussed in Section 4.2, both the site establishment and operational scenarios were modelled under the following atmospheric conditions.

- *Daytime lapse:*25°C, 50% relative humidity (RH), no wind, −1°C/100m vertical temperature gradient (dry adiabatic lapse rate, DALR).
- *Inversion:*5°C, 70% R.H., inversion strengths of +8°C/100m.

6.3 SLEEP DISTURBANCE

A potential for sleep disturbance would occur during operations within the ROM due to general impact noises from the crushing and screening plant, front-end loader and haul trucks. These sources would produce higher maximum noise levels than the night time site establishment scenario and is considered worst case in terms of potential sleep disturbance impacts. Sound power levels of modelled L_{Amax} noise sources (as an estimation of $L_{A1(1-min)}$levels) are shown in **Appendix A**. Impact noise was modelled using the ENM program under neutral and inversion conditions discussed in Section 4.2.

6.4 ROAD TRAFFIC

Additional road traffic generated by the Project will be of an intermittent rather than constant nature. There are many methods available for calculating the cumulative noise impact arising from intermittent signals of various shapes. The methodology employed in this assessment was sourced from the US Environmental Protection Agency document No. 550/9-74-004 *"Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974".*

The document refers to 'triangular' and 'trapezoidal' time signals, which are illustrated in **Figure 5**. A triangular time signal rises from the background level to a peak noise level and then immediately begins to subside. A trapezoidal time signal rises from the background level to a maximum level and sustains that level for a period of time before subsiding.

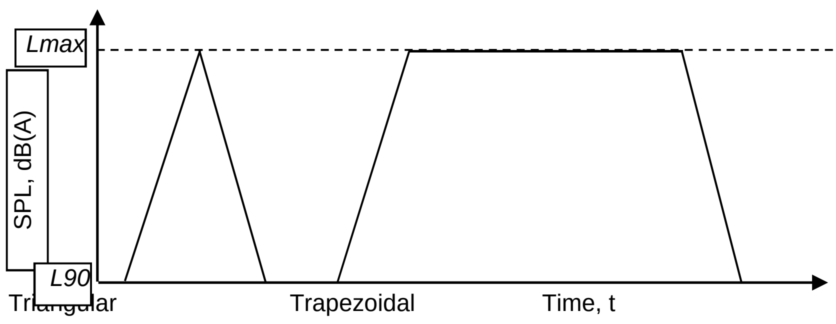


Figure 5 Triangular and Trapezoidal Time Signals

Road traffic on Burthong Road generated by the Project would be intermittent rather than constant with each passing vehicle approximated by a triangular time signal. The value of L_{eq},T for a series of triangular time patterns having maximum levels of L_{max} is given by Equation (1)**.**

$$L_{eq},T = L_b + 10\log\left[1 + \frac{n\tau}{T}\left(\frac{10^{\frac{\Delta L}{10}} - 1}{2.3} - \left(\frac{\Delta L}{10}\right)\right)\right] \tag{1}$$

where

L_{max}	= maximum vehicle noise at residence, dB(A);
L_b	= ambient equivalent noise level, dB(A);
ΔL	= L_{max}–L_b;
T	= assessment period (minutes);
τ	= "10dB-down" duration per vehicle, and
n	= number of vehicles during assessment period.

6.5 BLASTING

The following sections provide standard equations for predicting blast overpressure and ground vibration levels, sourced from the United States Bureau of Mines.

6.5.1 Blast Overpressure

Unweighted airblast overpressure levels (OP) are predicted from Equation (2) below.

$$\text{OP} = 165 - 24(\log_{10}(D) - 0.3\log_{10}(Q)), \text{ dB} \tag{2}$$

where D is distance from the blast to the assessment point (in metres)
Q is the weight of explosive per delay (kg)

Analysis of blast data from several coal mine in the Hunter Valley has shown Equation (2) to underestimate overpressure levels by up to 3 dB for small blasts (maximum instantaneous charge, MIC of 100 – 400 kg) and overestimate by 1 dB for larger blasts (MIC >400 kg). Given the small MIC values likely to be utilised a 3 dB correction has been applied to Equation (2).

6.5.2 Blast Vibration

The basic equations for calculation of peak particle vibration (PPV) levels from blasting are as follows:

$$\text{PPV} = 1140\left(\frac{D}{Q^{0.5}}\right)^{-1.6}, \text{ mm/s(for average ground type)} \tag{3}$$

$$\text{PPV} = 500\left(\frac{D}{Q^{0.5}}\right)^{-1.6}, \text{ mm/s(for hard rock)} \tag{4}$$

where$D$ and Q are defined as in Equation (2). The site geology indicates particularly hard ground and Equation (4) will be adopted.

7. IMPACT ASSESSMENT

7.1 INTRODUCTION

This section of the report presents predicted noise and vibration levels and, if required, provides mitigation recommendations where criterion exceedances are predicted. In all tables of results that follow, any predicted exceedances of the relevant criteria are highlighted in bold type.

7.2 SITE ESTABLISHMENT NOISE ASSESSMENT

7.2.1 Predicted Noise Levels – Site Establishment

Predicted noise levels at non-Project-related receivers from site establishment activities are shown in **Table 7.1**. Noise contours constructed using the predicted noise levels are shown in **Figures C1** and **C2** in **Appendix C**.

Table7.1
Predicted Site Establishment Noise Levels

Residence	Residence Coordinates		Predicted Noise Level dB(A),$L_{eq(15min)}$		Criterion dB(A),$L_{eq(15min)}$
	MGA (E)	MGA (N)	Neutral	Inversion	
R1	434054	6444176	<20	25	35
R2	434182	6444316	<20	26	35
R3	434871	6448174	20	33	35
R4	435387	6450587	<20	31	35

7.2.2 Recommendations – Site Establishment

The predicted site establishment noise levels in **Table 7.1** are below the operational noise criterion, even for night time activities under adverse conditions.

7.3 OPERATIONAL NOISE ASSESSMENT

7.3.1 Predicted Noise Levels– Operations

Predicted noise levels at non-Project-related receivers from operational activities are shown in **Table 7.2**. Noise contours are shown in **Figures C3** and **C4** in **Appendix C**.

7.3.2 Recommendations – Operations

The predicted operational noise levels in **Table 7.2** are below the operational noise criterion at receivers R1, R2 and R4 under neutral and adverse conditions. Worst case noise levels from the movement of heavy vehicles on the internal haul road up to the western property boundary are primarily responsible for the predicted worst case level at R3 being equal to the criterion.

Table 7.2
Predicted Operational Noise Levels

Residence	Residence coordinates		Predicted Noise Level dB(A),$L_{eq(15min)}$		Criterion dB(A),$L_{eq(15min)}$
	MGA (E)	MGA (N)	Neutral	Inversion	
R1	434054	6444176	<20	<20	35
R2	434182	6444316	<20	<20	35
R3	434871	6448174	25	35	35
R4	435387	6450587	<20	28	35

In cases where compliance with a noise criterion is marginal, it is justifiable for the DECCW to require periodic noise compliance monitoring, at least for a long enough period to determine compliance under all local meteorological conditions.

7.3.3 Low frequency Noise

The INP requires that noise from industrial sources does not contain annoying characteristics such as tonal, intermittent or low-frequency noise. Of particular concern is low-frequency noise which, when excessive, can significantly impact on residential amenity. The INP recommends that a 5 dB ‘modifying factor’ adjustment of 5 dB be added to the predicted noise level if the C-weighted noise level exceeds the A-weighted level by more than 15 dB.

An analysis of the third-octave point calculations at each receiver has found that the difference between the C- and A-weighted levels are in the range 4-9 dB. The modifying factor correction is therefore not applicable and the low-frequency content of the predicted noise at each receiver is unlikely to impact residential amenity.

7.4 SLEEP DISTURBANCE ASSESSMENT

7.4.1 Predicted Noise Levels – Sleep Disturbance

Predicted sleep disturbance (maximum) noise levels at all non-Project-related residences under night time adverse conditions (temperature inversion) are shown in **Table 7.3** which also includes the “differentials” between the predicted levels and the noise criterion.

Table 7.3
Predicted Sleep Disturbance Levels

Residence	Residence coordinates		Predicted Noise Level dB(A),L_{max}	Sleep Disturbance CriteriondB(A),L_{max}	Differential dB(A),L_{max}
	MGA (E)	MGA (N)			
R1	434054	6444176	30	45	-15
R2	434182	6444316	31	45	-14
R3	434871	6448174	39	45	-6
R4	435387	6450587	33	45	-12

7.4.2 Recommendations – Sleep Disturbance

Predicted maximum noise levels in **Table 7.3** are below the sleep disturbance criterion at all receivers.

7.5 ROAD TRAFFIC NOISE ASSESSMENT

An assessment of the road traffic noise from vehicles (heavy and light) being used for Project-related activities (for example, product transport off site by heavy vehicles, use of light vehicles by mine personnel as a mode of transport). The road traffic noise impacts were assessed on the four residences (R1 – R4) in the vicinity of the Project Site and on residences within Cobar along the product haul routes.

Traffic figures published by the RTA (AADT, Western, 1999) show a general pattern of roads passing through Nymagee from Condobolin, Hermidale, Canbelego, Cobar and Gilgunnia carrying approximately 20–70 vehicles per day. This is in the order of 1–3 vehicles per hour and, as such, the noise generated due to the existing road traffic within Nymagee would be considered negligible. Given that the existing traffic noise levels is significantly below the traffic noise criteria listed in Section 5.5the full values of the criteria become applicable to the Project. Table 2.12 in Section 2 of the *Environmental Assessment* gives the anticipated vehicle movements that would be generated by the Project and is reproduced in this report as **Table 7.4**.

Table 7.4
Anticipated Vehicle Movements

Vehicle Type	Anticipated 85th Percentile Daily Movements[1]
Construction	
Light Vehicles	60
Heavy Vehicles[2]	10
Oversize/Over-weight Vehicles[3]	4
Operations	
Light Vehicles	15
Heavy Vehicles[2]	12
Oversize/Over-weight Vehicles[3]	0

Note 1: One trip = two movements.
Note 2: Includes semi-trailers, B-double trucks and road trains.
Note 3: The Proponent would ensure that oversize and overweight vehicles would have the appropriate permits and approvals and would be appropriately escorted, when required.

Source: YTC Resources Limited

Table 2.5 in Section 2 of the *Environmental Assessment* lists the proposed hours for construction activities as 7 am – 10 pm. These hours correspond to daytime as defined in the ECRTN. In the assessment of the impact of road traffic assessment on the Residences R1 – R4 the following assumptions were made:

- that 50% of the daytime light vehicle movements noted in **Table 7.4** (i.e. 30 movements) could occur in the hour prior to commencement of construction activities at 7am and would therefore be occurring during the night time period for which he applicable traffic noise criterion is 50 dB(A),$L_{eq(1hour)}$.
- two heavy vehicle movements have also been assumed to occur between 6am and 7am to present a worst case assessment.

All the heavy vehicles and most of the light vehicles would access the Project Site via Burthong Road and Cobar-Condobolin Road (Priory Tank Road). The nearest residence to this route is R3 located on Burthong Road, set back 75 m on the west side of the road.

Based on Equation (2) and using a maximum pass-by sound power level of 108 dB(A) for trucks and 97 dB(A) for light vehicles, the predicted traffic noise level at R3 from two truck movements and 30 light vehicle movements in a 1-hour period is 44.3 dB(A). This is significantly below both the daytime and night time traffic noise criteria of 55 and 50 dB(A), respectively.

Further from the Project Site, heavy vehicles transporting product would pass through Cobar en-route to the Hermidale Rail Siding, the Cobar Rail Siding or destinations north of Cobar. These proposed transport routes are shown in **Figure 6**.

In Cobar, the closest residences to the proposed haul routes are along Railway Parade South, Louth Road and the Barrier Highway (east of Kidman Way) at approximately 20 m from the road. The calculated noise level for a single truck pass-by (travelling at 60 km/h) at this distance is 40.8 dB(A),$L_{eq(1hour)}$, which is significantly below the both the daytime and night time traffic noise criteria of 55 and 50 dB(A), respectively.

Calculations were undertaken to determine the maximum number of heavy vehicle movements that would achieve compliance with the traffic noise criteria. The following recommendation is made.

- Project-related heavy vehicle movements through Cobar should be limited to nine per hour during the night time and 31 per hour during the day in order to achieve compliance with the traffic noise criteria.

It should be noted that the Project would generate substantially fewer vehicle movements than the limiting values noted above.

7.6 BLASTING ASSESSMENT

Blasting is likely to be required at the surface to develop the mine access drift and then small blasts would be required underground to fracture material for subsequent extraction. The greatest potential for blast impacts on residential receivers would occur with blasting on the surface. The nearest residence to the southernmost point of the box cut would be R3 at a distance of approximately 2200 m. All other residences are greater than 3 km from the area designated for surface blasting.

The Proponent has provided an indicative blasting schedule given in **Table 7.5**.

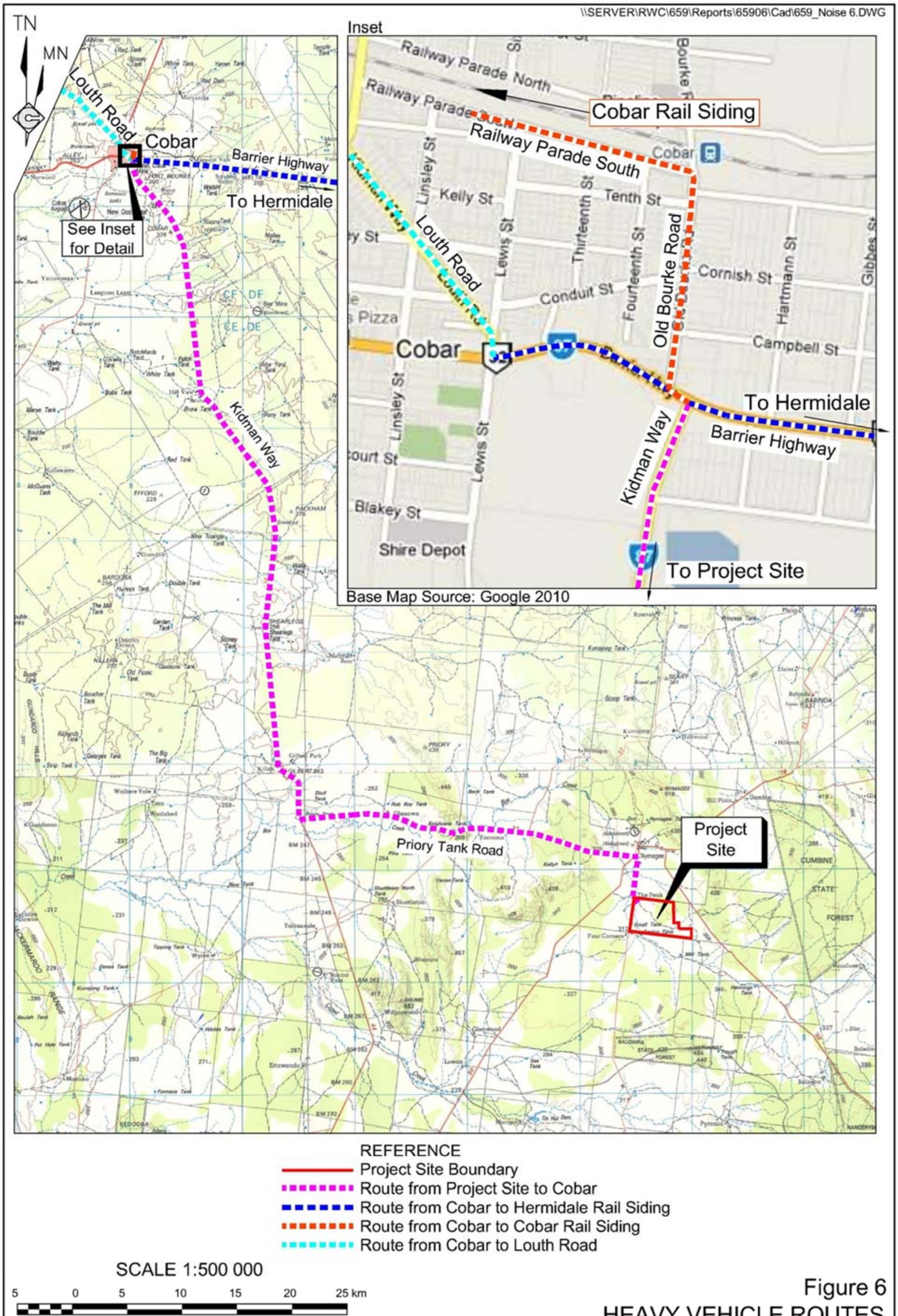


Figure 6
HEAVY VEHICLE ROUTES

Table 7.5
Blasting Schedule

Blast Location	Maximum Instantaneous Charge (MIC) in kg
Box cut bench	36
Decline development face	22
Production stope	66

All blast types would generate ground vibrations, but only the box cut blasts would generate overpressure waves. Calculations based on data presented in **Table 7.5** yield the following results.

- For a MIC of 66 kg (production stope), Equation (4) gives a peak vibration velocity of 0.1 mm/s at 2200 m. This is well below the 95% exceedance criterion of 5 mm/s for a sensitive (heritage) building damage.
- For a MIC of 36 kg (box cut bench), Equation (2) (with +3 dB correction) gives a peak blast overpressure of 105 dB at 2200 m. This is well below the 95% exceedance criterion of 115 dB.

8. CONCLUSIONS

This noise assessment has investigated the potential noise and vibration impacts from both the site establishment (construction) and operational phases. It has been conducted in accordance with the relevant guidelines including the NSW Industrial Noise Policy (INP) and Environmental Criteria for Road Traffic Noise (ECRTN), both of which are Department of Environment, Climate Change and Water (DECCW) publications.

Specifically, the assessment investigated the potential noise and vibration impacts on the four closest non-Project related residences (R1 – R4) in the vicinity of the Project Site and noise impacts on residences in Cobar along the product transport routes to the Hermidale Rail Siding, the Cobar Rail Siding and destinations north of Cobar.

The noise assessment yielded the following results.

- The predicted noise levels at the four residences (R1 – R4) under neutral and temperature inversion conditions are presented in **Table 8.1**. All values are below the relevant criterion.

Table 8.1
Predicted Site Establishment, Operational and Sleep Disturbance Noise Levels at the nearest Four Receivers (R1 – R4)

Residence	Predicted Noise Level				
	Site Establishment dB(A),$L_{eq(15min)}$ Criterion = 35 dB(A),$L_{eq(15min)}$)		**Operational Phase dB(A),$L_{eq(15min)}$** (Criterion = 35 dB(A),$L_{eq(15min)}$)		**Sleep Disturbance (dB(A),L_{max})** (Criterion = 45 dB(A),$L_{1(1\text{-}minute)}$)
	Neutral	**Inversion**	**Neutral**	**Inversion**	**Inversion**
R1	<20	25	<20	<20	30
R2	<20	26	<20	<20	31
R3	20	33	25	35	39
R4	<20	31	<20	28	33

- The predicted road traffic noise level at R3 (the nearest residence to the product transportation route) from two truck movements and 30 light vehicle movements in a 1-hour period is 44.3 dB(A). This is significantly below both the daytime and night time traffic noise criteria of 55 and 50 dB(A), respectively.
- In Cobar, the predicted road traffic noise level at the closest residences to the proposed haul routes along Railway Parade South, Louth Road and the Barrier Highway (east of Kidman Way) at approximately 20 m from the road has been calculated to be 40.8 dB(A),Leq(1hour) for a single truck pass-by (travelling at 60 km/h). The value is significantly below both the daytime and night time traffic noise criteria of 55 and 50 dB(A), respectively.
- Additionally, calculations undertaken to determine the maximum number of Project-related heavy vehicle movements that would achieve compliance with the traffic noise criteria are:
  - nine per hour during the night time; and
  - 31 per hour during the day time.
- The blasting assessment for noise and vibration levels experienced at R3, which at 2200 m distance is the nearest receptor to the source of surface blasting (box cut),yields the following results.
  - For the highestmaximum instantaneous charge (MIC) of 66kg required for the production stope, the peak vibration velocity has been calculated to be0.1 mm/s at 2200 m. This is well below the 95% exceedance criterion of 5 mm/s for a sensitive (heritage) building damage.
  - For an MIC of 36 kg blast required for the box cut bench, a peak blast overpressure (with +3 dB correction) has been calculated to be 105 dB at 2200 m. This is well below the 95% exceedance criterion of 115 dB.

The noise assessment has found no exceedances of noise or blasting criteria at any assessed receiver. Worst case noise levels equal to the operational noise criterion have been predicted at one of the receivers (labelled R3 in **Appendix B Figure B1** and **B2**) under adverse meteorological conditions (night time inversions). Noise monitoring at this receiver may become a requirement should the Project be approved.

In summary, this noise assessment has found that the Project would be able to operate within applicable noise and vibration criteria with the noise mitigation measures already incorporated in the mobile plant and vehicles, and that no additional operational safeguards and / or mitigation measures are required.

9. REFERENCES

Air Quality and Greenhouse Gas Assessment for the Hera Project, ENVIRON Australia Pty Ltd, November 2010.

NSW *Industrial Noise Policy* (EPA, 1999)

NSW *Environmental Criteria for Road Traffic Noise* (EPA, 1999)

Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZECC 1990)

Appendices

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Appendix A

Noise Source Sound Power Levels

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Noise Source Sound Power Levels

Noise Source	Lw,dB(A)	
Construction noise sources	**(L_{A10})**	
Pneumatic drill/compressor	112	
Excavator	112	
50T truck[1]	113	
Front end loader (CAT 998)[1]	114	
Bulldozer (CAT D10)	116	
Grader (CAT H14)	111	
Crane	108	
Diesel generator – camp site	106	
Operational noise sources	**(L_{Aeq})**	**(L_{Amax})**
Road train / B-double (point source per 350 m)	98	113
Diesel generator – mining operations	105	108
Crushing circuit	112	118
Grinding circuit	109	114
Tool carrier	108	113

[1]Construction and operational noise source.

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Appendix B

Noise Source Locations

(No. of pages including blank pages = 4)

Note: A colour version of Appendix B is available on the Project CD

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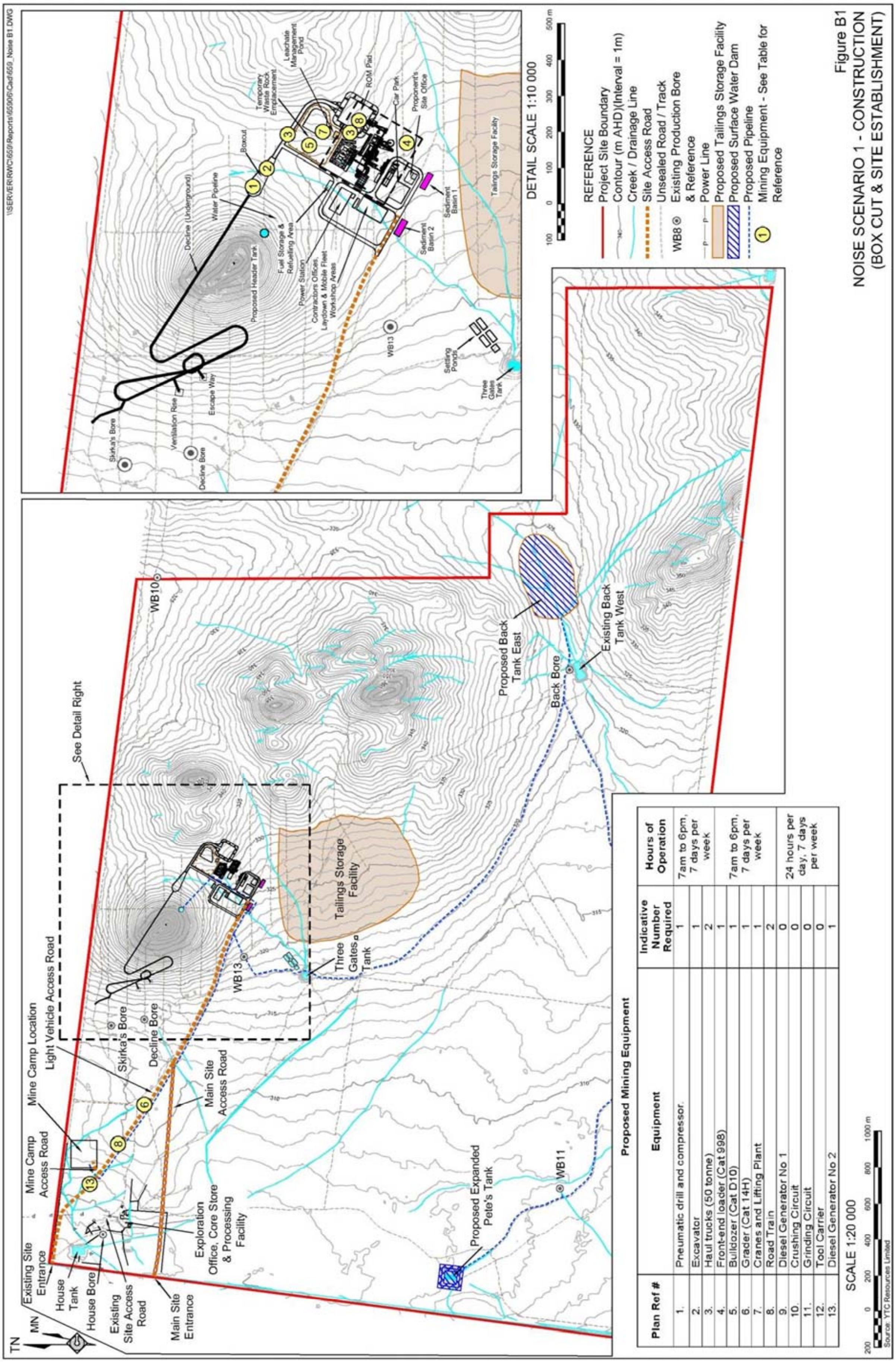
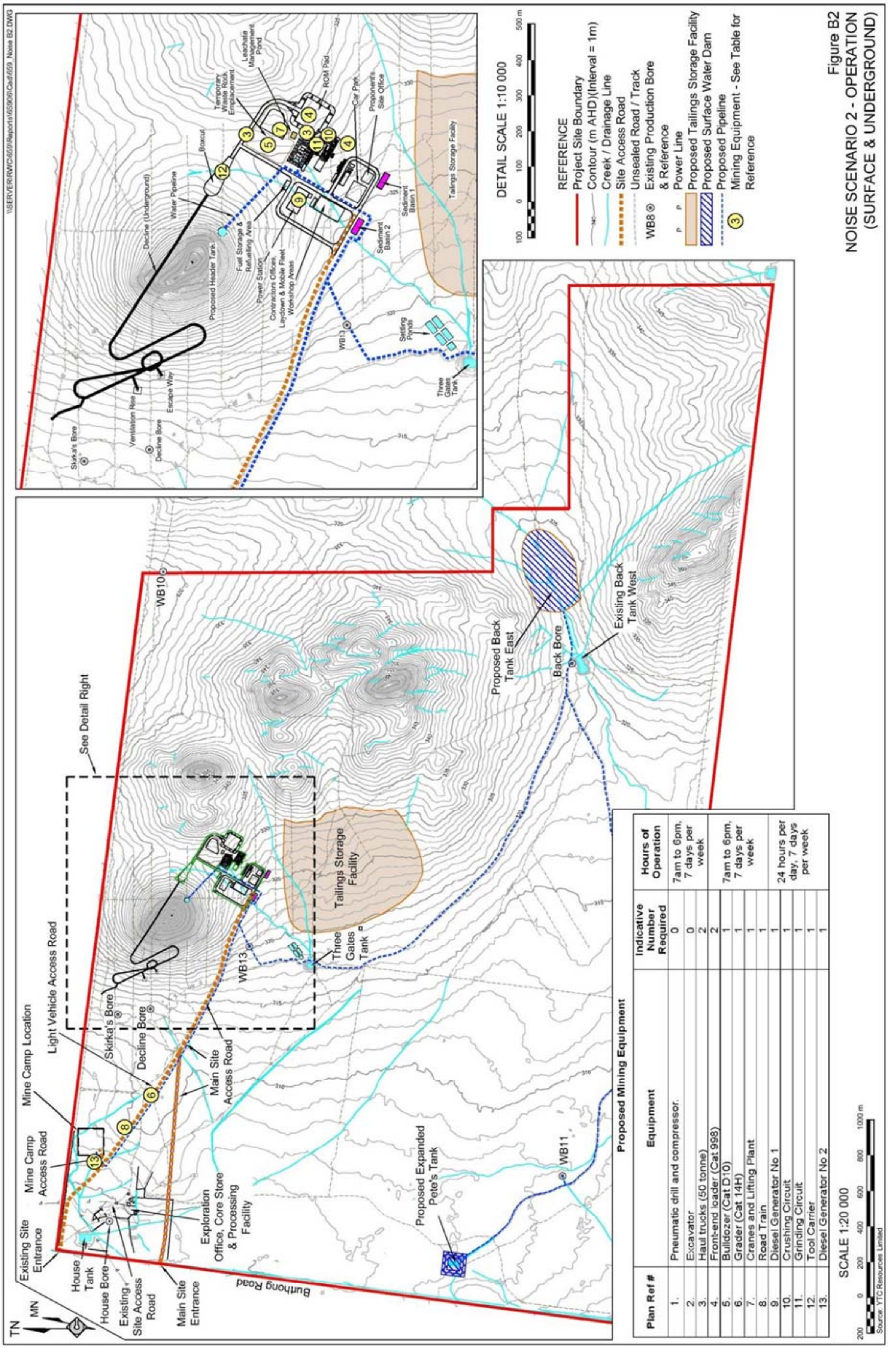


Proposed Mining Equipment

Plan Ref #	Equipment	Indicative Number Required	Hours of Operation
1.	Pneumatic drill and compressor.	1	7am to 6pm, 7 days per week
2.	Excavator	1	
3.	Haul trucks (50 tonne)	2	
4.	Front-end loader (Cat 998)	1	
5.	Bulldozer (Cat D10)	1	7am to 6pm, 7 days per week
6.	Grader (Cat 14H)	1	
7.	Cranes and Lifting Plant	1	
8.	Road Train	2	
9.	Diesel Generator No 1	0	24 hours per day, 7 days per week
10.	Crushing Circuit	0	
11.	Grinding Circuit	0	
12.	Tool Carrier	0	
13.	Diesel Generator No 2	1	

Figure B1
NOISE SCENARIO 1 - CONSTRUCTION
(BOX CUT & SITE ESTABLISHMENT)



Proposed Mining Equipment

Plan Ref #	Equipment	Indicative Number Required	Hours of Operation
1.	Pneumatic drill and compressor.	0	7am to 6pm, 7 days per week
2.	Excavator	0	
3.	Haul trucks (50 tonne)	2	
4.	Front-end loader (Cat 998)	2	
5.	Bulldozer (Cat D10)	1	7am to 6pm, 7 days per week
6.	Grader (Cat 14H)	1	
7.	Cranes and Lifting Plant	1	
8.	Road Train	1	
9.	Diesel Generator No 1	1	24 hours per day, 7 days per week
10.	Crushing Circuit	1	
11.	Grinding Circuit	1	
12.	Tool Carrier	1	
13.	Diesel Generator No 2	1	

Figure B2
NOISE SCENARIO 2 - OPERATION
(SURFACE & UNDERGROUND)

Appendix C

Predicted Noise Level Contours

(No. of pages including blank pages = 6)

Note: A colour version of Appendix C is available on the Project CD

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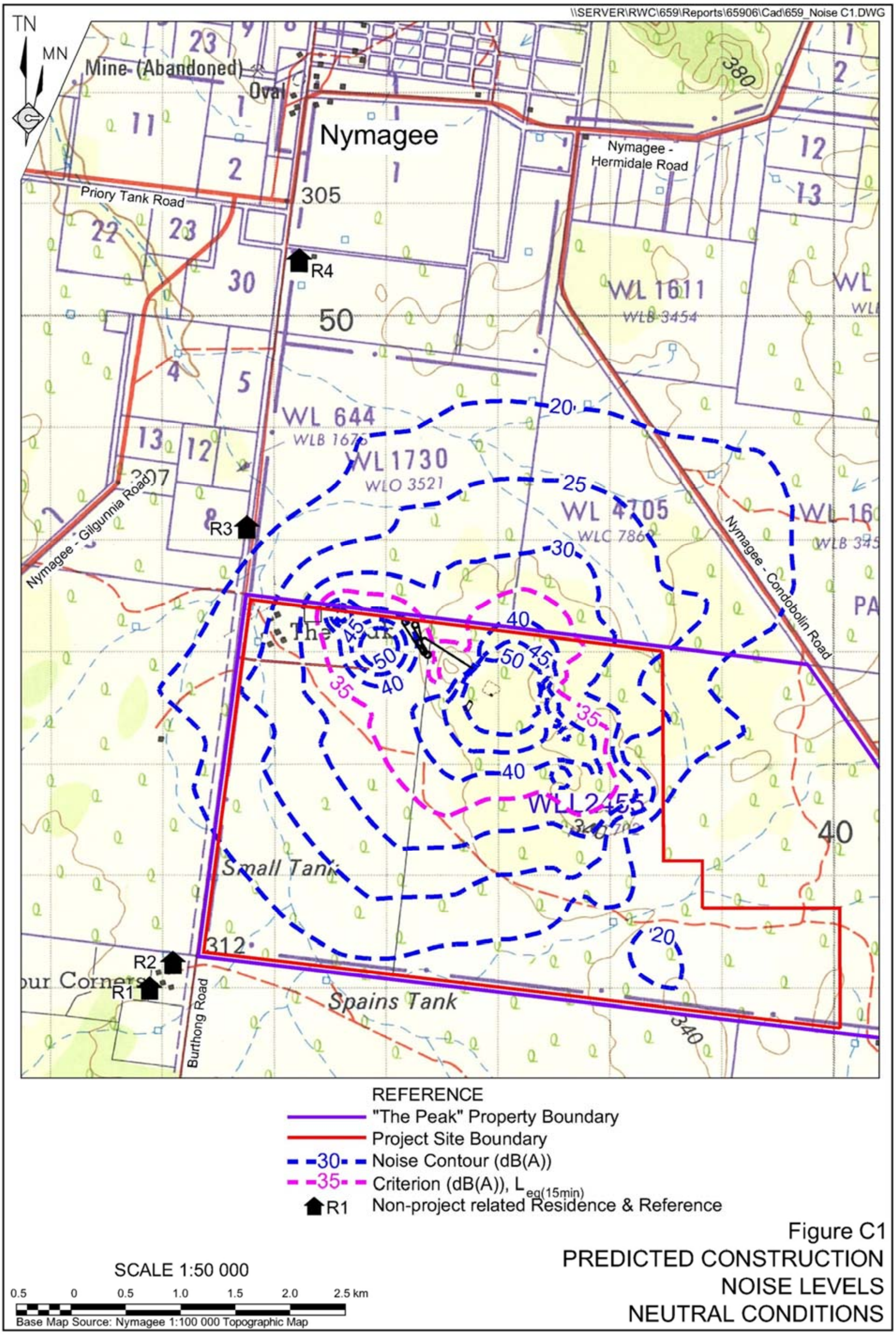

Figure C1
PREDICTED CONSTRUCTION NOISE LEVELS NEUTRAL CONDITIONS

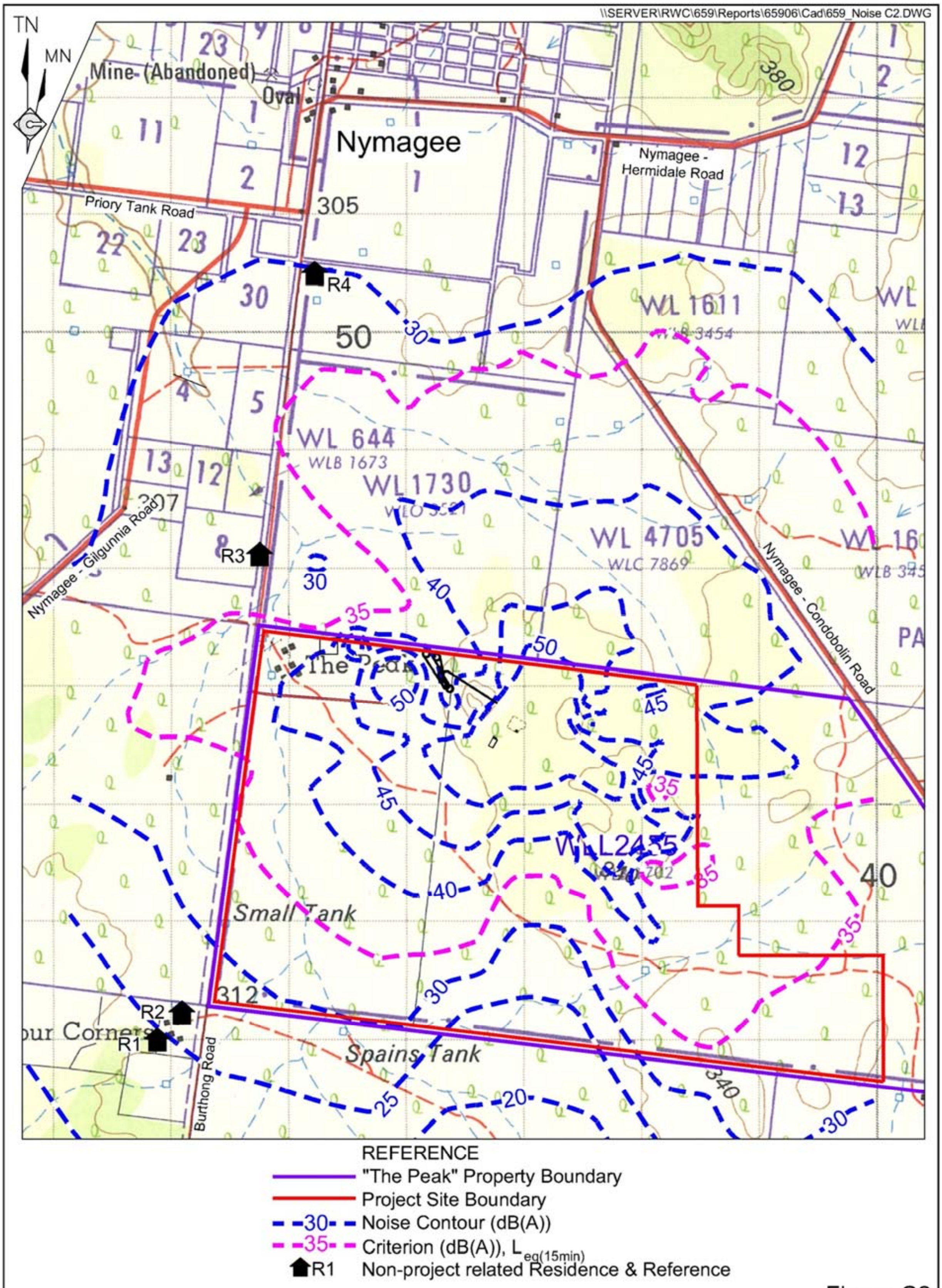

Figure C2
PREDICTED CONSTRUCTION NOISE LEVELS TEMPERATURE INVERSION

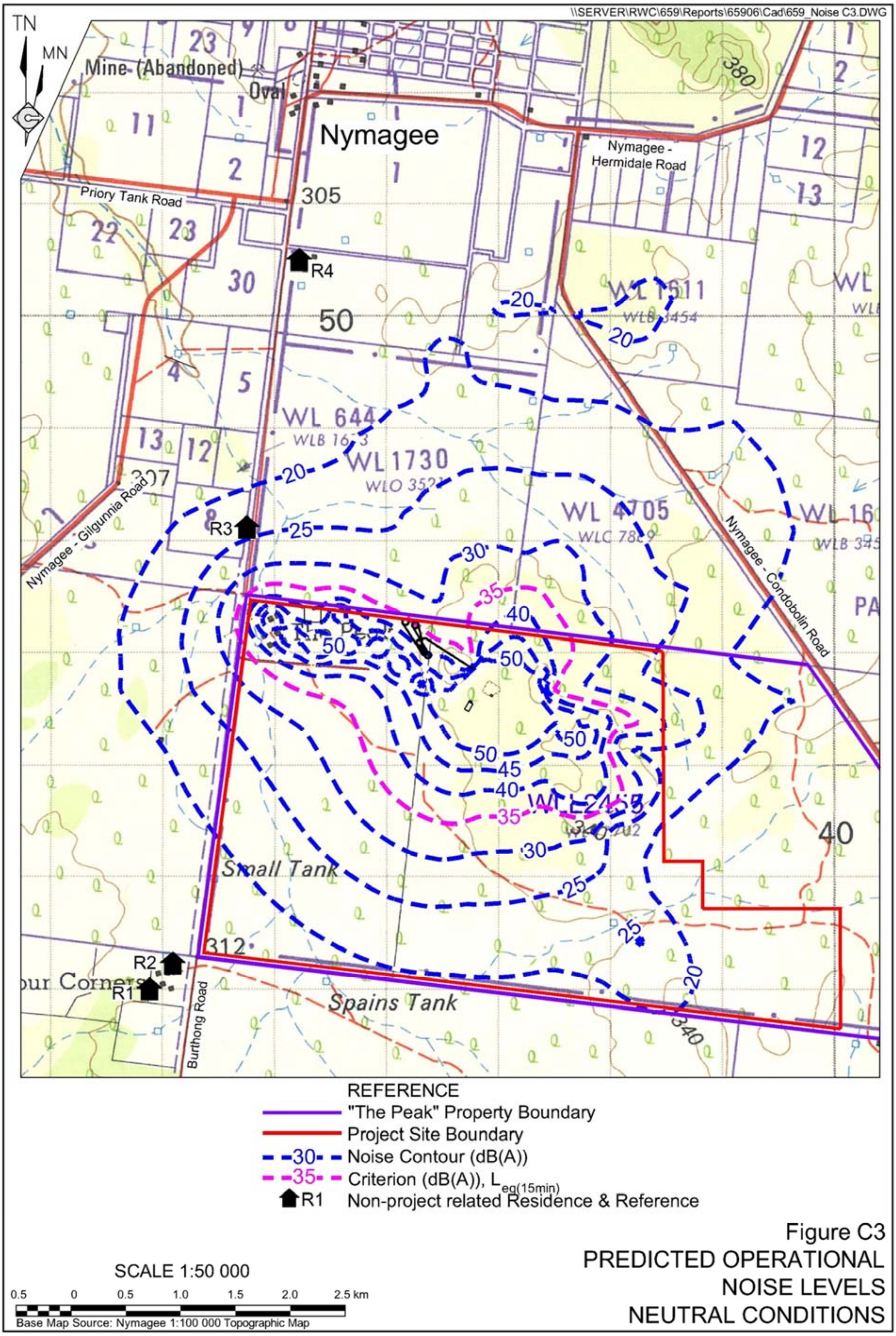

Figure C3
PREDICTED OPERATIONAL NOISE LEVELS
NEUTRAL CONDITIONS

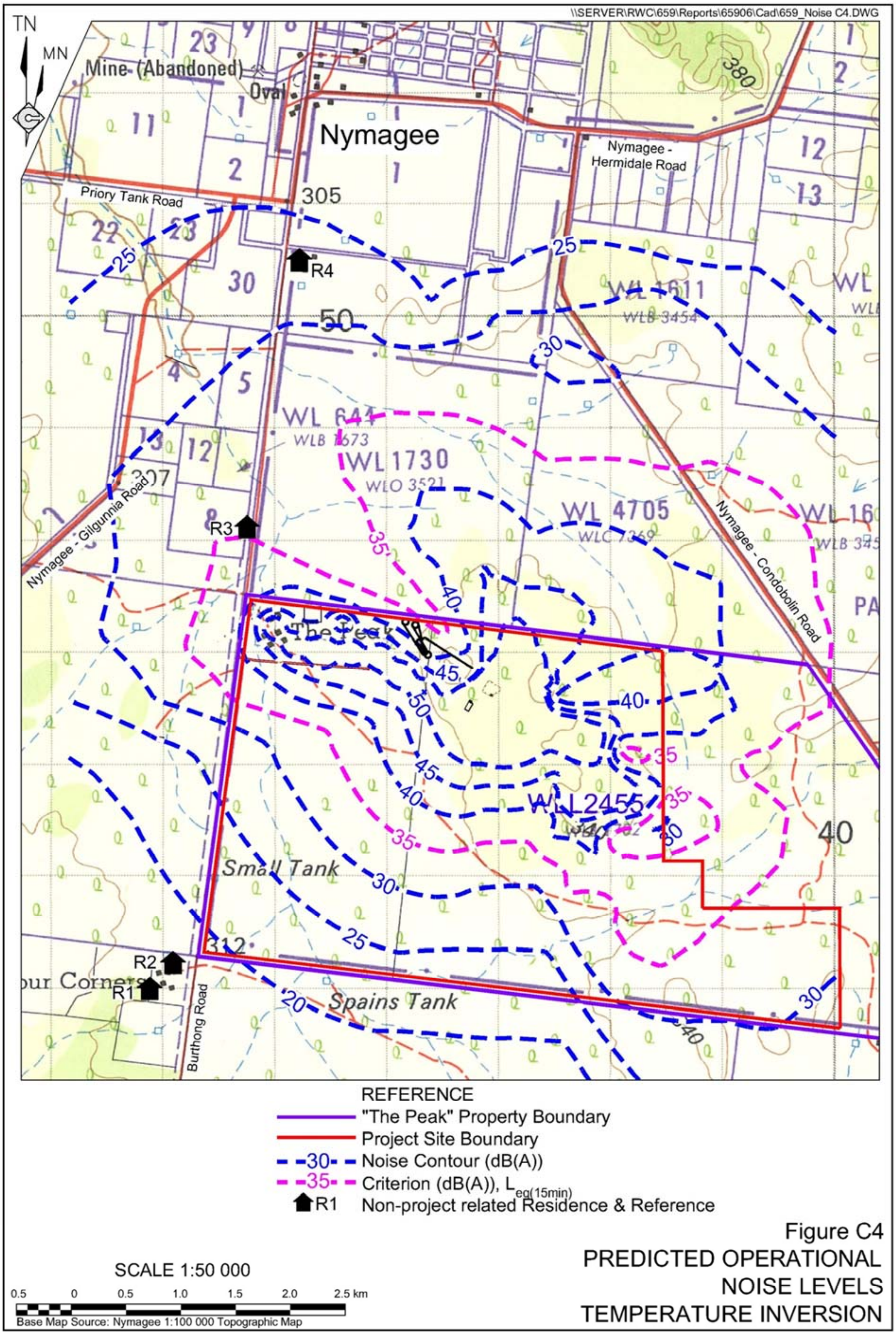

Figure C4
PREDICTED OPERATIONAL NOISE LEVELS TEMPERATURE INVERSION