SHEFFIELD RESOURCES

# Environmental Noise Impact Assessment

## THUNDERBIRD MINERAL SANDS PROJECT MINE SITE DEVELOPMENT ENVELOPE

NOVEMBER 2016

WSP | PARSONS BRINCKERHOFF

# Environmental Noise Impact Assessment

## THUNDERBIRD MINERAL SANDS PROJECT
## MINE SITE DEVELOPMENT
## ENVELOPERAL SANDS PROJECT

**Sheffield Resources**

| REV | DATE | DETAILS |
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# ABBREVIATIONS

| | |
|---|---|
| Km | Kilometre |
| Bt | Billion Tonnes |
| MUP | Mining Unit Plant |
| M | Metre |
| Mt | Million Tonnes |
| Tph | Tonnes per hour |
| WCP | Wet Concentrator Plant |
| Mw | Megawatt |
| dB | Decibel |
| MCP | Mineral Separation Plant |
| LTR | Low Temperature Roast |

# EXECUTIVE SUMMARY


**Background**

WSP | Parsons Brinckerhoff was commissioned by Sheffield Resources Limited (Sheffield Resources) to undertake an environmental noise impact assessment of the proposed Thunderbird Mineral Sands Project (Thunderbird Project) in Western Australia.

The Thunderbird Project proposes the following:

- Progressive mining, backfill and rehabilitation.
- Use of mining unit plants.
- Minerals processed through conventional heavy mineral sands processing circuit.
- Final product transported by road trains to the Port of Derby (not a part of this assessment).

This report addresses noise associated with the mine site development envelope. Noise associated with transport of product to the Port of Derby is covered in a separate report (2300650A-ACS-REP-PORT Rev001).

The identified nearest potential known sensitive human receivers to the mine site are as follows:

- Thunderbird Project accommodation camp, approximately 5 km from the mine site.
- Mt Jowlaenga Homestead (currently uninhabited, but may be reopened), located approximately 7 km from the mine site.
- Nillibubbica designated rest area, Great Northern Highway 27 km from the mine site.
- Bidan (formerly known as Bedunburra) Aboriginal Community 28 km from the mine site.
- Yeeda Outstation, Mount Jowlaenga Road 28 km from the mine site.

**Applicable criteria**

The Environmental Protection (Noise) Regulations 1997 have been used to assess the noise levels at the sensitive receivers.

**Modelling**

The acoustic modelling program SoundPLAN has been used to predict the noise levels at the receivers. The model results are for night time operations with all equipment operating for the year 1 and year 35 scenarios.

**Assessment**

The predicted results from the noise model show that the noise levels are compliant with the relevant noise criteria at all identified receivers for both scenarios.

# 1 INTRODUCTION

The proposed Thunderbird Mineral Sands Project (Thunderbird Project) mine site is located on the Dampier Peninsula about 60 Kilometres (km) west of Derby and 25 km north of the Great Northern Highway joining Derby and Broome.

The Thunderbird Project is one of the largest mineral sands deposits discovered in the last 30 years. It has a total mineral resource of 3.2 Billion Tonnes (Bt) and supports a 47 year mine life.

This report has been prepared by WSP | Parsons Brinckerhoff for Sheffield Resources Limited (Sheffield Resources) to support its environmental impact assessment of the Thunderbird Project.

The aims of the study are:

- Provide a description of the proposed mining operation based on the project information provided by Sheffield Resources, identifying the main sources of noise associated with construction and operation of the mine.
- Identify all nearby potentially-affected sensitive receivers.
- Provide a description of the environmental noise criteria relevant to the Thunderbird Project.
- Assess the potential noise impacts associated with the mine site on the nearest sensitive receivers.

# 2 BACKGROUND INFORMATION

## 2.1 Project description

The proposed location of the Project is shown in Figure 2-1.

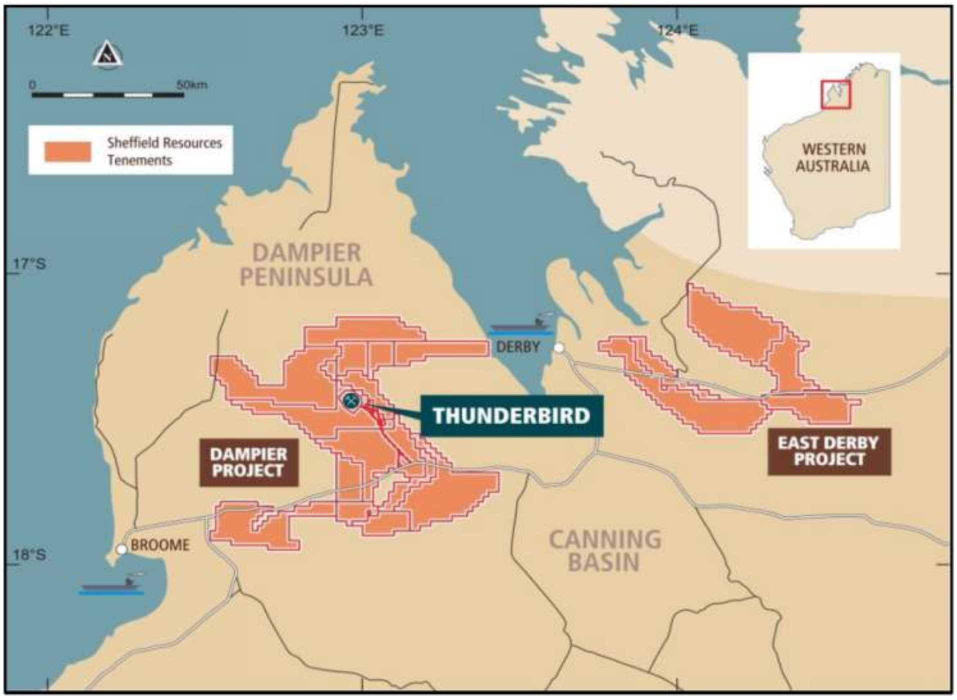


Figure 2-1 Site location

The mining schedule comprises two Mining Unit Plants (MUPs) advancing in sequence with up to 200 ha of pit open at any one time. Mining is scheduled to start in the north-eastern part of the deposit then progress to the southwest before turning southeast.

The mining method employed at the Thunderbird Project would involve progressive mining and backfill typically used in dry mining operations in the mineral sands industry. Mining commences with excavation of an initial pit to expose the ore. As the pit advances, waste overburden is used to provide a dam wall within the mine void, which is then backfilled with tailings, then contoured and rehabilitated as shown in Figure 2-2.

At commencement of mining, 7.5 mega tonnes per annum (Mtpa), four large dozers will deliver the ore to two 810 tonnes per hour (tph) skid mounted dozer trap MUPs.

At year 5 the throughput will increase to 15 Mtpa by deploying an additional MUP and supporting equipment/plant.

Ore mining will be supported by a fleet of loaders and 100 tonne trucks. The waste mining, oversize removal and dam wall construction and rehandling will be carried out with a fleet of loaders, trucks, excavators and scrapers.

The MUPs will screen coarse oversize material with undersize fed to a scrubber trammel. The undersize material from the trammel is slurried and pumped to the Wet Concentrator Plant (WCP).

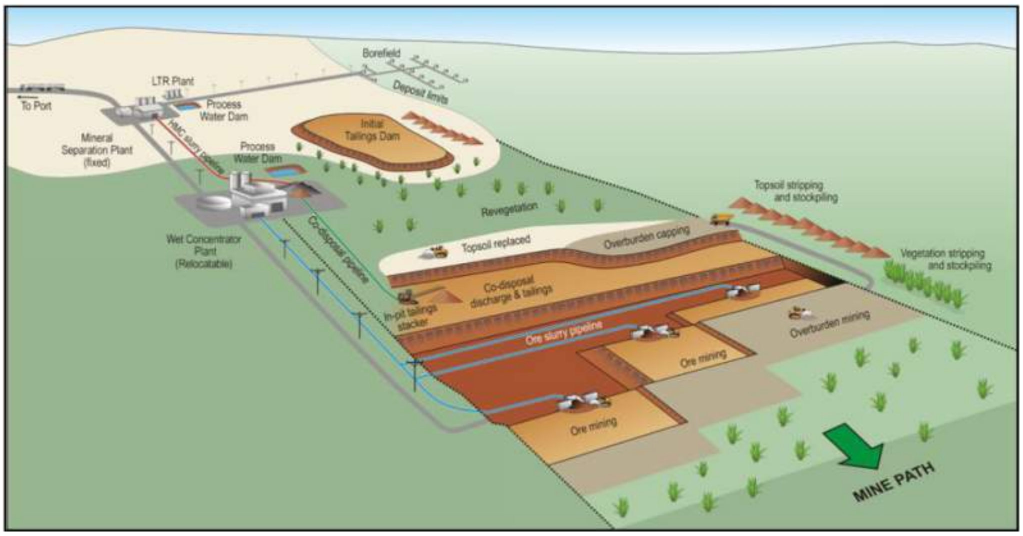


**Figure 2-2 Mine design**

The Thunderbird Project mineralisation will be processed through a conventional heavy mineral sands processing circuit to deliver a suite of zircon, ilmenite and HiTI88 products. The process flow sheet is shown in Figure 2-3.

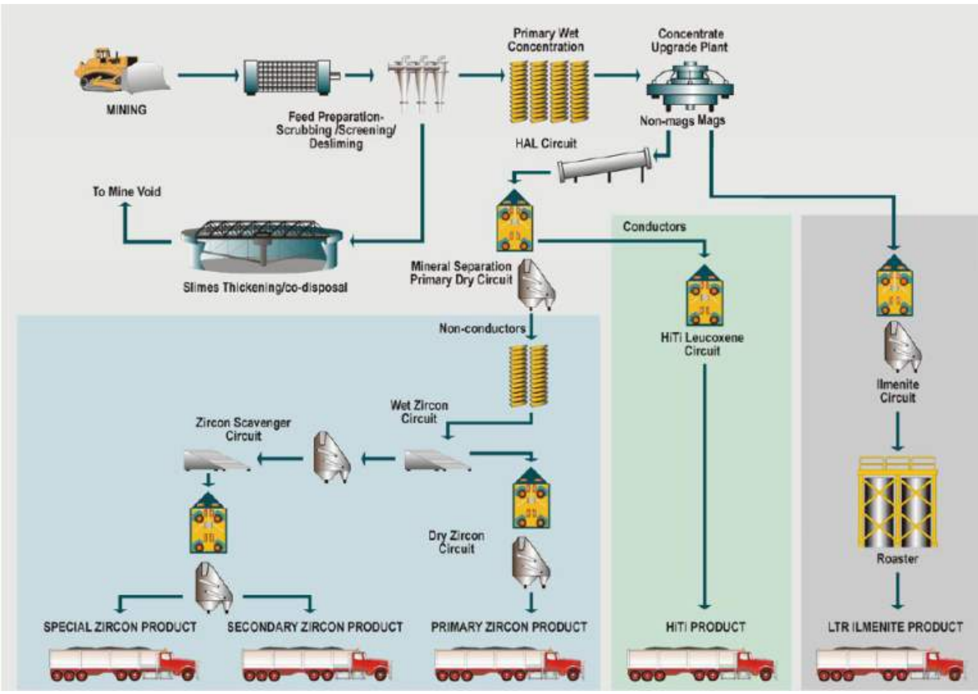


**Figure 2-3 Thunderbird process flow sheet**

Infrastructure and buildings on site will include a 35 Megawatt (MW) LNG/diesel power station, communication buildings, offices, store, laboratory and workshops.

The accommodation camp will be located 5 km east-southeast from the mine site with a capacity of approximately 150 persons.

A preliminary site layout is outlined in Figure 2-4.

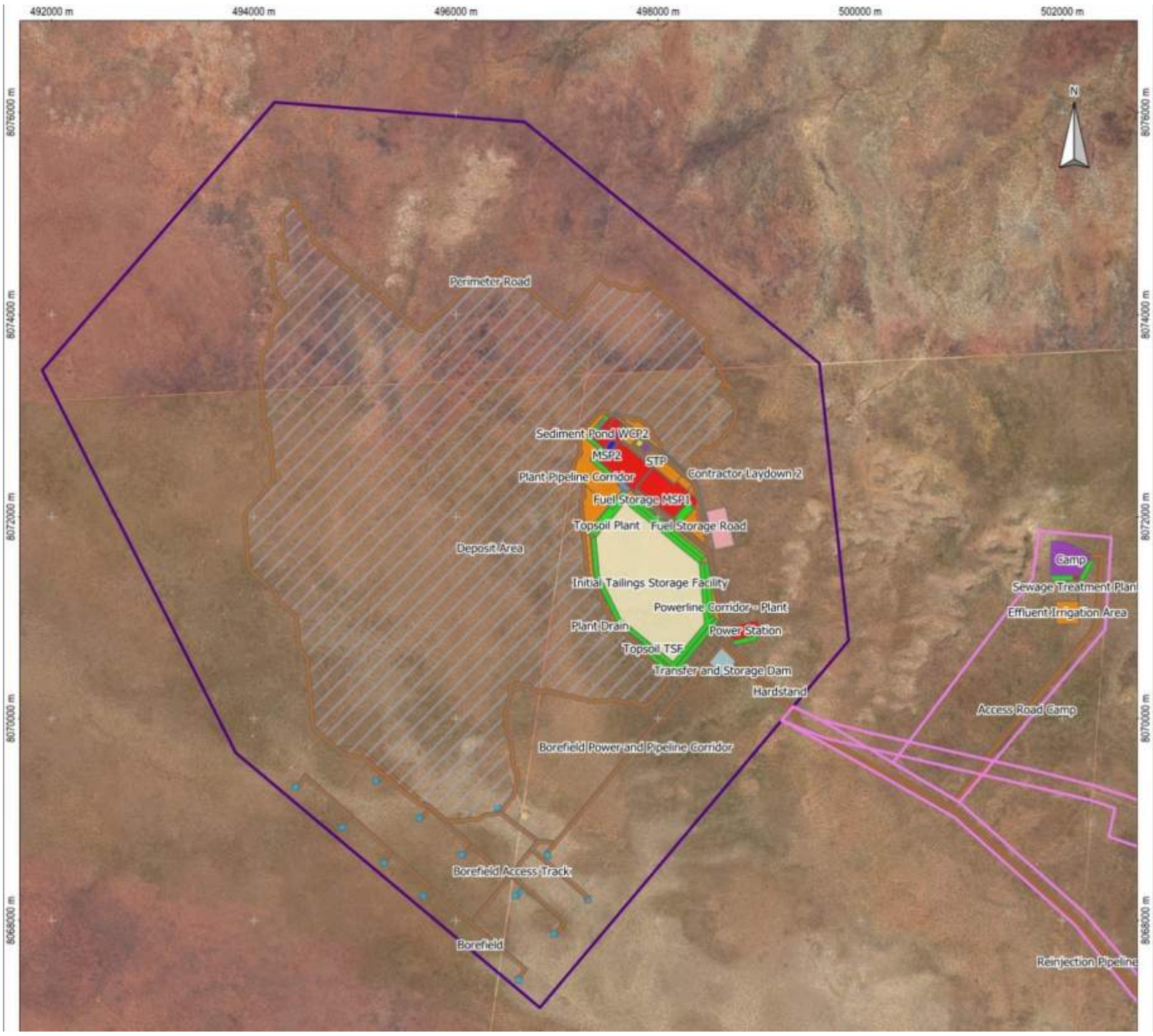


Figure 2-4 Thunderbird site layout

Final product will be transported in bulk by a fleet of five quad road trains from the mine to the Port of Derby for storage and export. The road trains will operate 24 hours a day six days per week and it is anticipated that each road train will complete two runs per 12 hour shift. The environmental noise assessment of Port of Derby is covered in a separate report (2300650A-ACS-REP-PORT Rev001).

## 2.2 Location of sensitive receivers

The identified nearest potential known sensitive human receivers as identified by an examination of Google Earth imagery and Broome and Derby Shire Maps are:

- Thunderbird accommodation camp 5 km from mine site.
- Mt Jowlaenga Homestead (currently uninhabited, but may be reopened), located approximately 7 km from the mine site.
- Nillibubbica designated rest area, Great Northern Highway 27 km from the mine site.
- Bidan (formerly known as Bedunburra) Aboriginal Community 28 km from the mine site.
- Yeeda Outstation, Mount Jowlaenga Road 28 km from the mine site.

The locations of these receivers in relation to the Project are shown in Figure 2-5.


Reproduced with permission Google Earth

**Figure 2-5 Location of sensitive receivers**

## 2.3 Existing noise environment

At this stage, no detailed background noise studies have been undertaken in the mine project area. As there are no industrial sources of noise in the area, the background noise levels in the project area are expected to be non-anthropogenic sources such as wind induced foliage noise, insects, bats and bird noise.

Attended noise measurements were taken at the Mount Jowalenga access road on the 24 May 2016 and a summary of the measurements are outlined in Table 2-1.

**Table 2-1 Mount Jowalenga noise measurement**

| Time | $L_{A90}$ dB | $L_{A10}$ dB | $L_{Amax}$ dB | Comments |
|---|---|---|---|---|
| **10.55 AM** | 23 | 26 | 30 | Paused for traffic pass by on Great Northern Highway<br>Insect and wind in foliage dominant |
| **11.05 AM** | 27 | 50 | 62 | Not paused<br>Traffic, insect and wind in foliage dominant |

In addition a literature review has been carried out of studies into background noise levels in the Kimberley and the most appropriate study containing background noise data was the *Browse Liquefied Natural Gas Precinct – Strategic Assessment Report Part 4: Environmental Assessment – Terrestrial Impacts* 2010 by the Government of Western Australia Department of State Development which are outlined in Table 2-2.

**Table 2-2 Background noise levels within North Western Australia**

| Measurement Site | $L_{90}$ Sound Pressure Level dBA[1] | | |
|---|---|---|---|
| **Northern Carnarvon Basin** | 24 | 33[2] | 29 |
| **Burrup Peninsula** | 25 - 30 | 25 - 30 | 25 - 30 |

1 Lowest 10th percentile of $L_{A90}$
2 Noise Levels influenced by people on beach

It should be noted that these locations are coastal and may also be influenced by noise from coastal wave action.

Based on WSP | Parsons Brinckerhoff project experience at similar remote inland locations within the Pilbara, Western Australian noise levels would be expected to be within the levels outlined in Table 2-3.

**Table 2-3 Expected existing noise levels**

| Sound Pressure Level dBA | Day (0700-1900) | Evening (1900-2200) | Night (2200-0700) |
|---|---|---|---|
| **$L_{10}$** | 39 - 45 | 34 - 45 | 37 - 42 |
| **$L_{90}$*** | 22 - 30 | 27 - 34 | 17 – 32 |

* Lowest 10$^{th}$ percentile of $L_{A90}$

# 3 ASSESSMENT CRITERIA

The applicable statutory requirements for noise emissions are contained within the *Environmental Protection Act 1986* (the Act) and the *Environmental Protection (Noise) Regulations 1997* (the Noise Regulations).

The Noise Regulations require that noise emitted from any premises must comply with assigned noise levels when received at any other premises and be free of the intrusive characteristics of tonality, modulation and impulsiveness. In addition, the noise emissions must not “significantly contribute” to an exceedance of the assigned levels.

The assigned levels are specified according to the type of premises receiving the noise. For noise sensitive receivers, the assigned levels recognise the time of day and the presence of commercial and industrial land zonings and roads within a 450 m radius of the receiver. The Noise Regulations specify requirements relating to tonality, modulation and impulsiveness, as well as to emissions that may “significantly contribute” to an exceedance.

**Assigned noise levels**

Assigned noise levels are the levels of noise allowed to be received at a premises at a particular time of the day.

There are different assigned levels for noise sensitive, commercial and industrial premises. The assigned levels for noise sensitive premises vary depending on the time of the day. The assigned levels also depend on how close the noise sensitive premises are to industrial and commercial areas and to major roads. The assigned noise levels always apply at the premises receiving the noise.

A noise emission is generally understood to “significantly contribute” if it is higher than a level which is 5 dBA below the assigned level at the point of reception.

The table of assigned levels, shown in Table 3-1 identifies three types of assigned levels: $L_{Amax}$, $L_{A1}$ and $L_{A10}$.

**Table 3-1 Table of assigned noise levels**

| Type of premises receiving noise | Time of day | Assigned level (dB) | | |
|---|---|---|---|---|
| | | $L_{A10}$ | $L_{A1}$ | $L_{Amax}$ |
| Noise sensitive premises at locations within 15 m of a building directly associated with a noise sensitive use | 0700 to 1900 hours Monday to Saturday | 45 + influencing factor | 55 + influencing factor | 65 + influencing factor |
| | 0900 to 1900 hours Sunday and public holidays | 40 + influencing factor | 50 + influencing factor | 65 + influencing factor |
| | 1900 to 2200 hours all days | 40 + influencing factor | 50 + influencing factor | 55 + influencing factor |
| | 2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays | 35 + influencing factor | 45 + influencing factor | 55 + influencing factor |
| Noise sensitive premises at locations further than 15 m from a building directly associated with a noise sensitive use | All hours | 60 | 75 | 80 |
| Commercial premises | All hours | 60 | 75 | 80 |
| Industrial and utility premises | All hours | 65 | 80 | 90 |

1 The "influencing factor" is calculated for each noise-sensitive premises receiving noise. It takes into account the amount of industrial and commercial land and the presence of major roads within a 450 m radius around the noise receiver.

2 The influencing factor will range from zero to about 20 in most cases.

The influencing factor increases with the amount of commercial and industrial premises in the vicinity of the receiver as well as the presence of major or minor roads. This is calculated by considering areas within 100 m and 450 m of the receiver. As there are no industrial or commercial premises or roads within 450 m of the Thunderbird Project the influencing factor is zero and the criteria within Table 3-1 are therefore unchanged.

If noise emitted from any premises when received at any other premises cannot reasonably be free of intrusive characteristics of tonality (e.g. drone), modulation (e.g. siren) and impulsiveness (e.g. bang), then a series of adjustments must be added to the emitted levels (measured or calculated) and the adjusted level must comply with the assigned level. The adjustments are detailed in Table 3-2.

**Table 3-2 Table of adjustments**

| Adjustment where noise emission is not music these adjustments are cumulative to a maximum of 15 dB | | |
|---|---|---|
| Where tonality is present | Where modulation is present | Where impulsiveness is present |
| +5 dB | +5 dB | +10 dB |

The combined noise spectrum of the mine site activities combined at the nearest receivers has been assessed and does not exhibit any of the above characteristics. Therefore no correction is to be made to the predicted results.

### Representative Assessment Period

The assigned levels are statistical noise levels over a Representative Assessment Period (RAP), for this assessment the RAP has been chosen as 15 minutes as an appropriate period for assessing the noise from the Project. As the noise from the mine site will be constant the $L_{10}$ criteria will be used for the assessment of the noise levels at the receivers.

# 4 METHODOLGY

## 4.1 Noise modelling

The model was prepared using the SoundPLAN Industrial Module a commercial software system developed by Braunstein and Bernt Gmbh in Germany.

The software allows the use of various internationally recognised noise prediction algorithms. The CONCAWE method, developed in the Netherlands for assessment of large industrial plants, has been selected for this assessment as it enables meteorological influences to be assessed.

The SoundPLAN model included the climatic parameters outlined in the EPA *Guidance for the Assessment of Environmental Factors Environmental Noise*, *Draft No.8*; these parameters are highlighted in Table 4-1. The modelling assumed a worst case scenario wind direction from the source to the receiver.

**Table 4-1 Meteorological conditions used in the noise predictions**

| Time of Day | Temperature | Relative Humidity | Wind Speed* | Pasquil Stability Category |
|---|---|---|---|---|
| Day (07:00 to 19:00) | 20°C | 50% | 4 m/s | E |
| Night (22:00 to 07:00) | 15°C | 50% | 3 m/s | F |

* - The wind is orientated so that it blows from the source to the receiver

## 4.2 Source Sound Power Levels

The potential for machinery to emit noise is quantified as the sound power level expressed in decibels (dB re 1x10-12 W). At the receiver, the noise is quantified as the sound pressure level expressed in decibels (dB re 20 µPa).

The Sound Power Levels used in the modelling are from Sheffield Resources, manufacturer data and WSP | Parsons Brinckerhoff's database and are shown in Table 4-2.

**Table 4-2 Source Sound Power Levels mine site**

| Source Item | Octave Band Sound Power Level dBL | | | | | | | | Total dBA | Source Height m |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency Hz | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | | |
| Dozer CAT D11 | 115 | 114 | 101 | 105 | 104 | 102 | 94 | 88 | 109 | 2.3 |
| Dozer CAT D10 | 115 | 114 | 101 | 105 | 104 | 102 | 94 | 88 | 109 | 2.3 |
| Dozer CATD9 | 112 | 111 | 108 | 110 | 103 | 101 | 99 | 93 | 110 | 2.3 |
| Loader CAT 992K | 128 | 126 | 109 | 107 | 102 | 98 | 95 | 90 | 113 | 4 |
| Excavator Komatsu PC1250 | 109 | 116 | 111 | 108 | 104 | 100 | 91 | 85 | 110 | 5 |
| Excavator Hitachi EX190 | 109 | 119 | 114 | 114 | 111 | 109 | 103 | 98 | 116 | 5 |
| Dump Truck CAT 777G | 120 | 120 | 121 | 114 | 110 | 111 | 106 | 107 | 118 | 4.3 |
| Dump Truck CAT 785 | 136 | 125 | 125 | 121 | 115 | 114 | 109 | 101 | 123 | 4.3 |
| Grader CAT 16M | 104 | 110 | 109 | 109 | 110 | 105 | 102 | 99 | 114 | 2.3 |
| Scraper CAT 657G | 108 | 113 | 105 | 109 | 108 | 107 | 101 | 95 | 113 | 2.3 |
| IT Loader CAT IT62 | 128 | 120 | 109 | 107 | 102 | 98 | 95 | 90 | 110 | 2.3 |
| Rockbreaker CAT 330 | 112 | 109 | 111 | 117 | 117 | 117 | 117 | 114 | 123 | 2.3 |
| Watercart CAT 740 | 112 | 105 | 98 | 96 | 99 | 97 | 92 | 86 | 103 | 4.3 |
| Road Train | 122 | 123 | 118 | 118 | 115 | 112 | 111 | 106 | 121 | 2.5 |

| Source Item | Octave Band Sound Power Level dBL | | | | | | | | Total dBA | Source Height m |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency Hz | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | | |
| MUP (dozer trap, feed conveyor, hopper and slurrying unit) | 73 | 93 | 93 | 101 | 99 | 102 | 97 | 87 | 106 | 2 |
| WCP (Wet Concentrator Plant) | 70 | 76 | 79 | 86 | 88 | 87 | 84 | 76 | 93 | 2 |
| MSP (Mineral Separation Plant) | 70 | 74 | 78 | 85 | 86 | 87 | 87 | 83 | 93 | 2 |
| LTR (Low Temperature Roast) Plant | 91 | 92 | 92 | 93 | 97 | 95 | 91 | 85 | 101 | 2 |
| Power Station | 124 | 118 | 114 | 112 | 108 | 107 | 102 | 96 | 115 | 2 |

## 4.3 Noise modelling scenarios

For the purposes of assessing noise impacts Year 1 and Year 35 scenarios were considered. All scenarios were predicted as night time occurrences as the criteria is more stringent. Compliance with the night time will therefore also achieve compliance with the day time criteria.

Key equipment numbers as provided by Sheffield Resources for the scenarios are shown in Table 4-3.

**Table 4-3 Mining fleet distribution**

| Item | Number of Plant Items | |
|---|---|---|
| | Year 1 Scenario | Year 35 Scenario |
| Dozer CAT D11 (D11) | 2 | 4 |
| Dozer CAT D10 (D10) | 1 | 1 |
| Dozer CATD9 (D9) | 1 | 1 |
| Loader CAT 992K (FEL) | 1 | 1 |
| Excavator 100T Komatsu PC1250 (EXC) | 1 | - |
| Excavator 200T Hitachi EX190 (EXC) | - | 2 |
| Haul Truck CAT 777G (HT) | 4 | - |
| Haul Truck CAT 785 (HT) | - | 8 |
| Grader CAT 16M (GRD) | 1 | 1 |
| Scraper CAT 657G (SCR) | 4 | 4 |
| IT Loader CAT IT62 (ITL) | 1 | 1 |
| Rockbreaker CAT 330 (RB) | 1 | 1 |
| Watercart CAT 740 (H20) | 2 | 2 |
| Road Train (RT) | 1 | 1 |
| MUP | 2 | 3 |

### 4.3.1 Year 1 scenario

The year one scenario was chosen to be representative of initial excavation of the open pit and construction of ore storage areas. The placement of the fixed and mobile plant noise sources within the model are outlined in Figure 4-1.

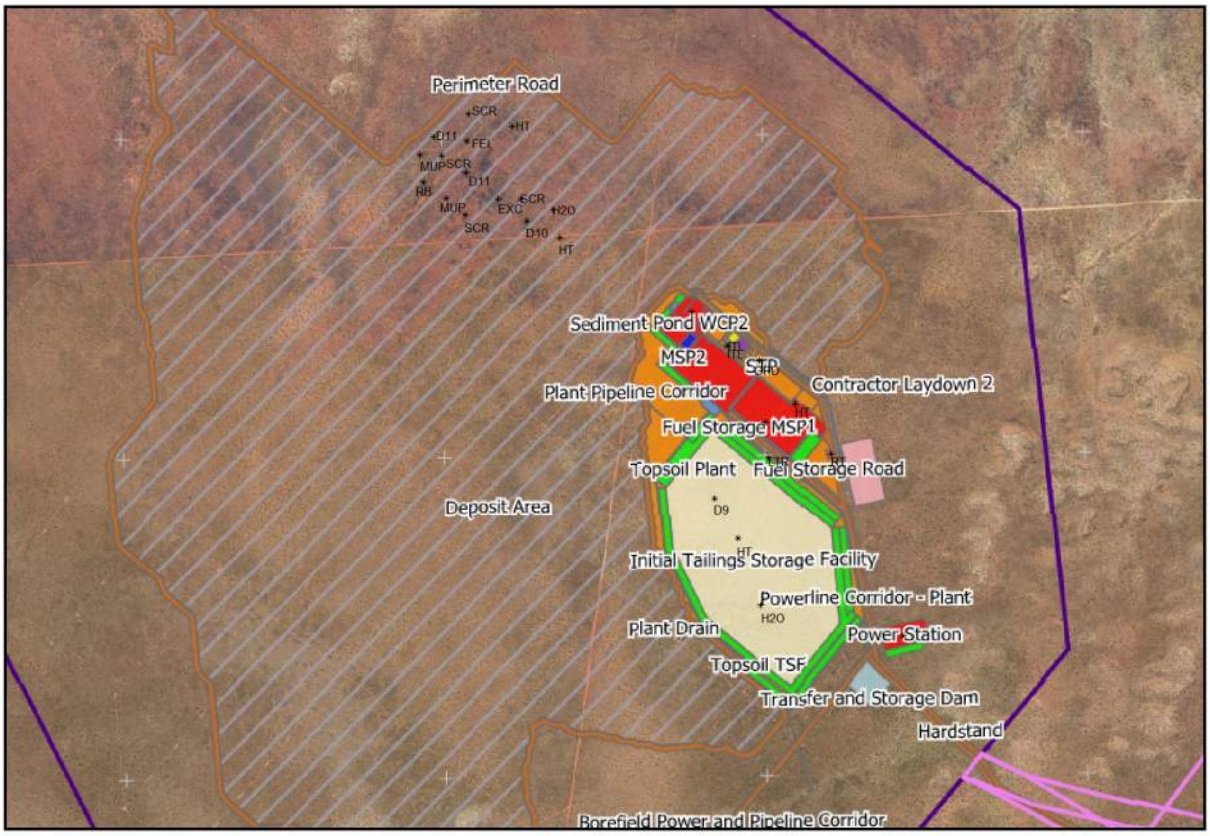


**Figure 4-1 Plant placement year 1 scenario**

### 4.3.2 Year 35 scenario

The Year 35 scenario was chosen as it has the maximum amount of plant on site. The placement of the fixed and mobile plant noise sources within the model are outlined in Figure 4-2.

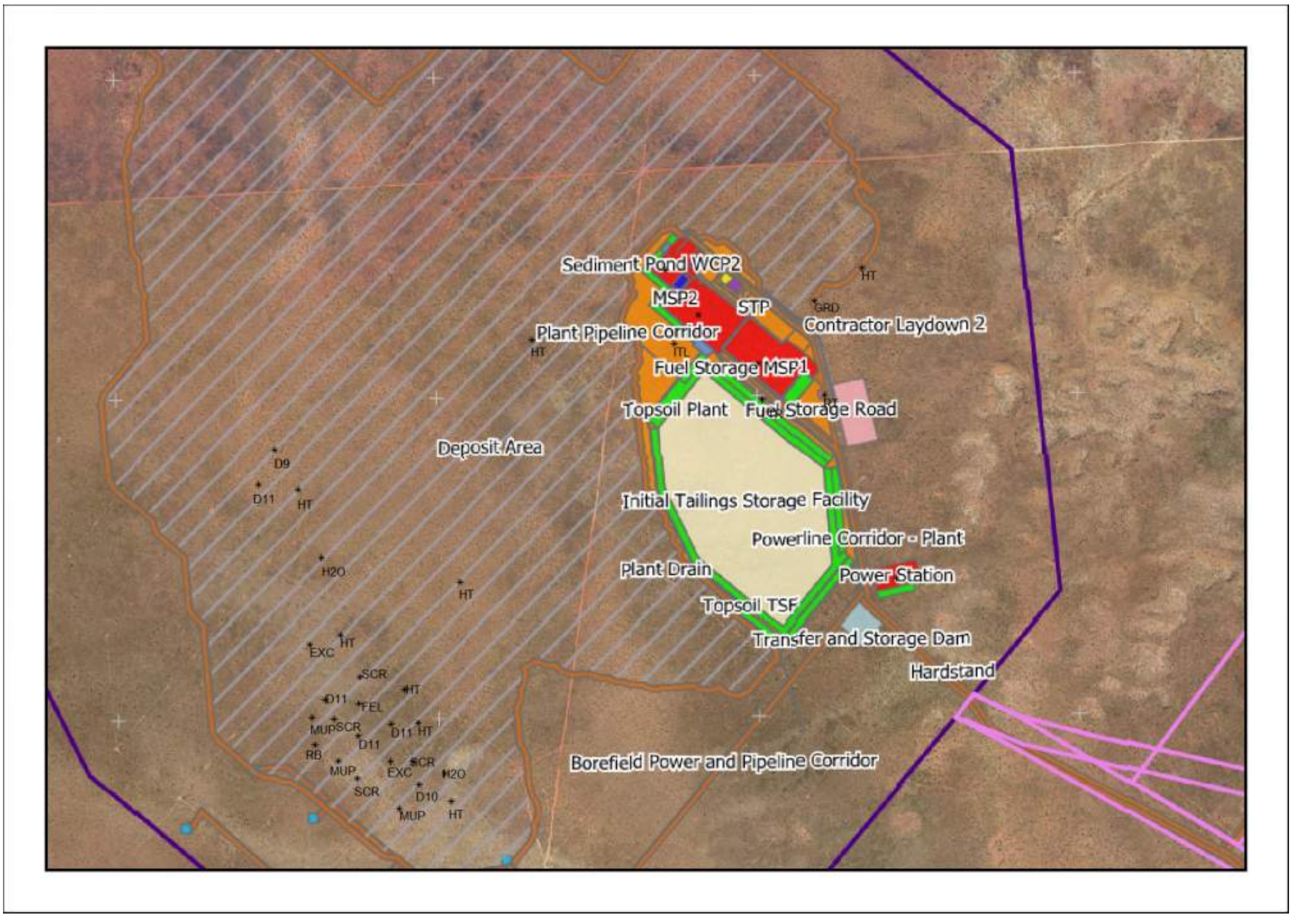


Figure 4-2 Plant placement year 35 scenario

## 4.4 Assumptions

The following assumptions were used in the modelling after discussions with Sheffield Resources:

- Source locations were within the designated area for that source and at an elevation representative of the activity/function.
- Pit heights were set to ground level (0 m). This is a 'worst case' assessment as once the works are below ground level, some attenuation will be provided by the pit edge.
- All noise sources are operating simultaneously and at high load.
- The sound levels referred to in this report represent the $L_{A10}$ emission level.
- Topography was provided by Sheffield Resources and incorporated into the SoundPLAN model. SoundPLAN defaults were used for ground absorption which assumes a porous ground cover (e.g. sand, loose rock).

# 5 PREDICTION OF NOISE LEVELS

The predicted noise levels at the nearest noise sensitive receivers from mining activities within the Project area under each scenario are shown in Table 5-1.

**Table 5-1 Predicted noise levels**

| Noise Sensitive Receiver | Predicted $L_{A10}$ (dB) | |
|---|---|---|
| | Year 1 | Year 35 |
| Site Village | 14 | 20 |
| Mount Jowalenga | 23 | 26 |
| Bidan | < 5 | < 5 |
| Nillibubbica | < 5 | < 5 |
| Yeeda | < 5 | < 5 |

The noise contour maps showing the predicted noise levels from mining activities within the project area and extending to the worst affected receivers under the year 1 and year 35 Scenarios are shown in Figure 5-1 and Figure 5-2 respectively.

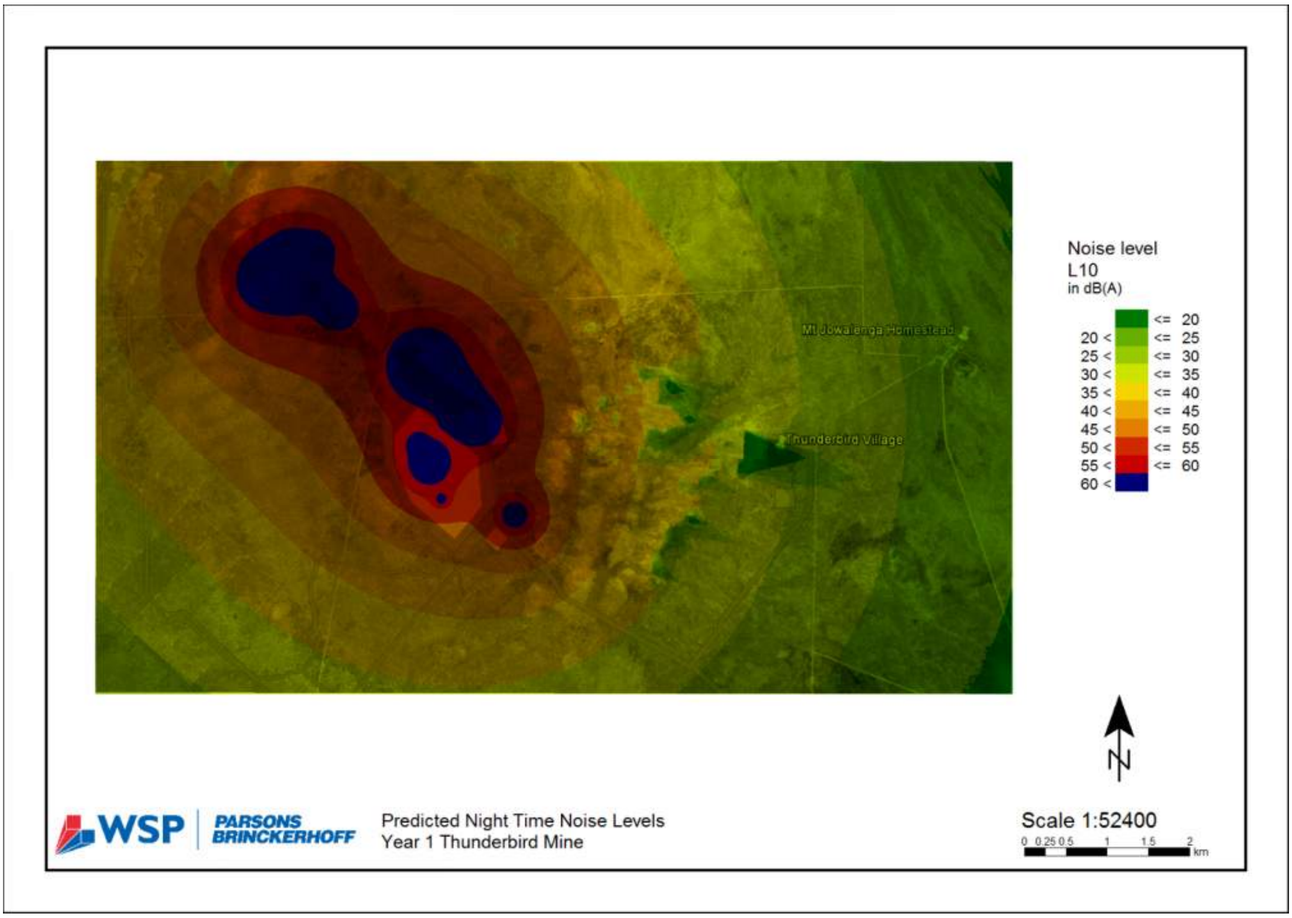


**Figure 5-1 Noise contours year 1 scenario**

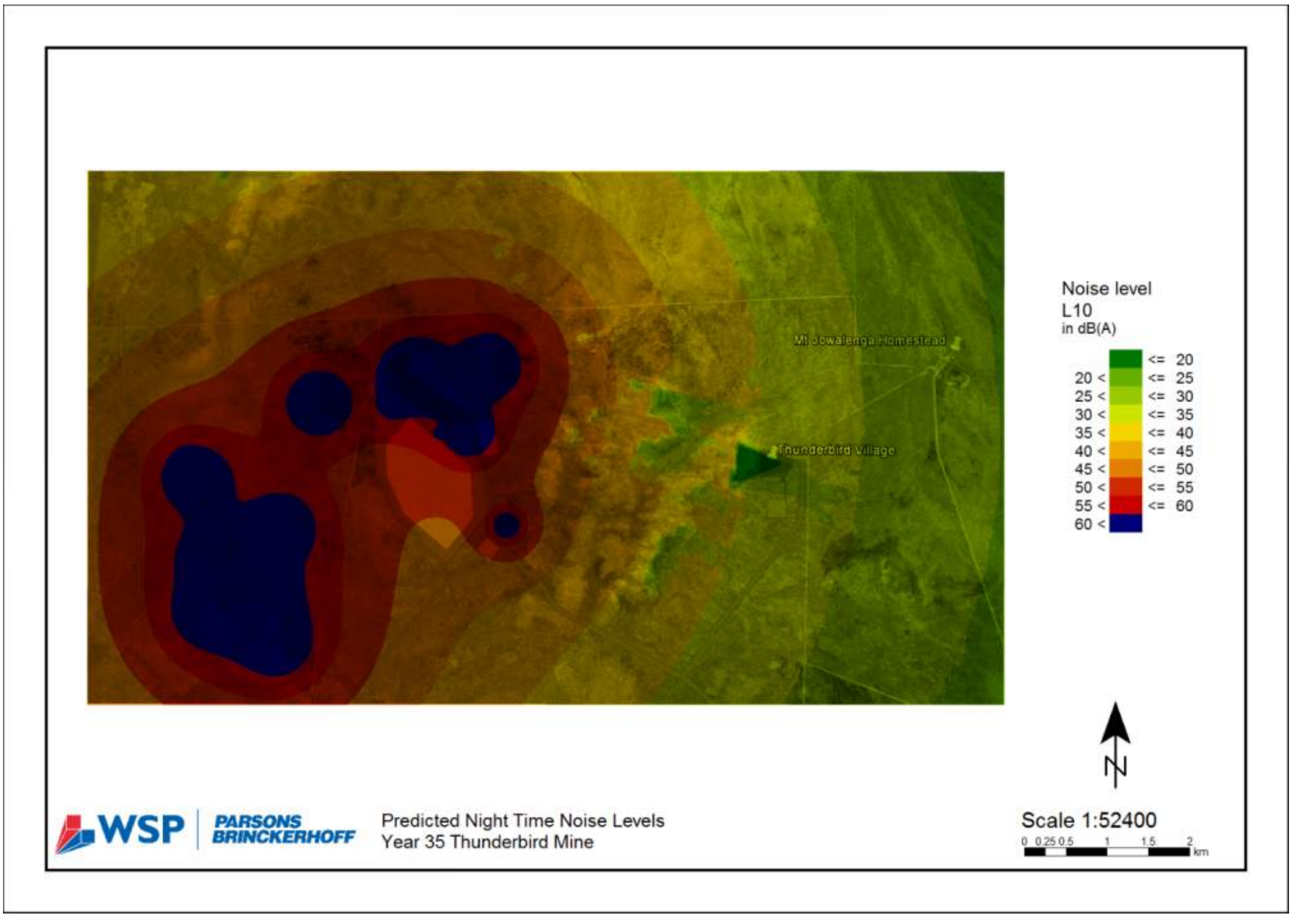


**Figure 5-2 Noise contours year 35 scenario**

# 6 IMPACT ASSESSMENT

The predicted noise levels at the nearest sensitive receiver compared against the relevant (night time) criteria are shown in Table 6-1.

**Table 6-1 Assessment of mine site noise**

| Receiver | Specific Criteria $L_{A10}$ (dB) | Predicted $L_{A10}$ (dB) | | Compliant with Specific Criteria |
|---|---|---|---|---|
| | | Year 1 | Year 35 | |
| Site Village | 35 | 14 | 20 | Yes |
| Mount Jowalenga | 35 | 23 | 26 | Yes |
| Bidan | 35 | < 5 | < 5 | Yes |
| Nillibubbica | 35 | < 5 | < 5 | Yes |
| Yeeda | 35 | < 5 | < 5 | Yes |

The predicted noise levels under both scenarios (year 1 and year 35) are compliant with the criteria contained within the Noise Regulations for all the identified nearest noise sensitive receivers.

It should be noted that the site village is part of the mine site, and is therefore not covered by the Noise Regulations. However, the *EPA Guidance for the Assessment of Environmental Factors Environmental Noise, Draft No.8* states that camps for operational staff should be located and designed so as to achieve compliance with the assigned levels.

# 7 CONCLUSION

From the results of the noise modelling, it has been shown that the noise levels from the Project are expected to comply with the relevant noise criteria at all the identified receivers.

Taking into account that the noise levels at the receivers are below their relevant criteria and that this is expected to be a worst case assessment, the mine site can be considered to have a safety margin for compliance at these receivers.

## A1.1 Acoustic terminology

### SOUND PRESSURE LEVEL (SPL):

The basic unit of sound measurement is the sound pressure level. The pressures are converted to a logarithmic scale and expressed in decibels (dB).

### SOUND POWER LEVEL (SWL):

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10 -12 W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

### A-WEIGHTING:

A frequency weighting devised to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies; it consists of an electronic filter in a sound level meter, which attempts to build in this variability into the indicated noise level reading so that it will correlate, approximately, with human response.

### STATISTICAL NOISE LEVELS

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels $L_{AN}$, where $L_{AN}$ is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the $L_{A1}$ is the noise level exceeded for 1% of the time, $L_{A10}$ the noise exceeded for 10% of the time, and so on.

Of particular relevance, are:

- $L_{A1}$ - The noise level exceeded for 1% of the sample period.
- $L_{A10}$ - The noise level exceeded for 10% of the sample period. This is commonly referred to as the average maximum noise level.
- $L_{A90}$ - The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- $L_{Aeq}$ - The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

### TONALITY

Tonal noise contains one or more prominent tones (i.e. distinct frequency components), and is normally regarded as more offensive than “broad band” noise.

### IMPULSIVENESS

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.