Vulcan Complex Project

Noise Impact Assessment

Report: 197401.0210.R01V01

Prepared for:
Vitrinite Pty Ltd

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Document Approval

Approver Signature

Name: Stephen Pugh
Title: Principal Engineer

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1. Introduction

1.1 Background

ASK Consulting Engineers (ASK) was commissioned by Mining & Energy Technical Services Pty Ltd to provide noise and vibration consultancy services for the proposed Vulcan Complex Project (VCP) coal mine. The proposed Project location is approximately 35 kilometres (km) south east from Moranbah as shown in Figure 1.1.

This report presents an assessment of the noise and vibration impacts associated with the proposed coal mine.

This report is based on the following tasks:

- Review the project and the associated potential noise emissions;
- Review existing noise monitoring data applicable to the project site;
- Model the noise emissions based on proposed activities using SoundPLAN to calculate noise levels at sensitive receptors and develop contours over the modelling area for a typical year of operations (Year 2);

Figure 1.1  Vulcan Complex Project Site Location (Image from QLD Globe)

This report presents an assessment of the noise and vibration impacts associated with the proposed coal mine.
• Analyse the results of noise modelling and compare modelling results with the relevant noise criteria selected to protect the acoustic environment;
• Assess blast information for vibration and airblast; and
• Provide recommendations on control measures, where required.

Note that assessment of offsite impacts (e.g. trucks) is excluded from the scope of this assessment.

ASK has previously assessed the proposed Bulk Sample Pit component of the project (ASK ref: 197401.0210.E01V02, dated 16/09/2019).

To aid in the understanding of the terms in this report a glossary is included in Appendix A.
2. Project Description

2.1 Overview

The Vulcan Complex Project (VCP) is located between Dysart and Moranbah in Queensland’s Bowen Basin (Figure 1.1). The Project lies to the immediate west of several established mining operations including BHP’s Peak Downs and Saraji mines.

The Jupiter hard coking coal target has been defined and selected for open cut development via a single pit. The project will operate for approximately four years and will extract approximately 6 Mt of ROM hard coking coal at a rate of up to 1.95 Million Tons Per Annum (Mtpa). The Project will target the Alex and multiple Dysart Lower (DLL) coal seams. Truck and shovel mining operations will be employed to develop the pit. ROM coal will be trucked off site for toll washing at a nearby facility between Moranbah and Coppabella on the Peak Downs Highway.

A small out-of-pit waste rock dump will be established prior to commencing in-pit dumping activities that will continue for the life of the operation. Ancillary infrastructure, including a Run of Mine (ROM) pad, Mine Infrastructure Area (MIA), offices, roads and surface water management infrastructure will be established to the west and south of the open cut.

A realignment of the existing Saraji Road and services infrastructure to the eastern boundary of the proposed Mining Lease Application (MLA) area, adjacent to the existing rail easement, is also proposed (Figure 2.1). The re-alignment will occur on lease however the connection back to the existing alignment of Saraji Road to the north will extend off lease and will be subject to a separate approvals process.

In-pit dumping will fill the majority of the pit during operations with the remaining final void to be backfilled upon cessation of mining, resulting in the establishment a low waste rock dump landform over the former pit area. The initial out-of-pit waste rock dump will be rehabilitated in-situ.

Vitrinite has been granted an Environmental Authority (EA0002054) and a Mineral Development Licence (MDL3039) to permit extraction of a bulk sample of coal from the Jupiter target. Prior to commencement of the VCP, Vitrinite will extract up to 600 kilotonnes (kt) of high-quality ROM coking coal from the bulk sample pit for testing by a number of international coal consumers. To access the coking coal within the bulk sample area, up to an additional 150 kt of thermal coal lying above the coking coal, will also be extracted incidentally. The bulk sample does not form part of the VCP however its features are assumed to form part of baseline conditions for the purposes of environmental assessment of the VCP.

2.2 Bulk Sample and Baseline Conditions

The approved Bulk Sample Project is located within the proposed VCP footprint. It will include an in-pit waste rock dump and two out of pit waste rock dumps, and small scale ancillary infrastructure including an MIA, ROM pad, haul roads and surface water management infrastructure. It is Vitrinite’s intention, subject to favourable testing of the bulk sample coal and successful approval of the VCP, to retain part of the bulk sample void to facilitate commencement of the VCP. Similarly the out-of-pit waste rock dump required for the initial stages of the VCP will be developed as an extension of the bulk sample out-of-pit dump. Figure 2.1 provides the approved bulk sample footprint and infrastructure layout at the end of the bulk sample activities. This ‘existing’ disturbance footprint has been incorporated in the consideration of baseline conditions at the site.

The bulk sample is planned to commence in 2020 and to run for nine to twelve months while the VCP is subject to environmental authority and mining lease application processes.
Figure 2.1 VCP and BSP Maximum Disturbance Areas
2.3 Project Development Stages

The VCP is a small-scale mining operation, with coal extraction planned for approximately three years, followed by completion of rehabilitation activities in year four. Construction of temporary infrastructure associated with the mining operation is expected to be completed within a month. Construction of the Saraji Road realignment is anticipated to be completed within six months. Ongoing establishment of internal road networks, surface water management infrastructure and other ancillary infrastructure will continue to be developed as the pit and in-pit dump advance. Annual stage plans are presented in Figure 2.2 to Figure 2.6.

2.4 Mining Activities

The open cut will extend to a depth of approximately 45 metres (m), following the seam as it dips eastwards. The footprint of the proposed open cut is approximately 136 hectares (ha). Development of the open cut will progress from the south western corner (starting in the former bulk sample pit) in a northerly direction, to the northern boundary of the proposed MLA. Truck and shovel mining methods will be employed to extract waste rock and coal from the pit. Rehabilitation will be undertaken progressively.

The open-cut operations are described as follows:

- Topsoil will be removed and hauled to the topsoil stockpile area;
- Drilling and blasting will be undertaken;
- Excavators will load trucks with overburden, which will then be hauled to the overburden dump;
- Dozers will push some overburden back into the pit;
- Excavators will load the mined coal into haul trucks to be transported from the pits to the run-of-mine (ROM) pad;
- Haul trucks will unload ROM coal at the ROM pad;
- The ROM coal will be crushed and screened;
- Rejects from the crushing and screening process will be stockpiled separately and placed within the relevant active dump;
- The product coal will be stockpiled and trucked off to existing coal wash and load out facility along the Peak Downs Highway. It is anticipated that average of 80 truck movements per 24 hours (each way); and
- Haulage will operate 24 hours a day on a seven day roster.

2.5 Plant and Production Quantities

An indicative annual mining schedule is provided in Table 2.1.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total ROM Coal (tpa)</th>
<th>Total Waste Rock (tpa)</th>
<th>Total anticipated product coal (Processed offsite) (tpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,950,000</td>
<td>7,434,900</td>
<td>1,170,000</td>
</tr>
<tr>
<td>2</td>
<td>1,950,000</td>
<td>7,441,500</td>
<td>1,170,000</td>
</tr>
<tr>
<td>3</td>
<td>1,865,000</td>
<td>6,182,700</td>
<td>1,118,210</td>
</tr>
<tr>
<td>Total</td>
<td>5,765,000</td>
<td>21,059,100</td>
<td>3,458,210</td>
</tr>
</tbody>
</table>
The following indicative mining equipment fleet is proposed for the Project:

- 2 x Excavators;
- Front end loader;
- 7 x Cat 789/777 mine trucks;
- 10 x AB triple haul trucks;
- 2 x D 10 Dozers;
- 1 x Grader;
- 1 x Water truck;
- 2 x Drill rigs;
- 1 x Service truck;
- 1 x Mobile crushing and screening plant (Sorterra); and
- Light vehicles.

2.6 Upset Conditions

Potential upset conditions and their effect on noise emissions are discussed as follows:

- If a piece of equipment malfunctions, this could result in an increased noise level for that item of equipment, although the overall effect on noise emissions from the whole site would likely be minor. When equipment malfunctions, it will be quickly taken out of operation, and adverse noise impacts are not expected to occur. In addition, all equipment will be maintained routinely, and malfunctions that increase noise levels are expected to be rare.
- Severe weather conditions could cause mining activity to reduce or stop. This would result in lower noise emission levels. Strong winds blowing from the mine towards sensitive receptors could increase the mining noise levels but would also likely increase the background noise levels significantly such that mining noise would be masked.

Overall it is not expected that upset conditions pose a risk of additional noise impact, and further assessment of such cases is not considered to be warranted.
Figure 2.2  Year 0 Indicative Project Layout Plan
Figure 2.3  Year 1 Indicative Project Layout Plan
Figure 2.4 Year 2 Indicative Project Layout Plan
Figure 2.5  Year 3 Indicative Project Layout Plan
Figure 2.6  Year 4 Indicative Project Layout Plan
3. **Study Area Description**

3.1 **Overview**

The site is located in a rural area. There are no residential sensitive receptors in close proximity to the Project; the nearest is over 10 km away. The closest town is Moranbah which is located approximately 35 km north-west from the proposed site.

3.2 **Receptors**

The nearest receptors are summarised in Table 3.1 including their locations (Latitude and Longitude) and are shown in Figure 3.1. The list includes commercial receptors and sensitive residential receptors, where the definition of a sensitive place required to be considered by operators of environmentally relevant activities is provided by the Department of Environment and Science (DES 2019). This definition is a place that could include but is not limited to:

- A dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises;
- A Motel, Hotel or Hostel;
- A Kindergarten, School, University or other Educational Institution;
- A Medical centre or Hospital;
- A protected area under the Nature Conservation Act 1992, the Marine Parks Act 2004 or a World Heritage Area;
- A Public park or garden; and
- A place used as a Workplace including an office for business or commercial purposes.

### Table 3.1 Commercial and Sensitive Residential Receptors

<table>
<thead>
<tr>
<th>#</th>
<th>Sensitive Receiver Name</th>
<th>Receptor Description</th>
<th>Location (Latitude and Longitude)</th>
<th>Distance (m) from nearest Project Disturbance area</th>
<th>Direction from the Project</th>
<th>Distance (m) from nearest BHP Mine Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kalari</td>
<td>Commercial-Storage compound and site office</td>
<td>-22.28604 148.18450</td>
<td>145</td>
<td>North</td>
<td>1,155</td>
</tr>
<tr>
<td>2</td>
<td>Dyno</td>
<td>Commercial-Storage compound and secondary site office</td>
<td>-22.29109 148.18515</td>
<td>70</td>
<td>West</td>
<td>1,345</td>
</tr>
<tr>
<td>3</td>
<td>Dyno</td>
<td>Commercial-Workshop and main site office</td>
<td>-22.29365 148.19274</td>
<td>230</td>
<td>South-east</td>
<td>700</td>
</tr>
<tr>
<td>4</td>
<td>BMA Peak Downs</td>
<td>Commercial-Sustaining projects construction support and geological services buildings</td>
<td>-22.276062 148.177274</td>
<td>1,365</td>
<td>North</td>
<td>850</td>
</tr>
<tr>
<td>#</td>
<td>Sensitive Receptor Name</td>
<td>Receptor Description</td>
<td>Location (Latitude and Longitude)</td>
<td>Distance (m) from nearest Project Disturbance area</td>
<td>Direction from the Project</td>
<td>Distance (m) from nearest BHP Mine Operations</td>
</tr>
<tr>
<td>----</td>
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<td>----------------------</td>
<td>-----------------------------------</td>
<td>-----------------------------------------------</td>
<td>--------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>BMA Peak Downs</td>
<td>Commercial- Field workshop and field office/crib area</td>
<td>-22.27497 148.18670</td>
<td>1,280</td>
<td>North-east</td>
<td>Within existing operations (Adjacent to Goonyella System Rail (100m) and main haul road (400m))</td>
</tr>
<tr>
<td>6</td>
<td>BMA Peak Downs</td>
<td>Commercial- Field office/crib area</td>
<td>-22.27351 148.18567</td>
<td>1,470</td>
<td>North-east</td>
<td>Within existing operations (Adjacent to Goonyella System Rail (80m), hardstands (10m) and main haul road (350m))</td>
</tr>
<tr>
<td>7</td>
<td>BMA Peak Downs</td>
<td>Commercial- Main offices area and workshop</td>
<td>-22.26044 148.17860</td>
<td>3,000</td>
<td>North</td>
<td>Within existing operations (Approx 400m from CHPP)</td>
</tr>
<tr>
<td>8</td>
<td>Property Manager Residence</td>
<td>Residential- Property managers residence</td>
<td>-22.390147 148.267067</td>
<td>13,380</td>
<td>South-east</td>
<td>410</td>
</tr>
<tr>
<td>9</td>
<td>Workers Residence</td>
<td>Residential- Workers residence</td>
<td>-22.394204 148.269578</td>
<td>13,900</td>
<td>South-east</td>
<td>480</td>
</tr>
<tr>
<td>10</td>
<td>BMA Saraji</td>
<td>Commercial- Main office area and workshop</td>
<td>-22.418965 148.277679</td>
<td>16,645</td>
<td>South-east</td>
<td>Within existing operations (Approx. 300m from CHPP)</td>
</tr>
<tr>
<td>11</td>
<td>Saraji Station Residence</td>
<td>Residential</td>
<td>-22.42916 148.259057</td>
<td>&gt;15,000</td>
<td>South-east</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>Luxor Residence</td>
<td>Residential</td>
<td>-22.527639 148.122611</td>
<td>&gt;20,000</td>
<td>South</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>Cheeseboro Residence</td>
<td>Residential</td>
<td>-22.427361 148.023250</td>
<td>&gt;20,000</td>
<td>South-west</td>
<td>-</td>
</tr>
</tbody>
</table>

It is noted that Receptors 1, 2 and 3 Kalari transport and Dyno explosives are located on the MLA area. The other commercial/industrial receptors are associated with BMA Peak Downs and those receptors are closer to the established BHP mine operations than the Project, and therefore would likely already be exposed to higher noise levels than produced by the Project.
Figure 3.1 Location of Site (Mine Lease Boundary) and Sensitive Receptors 1 to 11
4. **Acoustic Criteria**

4.1 **Overview**

Noise and vibration criteria are required to assess the potential impacts of the proposed mine operations on sensitive receptors.

The relevant Department of Environment and Science (DES) noise and vibration criteria have been considered and are listed as follows:

- Environmental Protection Act 1994;
- Environmental Protection (Noise) Policy 2019;
- Guideline “Planning For Noise Control”, Department of Environment and Science;
- Guideline “Noise and Vibration from Blasting”, Department of Environment and Science; and
- Guideline “Model Mining Conditions”, Department of Environment and Science.

4.2 **Environmental Protection Act**

In Queensland, the environment is protected under the *Environmental Protection Act 1994* (EP Act).

Section 3 of the EP Act states that the object of the Act is to protect Queensland’s environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

Section 12 of the EP Act defines noise as including “vibration of any frequency, whether emitted through air or another medium”.

Section 319 of the EP Act relates to General Environmental Duty and states that a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm.

Section 14(1) of the EP Act defines environmental harm as any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance.

Section 15 of the EP Act defines environmental nuisance as an unreasonable interference or likely interference with an environmental value caused by (a) noise.

The EP Act refers to the Environmental Protection Policies as being subordinate legislation to the Act.

4.3 **Environmental Protection (Noise) Policy**

4.3.1 **Overview**

With respect to the acoustic environment, the object of the EP Act is achieved by the Environmental Protection (Noise) Policy 2019 (EPP (Noise)). This policy identifies environmental values to be enhanced or protected, states acoustic quality objectives, and provides a framework for making decisions about the acoustic environment.

4.3.2 **Acoustic Quality Objectives**

The EPP (Noise) contains a range of acoustic quality objectives for a range of receptors. The objectives are in the form of noise levels, and are defined for various periods of the day, and use a number of acoustic parameters.
Schedule 1 of the EPP(Noise) includes the following acoustic quality objectives to be met at residential dwellings:

- **Outdoors**
  - Daytime and Evening: 50 dBA $L_{Aeq,adj,1hr}$, 55 dBA $L_{A10,adj,1hr}$ and 65 dBA $L_{A1,adj,1hr}$

- **Indoors**
  - Daytime and Evening: 35 dBA $L_{Aeq,adj,1hr}$, 40 dBA $L_{A10,adj,1hr}$ and 45 dBA $L_{A1,adj,1hr}$
  - Night: 30 dBA $L_{Aeq,adj,1hr}$, 35 dBA $L_{A10,adj,1hr}$ and 40 dBA $L_{A1,adj,1hr}$

Based on a conservative 5 dBA façade reduction (5 dBA reduction in noise levels from outside a house to inside a house when windows are fully open), the indoor noise objectives noted above could be converted to the following external objectives (with windows open):

- Daytime and Evening: 40 dBA $L_{Aeq,adj,1hr}$, 45 dBA $L_{A10,adj,1hr}$ and 50 dBA $L_{A1,adj,1hr}$
- Night: 35 dBA $L_{Aeq,adj,1hr}$, 40 dBA $L_{A10,adj,1hr}$ and 45 dBA $L_{A1,adj,1hr}$

### 4.3.3 Background Creep

The current 2019 version of the EPP (Noise) no longer contains criteria for background creep, but states that background creep should be prevented or minimised, to the extent that it is reasonable to do so.

Background creep is defined as “a gradual increase in the total amount of background noise in the area or place as measured under the document called the ‘Noise measurement manual’ published on the department’s website” (Section 9(4) of EPP Noise). This is understood to require consideration of cumulative impacts, including other developments.

### 4.4 Guideline – Planning for Noise Control

DES had previously published a guideline titled “Planning for Noise Control”. The Planning for Noise Control guideline is currently listed as being “under review” according to the DES website. As such, it is not proposed to utilise the noise criteria contained within the document.

The document contains a method for determining the minimum background noise level using the lowest tenth percentile methodology.

### 4.5 Guideline – Noise & Vibration from Blasting

The DES Guideline “Noise and vibration from blasting” contains criteria and procedures that are applicable to noise and vibration emitted from blasting. It applies to activities such as mining, quarries, construction and other operations which involve the use of explosives for fragmenting rock.

The criteria are presented in Table 4.1. These criteria address human comfort and apply at residential and commercial receptors.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airblast</td>
<td>Airblast overpressure of 115 dB (linear peak) for nine (9) out of ten (10) consecutive blasts initiated and not greater than 120 dB (linear peak) at any time.</td>
</tr>
<tr>
<td>Vibration</td>
<td>5 mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts and not greater than 10 mm/s peak particle velocity at any time.</td>
</tr>
</tbody>
</table>

It is noted that higher limits would typically be used for prevention of structural damage.
4.6 Guideline – Assessment of Low Frequency Noise

The DES Guideline “Assessment of Low Frequency Noise” contains methods and procedures that are applicable to low frequency noise emitted from industrial premises and mining operations for planning purposes. Items such as boilers, pumps, transformers, cooling fans, compressors, oil and gas burners, foundries, wind farms, electrical installations, diesel engines, ventilation and air-conditioning equipment, wind turbulence and large chimney resonance may comprise sources of high level noise having frequency content less than 200 Hz.

These sources may exhibit a spectrum that characteristically shows a general increase in sound pressure level with decrease in frequency. Annoyance due to low frequency noise can be high even though the dBA level measured is relatively low. Typically, annoyance is experienced in the otherwise quiet environments of residences, offices and factories adjacent to or near low frequency noise sources. Generally, low level/low frequency noises become annoying when the masking effect of higher frequencies is absent. This loss of high frequency components may occur as a result of transmission through the fabric of a building, or in propagation over long distances.

Where a noise immission occurs exhibiting an unbalanced frequency spectrum, the overall sound pressure level inside residences should not exceed 50 dBZ to avoid complaints of low frequency noise annoyance. A spectrum is considered unbalanced when the un-weighted overall noise level is more than 15 dB higher than the A-weighted overall noise level.

4.7 Proposed Criteria

4.7.1 Noise Emissions

In accordance with the EPP (Noise) and based on the calculated external limits as discussed in Section 5.3.2, the resulting noise objectives for the site to protect the acoustic environment and to be proposed as noise limits for the operation are presented in Table 4.2.

<table>
<thead>
<tr>
<th>Period</th>
<th>Noise Limit $L_{Aeq,adj,1hr}$ dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (7am to 6pm)</td>
<td>Outdoor 40 dBA $L_{Aeq,adj,1hr}$ and Indoor 50 dBZ $L_{eq,adj,1hr}$ (and dBZ-dBA &gt; 15 dB)</td>
</tr>
<tr>
<td>Evening (6pm to 10pm)</td>
<td>Outdoor 40 dBA $L_{Aeq,adj,1hr}$ and Indoor 50 dBZ $L_{eq,adj,1hr}$ (and dBZ-dBA &gt; 15 dB)</td>
</tr>
<tr>
<td>Night (10pm to 7am)</td>
<td>Outdoor 35 dBA $L_{Aeq,adj,1hr}$ and Indoor 50 dBZ $L_{eq,adj,1hr}$ (and dBZ-dBA &gt; 15 dB)</td>
</tr>
</tbody>
</table>

4.7.2 Blasting

It is proposed to adopt the blasting criteria from the Guideline “Noise and vibration from blasting”. The criteria are presented in Table 4.3.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airblast</td>
<td>Airblast overpressure of 115 dB (linear peak) for nine (9) out of ten (10) consecutive blasts initiated and not greater than 120 dB (linear peak) at any time.</td>
</tr>
<tr>
<td>Vibration</td>
<td>5 mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts and not greater than 10 mm/s peak particle velocity at any time.</td>
</tr>
</tbody>
</table>
5. Existing Noise Environment

5.1 Overview and Location

Attended noise measurements and noise logging were undertaken at the following locations:

- Location A – Located back yard of the property (-22.394338, 148.269479). This is the adjacent sensitive receptor 9 in Figure 5.1;
- Location B – Located front yard of the property adjacent the fence (-22.527639, 148.122611). This is the adjacent sensitive receptor 12 in Figure 5.1;
- Location C – Located centre of the property under the trees (-22.427361, 148.023250). This is the adjacent sensitive receptor 13 in Figure 5.1; and
- Location D – Located centre of the property (-22.429444, 148.259111). This is the adjacent sensitive receptor 11 in Figure 5.1.

The noise monitoring was undertaken in general accordance with Australian Standard AS1055 Acoustics – Description and measurement of environmental noise and the EHP Noise Measurement Manual 2013.

![Figure 5.1 Aerial View of Monitoring Locations A to D](image)

5.2 Attended Noise Measurements

Attended noise measurements were undertaken at Locations A, B, C and D. The measurements were undertaken on 6th November 2019 over 15 minute periods using a field and laboratory calibrated Norsonic...
sound level meter. The microphone height was approximately 1.3 m above natural ground level and was located in the free field. Weather during the time of monitoring was generally moderate with a breeze in the daytime, and still at night. The conditions were as follows:

- Daytime: Approximately 30 °C to 35 °C with a 0 m/s to 1.5 m/s slight breeze and no cloud cover.
- Night time: Approximately 25 °C with calm and no cloud cover.

Noise measurements were only conducted at Locations A and D at night as they were expected to be affected by existing mine noise. Location B and C were expected to have low background noise levels which would be adequately demonstrated by noise logging. The measured noise levels are summarised in Table 5.1.

Table 5.1  Attended Noise Measurement Results

<table>
<thead>
<tr>
<th>Location</th>
<th>Date &amp; Time</th>
<th>Period (Minutes)</th>
<th>Results &amp; Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| A (Receptor 9) | 02:12pm 06/11/19 | 15 | Statistical noise levels: $L_{10}$ 44 dBA, $L_{eq}$ 42 dBA, $L_{90}$ 34 dBA  
Road traffic 40 to 44 dBA  
Distance mine noise 32 to 43 dBA |
| B (Receptor 12) | 04:39pm 06/11/19 | 15 | Statistical noise levels: $L_{10}$ 40 dBA, $L_{eq}$ 45 dBA, $L_{90}$ 26 dBA  
Birds 27 to 70 dBA |
| C (Receptor 13) | 12:26pm 06/11/19 | 15 | Statistical noise levels: $L_{10}$ 44 dBA, $L_{eq}$ 41 dBA, $L_{90}$ 30 dBA  
People walking/talking 32 to 49 dBA  
Garden watering 35 to 36 dBA  
Distance weigh drop 36 to 39 dBA  
Wind through trees 38 to 51 dBA  
Birds 40 to 42 dBA |
| D (Receptor 11) | 03:09pm 06/11/19 | 15 | Statistical noise levels: $L_{10}$ 38 dBA, $L_{eq}$ 43 dBA, $L_{90}$ 29 dBA  
Distance traffic 31 to 40 dBA  
Horse noise 41 to 71 dBA  
Workshop activities 41 to 46 dBA  
Birds 31 to 51 dBA |
| Night    |             |                  |                 |
| A (Receptor 9) | 10:47pm 06/11/19 | 15 | Statistical noise levels: $L_{10}$ 43 dBA, $L_{eq}$ 39 dBA, $L_{90}$ 32 dBA  
Mine noise 32 to 49 dBA |
| D (Receptor 11) | 10:08pm 06/11/19 | 15 | Statistical noise levels: $L_{10}$ 36 dBA, $L_{eq}$ 35 dBA, $L_{90}$ 32 dBA  
Mine noise 31 to 43 dBA |

Note: * The reported noise levels, excluding the statistical noise levels, are the instantaneous levels read from the sound level meter, and generally represent the range in noise levels or maximum noise levels for a particular noise source.

5.3 Noise Logging

Noise logging was undertaken at Locations A, B, C and D. Logging was undertaken from Tuesday 5th to Tuesday 12th November 2019 using field and laboratory calibrated Larson Davis LD831 environmental noise loggers. Noise logging was undertaken in the free field.
Data from the Bureau of Meteorology (BoM) (Collinsville) indicates that weather during the monitoring period was generally fine and warm. Overall, the noise monitoring data is considered acceptable for use in this report.

Photos of the noise monitoring locations are shown in Figures B.1 to B.2 in Appendix B.

The measured noise levels are shown graphically in Figures C.1 to C.8 in Appendix C. The statistical results from the noise logging have been summarised in Tables C.1 to C.4 in Appendix C.

The background noise levels at Locations A to D were calculated using the lowest tenth percentile method (as per Section 4.4) and are shown in Table 5.2.

### Table 5.2  Background Noise Levels at Locations A to D

<table>
<thead>
<tr>
<th>Period</th>
<th>Location A (Receptor 9)</th>
<th>Location C (Receptor 13)</th>
<th>Location D (Receptor 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (7am to 6pm)</td>
<td>32</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>Evening (6pm to 10pm)</td>
<td>31</td>
<td>24</td>
<td>33</td>
</tr>
<tr>
<td>Night (10pm to 7am)</td>
<td>31</td>
<td>18</td>
<td>32</td>
</tr>
</tbody>
</table>

The background noise level at Location B (Receptor 12) was affected by insect noise. As the insect noise is likely a seasonal influence, the noise level data has been filtered to remove the insect noise. The resulting background noise levels calculated using the lowest tenth percentile method are shown in Table 5.3.

### Table 5.3  Background Noise Levels at Location B (Receptor 12) - Measured and with Insect Noise Removed

<table>
<thead>
<tr>
<th>Period</th>
<th>Measured Background Noise Level $L_{90}$ dBA</th>
<th>Filtered (Less Insect Noise) Background Noise Level $L_{90}$ dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (7am to 6pm)</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Evening (6pm to 10pm)</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Night (10pm to 7am)</td>
<td>17</td>
<td>15</td>
</tr>
</tbody>
</table>

From the results above, the following comments on background noise are made:

- Location A (Receptor 9): Continuous mine noise from nearby operating mines is audible at this location and road traffic noise from Saraji Road was audible at this location at day and night.
- Location B (Receptor 12) & Location C (Receptor 13): Overall, the measurement results indicate the area is very quiet, as is typical of a rural environment. The major noise sources are natural (birds, wind in trees) and farm related (farm machinery, livestock, dogs).
- Location D (Receptor 11): Continuous mine noise from nearby operating mines is audible at this location at night. Other noise sources are natural (birds, wind in trees), farm related (farm machinery, livestock, dogs) and distant road traffic.

### 5.4  Seasonal Variability

Ambient noise levels are affected by many noise sources including wind, rustling grass and leaves, distant highway traffic, insects, birds and other animals.

The noise monitoring was conducted in Spring (November) when insect noise levels can be relatively high. During colder months, the noise from insects will tend to be quieter. However, it is not normally necessary to conduct monitoring across warmer and cooler months as insect noise can be filtered from the noise.
data, as has occurred in Section 5.3. In this instance, significant insect noise was only identified at Location B and was removed accordingly as shown in Table 5.3.
6. Noise Assessment

6.1 Model Description

Noise modelling was carried out using the SoundPLAN v8.2 computer program using the CONCAWE algorithm, which are widely used and accepted for noise modelling and is approved by DES.

The SoundPLAN program was used to develop a three-dimensional digital terrain noise model of the Vulcan Complex Project and the surrounding area including the location of sensitive receptors. The model incorporates terrain data for the proposed Vulcan Complex Project and the surrounding natural topography.

6.2 Meteorology

The mining noise levels at residential receptors can vary significantly depending upon the meteorology and the mining activities. Meteorology has a significant effect on the noise levels, particularly due to wind speed and direction and vertical temperature gradients, which include temperature inversions.

It is possible to measure noise variations of the order of 15 to 20 dBA due to changes in meteorology. Assessment is required under worst-case meteorological conditions according to the Planning for Noise Control guideline.

The SoundPLAN model was setup to predict noise levels under neutral and adverse meteorological conditions. The conditions used in the noise model are as follows:

- **Neutral**
  - Pasquill Stability Class: D (no temperature inversion)
  - Temperature: 25 °C
  - Wind Speed: 0 m/s
  - Relative Humidity: 40%

- **Adverse**
  - Pasquill Stability Class: F (temperature inversion)
  - Temperature: 10 °C
  - Wind Speed: 2 m/s directed to produce the highest noise level
  - Relative Humidity: 70%

The ‘Neutral’ scenario is most likely to occur during the daytime, and as such this is referred to as the Day ‘Neutral’ scenario in the modelling. The ‘Adverse’ scenario is most likely to occur during the night-time, particularly temperature inversions, and as such this is referred to as the Night ‘Adverse’ scenario in the modelling. It is noted that neutral conditions could occur during the night, and adverse conditions could occur to some extent during the day and evening.

These meteorological scenarios are presented to give an indication of the range of noise levels from neutral to adverse conditions and are assessed against the criteria corresponding to the periods when they will be most likely to occur. The most critical predictions are the Night ‘Adverse’, since this assessed the highest predicted noise levels against the most stringent night-time criteria.

The SoundPLAN model assumes the wind direction is from the source to each receiver and thus modelling for multiple wind directions is not required.
6.3 Noise Source Data

The model uses the sound power level (Lw) of each noise source to predict noise emissions. The sound power levels used in the model were based on noise source data obtained from previous mining projects. The sound power levels for the mobile and fixed equipment proposed for the VCP are presented in Table 6.1.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Data Source</th>
<th>Octave Band Sound Power Level L_{W, eq} dBZ</th>
<th>Overall L_{W, eq}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>63</td>
<td>125</td>
</tr>
<tr>
<td>Excavator 1,2,3</td>
<td>1,2,3</td>
<td>129</td>
<td>124</td>
</tr>
<tr>
<td>Front end loader</td>
<td>2,3</td>
<td>103</td>
<td>110</td>
</tr>
<tr>
<td>CAT 789/777 mine truck</td>
<td>3,4</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td>AB triple haul truck</td>
<td>3,4</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td>D10 dozers</td>
<td>2,3</td>
<td>102</td>
<td>110</td>
</tr>
<tr>
<td>Grader</td>
<td>3,4</td>
<td>108</td>
<td>115</td>
</tr>
<tr>
<td>Water truck</td>
<td>3,4</td>
<td>110</td>
<td>112</td>
</tr>
<tr>
<td>Drill rig</td>
<td>4</td>
<td>109</td>
<td>111</td>
</tr>
<tr>
<td>Crusher</td>
<td>1</td>
<td>125</td>
<td>122</td>
</tr>
</tbody>
</table>

The sources of data used to compile the sound power level data in Table 6.1 are presented in Table 6.2.

<table>
<thead>
<tr>
<th>Source #</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data based on measurements undertaken by ASK at another coal mine.</td>
</tr>
<tr>
<td>2</td>
<td>Manufacturer’s noise data.</td>
</tr>
<tr>
<td>3</td>
<td>ASK database, based on sound power level calculated from measurements at another coal mine for the same/similar equipment.</td>
</tr>
<tr>
<td>4</td>
<td>Data for these sources was extracted from another similar coal mine project. Generally this data is similar to noise data for similar equipment at other mine sites and is considered suitable for noise modelling purposes.</td>
</tr>
</tbody>
</table>

The equipment modelled has been chosen to closely reflect the anticipated mining fleet. However, there is potential for alternate makes and models of equipment to be used in the operating mine. If the equipment model is changed, the sound power level of the alternative model should be reviewed to determine if noise level increases are expected.

6.4 Modelling Scenario

Mining noise emissions from the Vulcan Complex Project mine have been predicted for year two of mine life. This year was selected because it included the highest production.

Modelling of the nominated Year 2 mine scenario has included mine ground elevations, equipment numbers and equipment locations based on information provided by Mining & Energy Technical Services Pty Ltd.
The mobile equipment numbers and locations for Year 2 are presented in Table 6.3 and the source locations and path of the mobile equipment are shown in Appendix D.

Table 6.3  Equipment Fleet and locations

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Map reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x Excavators</td>
<td>Pit</td>
</tr>
<tr>
<td>1 x Front end loader</td>
<td>ROM</td>
</tr>
<tr>
<td>7 x Cat 789/777 mine trucks</td>
<td>Pit, In-Pit dump, western edge of rehab area to ROM, up to MIA for park up and maintenance (via haul road)</td>
</tr>
<tr>
<td>10 x AB Triple haul trucks</td>
<td>Access road as far as ROM, ROM</td>
</tr>
<tr>
<td>2 x D 10 Dozers</td>
<td>In-Pit dump</td>
</tr>
<tr>
<td>1 x Grader</td>
<td>All roads, in-pit dump, occasionally in Pit</td>
</tr>
<tr>
<td>1 x Water truck</td>
<td>All roads, in-pit dump, occasionally in Pit</td>
</tr>
<tr>
<td>2 x Drill rigs;</td>
<td>Pit (advancing northern end)</td>
</tr>
<tr>
<td>1 x Mobile crushing and screening plant (including Sorterra)</td>
<td>ROM</td>
</tr>
</tbody>
</table>

6.5  Predicted A-Weighted Noise Levels & Assessment

6.5.1  Noise from Project

The predicted noise levels at nearby sensitive receptors for the Year 2 of the mine are presented in Table 6.4. The noise contours are presented in Appendix E.

Table 6.4  Predicted A-weighted Noise Levels

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Sensitive Receptor Name</th>
<th>Predicted $L_{eq}$ dBA</th>
<th>Neutral Condition</th>
<th>Adverse Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Commercial</td>
<td>Kalari</td>
<td>66</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Commercial</td>
<td>Dyno</td>
<td>55</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Commercial</td>
<td>Dyno</td>
<td>60</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Commercial</td>
<td>BMA Peak Downs</td>
<td>45</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Commercial</td>
<td>BMA Peak Downs</td>
<td>49</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Commercial</td>
<td>BMA Peak Downs</td>
<td>47</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Commercial</td>
<td>BMA Peak Downs</td>
<td>35</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Residential</td>
<td>Property Manager</td>
<td>11</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Residential</td>
<td>Workers Accommodation</td>
<td>11</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Commercial</td>
<td>BMA Saraji</td>
<td>8</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Residential</td>
<td>Saraji Station Residence</td>
<td>4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Residential</td>
<td>Luxor Residence</td>
<td>1</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
From Table 6.4 it can be seen that:

- All residential receptors (8, 9, 11, 12 and 13) are more than 10 km away and the predicted noise levels are less than 11 dBA under neutral conditions and less than 17 dBA under adverse conditions;
- Predicted noise levels at onsite commercial receptors 1 to 3 are 55 to 68 dBA, as would be expected in close proximity to mine operations;
- Predicted noise levels at BMA Peak Downs receptors 4 to 7 are 35 to 55 dBA, which would be considered acceptable outside mining support facilities; and
- Predicted noise levels at BMA Saraji receptor 10 are 8 to 14 dBA, which is acceptable.

The proposed noise limits for residential receptors are 35 dBA $L_{eq}$ and 40 dBA $L_{eq}$ for the night and daytime/evening respectively, as per Table 4.2. The predicted noise levels are well below these noise limits and are therefore acceptable.

### 6.5.2 Cumulative Noise from Project Mine and Other Nearby Mines

The Project noise emissions are well below proposed noise limits at residential receptors 8, 9, 11 and 12, and thus would not contribute to mine noise level exceedances due to cumulative impacts from all local mines.

It is noted that the proposed night time limit at residential receptors is 35 dBA $L_{eq,1hr}$, and the existing mine noise levels at Locations A (Receptor 9) and Location D (Receptor 11) were measured at 39 dBA $L_{eq,15min}$ and 35 dBA $L_{eq,15min}$ respectively. Based on these measurement results it is possible that existing mine noise limits at these receptors are higher than the proposed limits in Table 4.2. It is proposed that the noise limits at Receptors 9 and 11 should be the higher of (i) the ASK proposed limits in Table 4.2; and (ii) the existing mine noise limits contained in the Environmental Authorities of other nearby mine(s).

If the existing mine noise limits for Receptors 9 and 11, as contained in the Environmental Authorities of other nearby mine(s), are the same as proposed in Table 4.2, then the allowable noise contribution from the Project at Receptors 9 and 11 should be 50% of the proposed in Table 4.2, i.e. 3 dB lower than the limits in Table 4.2.

### 6.6 Predicted Low Frequency Noise Emission Levels & Assessment

An assessment of low frequency noise emissions at residential receptors has been included in accordance with the guideline “Assessment of Low Frequency Noise criteria”.

The internal noise limit at a residence is an un-weighted noise level of 50 dBZ which is considered to correlate with an external noise limit of 57 dBZ, assuming a 7 dB reduction from outside to inside through a residential building with open windows. If the external noise level exceeds 57 dBZ and the difference between the un-weighted and A-weighted noise levels exceeds 15 dB, then the noise is considered to have unacceptable low frequency content and further assessment is required.

The predicted un-weighted (Z-weighted) noise levels are shown in Table 6.5.
### Table 6.5 Predicted Z-weighted Noise Levels

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Sensitive Receptor Name</th>
<th>Predicted L&lt;sub&gt;eq&lt;/sub&gt; dBZ and (dBZ-dBA difference)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Neutral Condition</td>
</tr>
<tr>
<td>1</td>
<td>Commercial</td>
<td>Kalari</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>Commercial</td>
<td>Dyno</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>Commercial</td>
<td>Dyno</td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td>Commercial</td>
<td>BMA Peak Downs</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>Commercial</td>
<td>BMA Peak Downs</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>Commercial</td>
<td>BMA Peak Downs</td>
<td>N/A</td>
</tr>
<tr>
<td>7</td>
<td>Commercial</td>
<td>BMA Peak Downs</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>Residential</td>
<td>Property Manager</td>
<td>29 (17.5 )</td>
</tr>
<tr>
<td>9</td>
<td>Residential</td>
<td>Workers Accommodation</td>
<td>29 (17.7 )</td>
</tr>
<tr>
<td>10</td>
<td>Commercial</td>
<td>BMA Saraji</td>
<td>N/A</td>
</tr>
<tr>
<td>11</td>
<td>Residential</td>
<td>Saraji Station Residence</td>
<td>22 (17.8 )</td>
</tr>
<tr>
<td>12</td>
<td>Residential</td>
<td>Luxor Residence</td>
<td>18 (17.2 )</td>
</tr>
<tr>
<td>13</td>
<td>Residential</td>
<td>Cheeseboro Residence</td>
<td>22 (17.3 )</td>
</tr>
</tbody>
</table>

From the results in Table 6.5 it can be seen that there are no results exceeding 57 dBZ and with a dBZ-dBA difference of greater than 15 dB. Therefore, the predicted low frequency noise levels are acceptable.
7. Blasting Assessment

7.1 Overview

It is anticipated that the existing vibration levels around the mine site and at the location of sensitive receptors will generally be negligible, except at locations which are close (e.g. within 100m) to roads, rail lines or near major items of fixed plant (e.g. diesel generator).

The only vibration source of significance from the proposed mining activities would be blasting. Blasting activities within the pits have been assessed for both ground vibration and airblast. The relevant criteria for ground vibration and airblast have been presented and discussed in Section 5.7.2.

7.2 Predictions

Ground vibration and airblast levels caused by blasting activities have been predicted based on the formulas and methodology of Australian Standard AS2187.2 “Explosives - Storage Transport and Use - Use of Explosives”, which predicts the peak particles velocity (PPV) in mm/s and the airblast over pressure (peak pressure) in dB.

7.2.1 Ground Vibration

In accordance with the criteria presented in Section 4.7.2, ground vibration levels are to achieve 5mm/s PPV for nine out of ten blasts and not greater than 10mm/s PPV at any time. Ground vibration can be calculated at various distances from a blast using the following formula from AS2187.2:

\[ V = K \left( \frac{R}{Q} \right)^{1/2} \]

Where:
- \( V \) = ground vibration as peak particle velocity (PPV) (mm/s)
- \( K \) = site constant
- \( R \) = distance between charge and point of measurement (m)
- \( Q \) = effective charge mass per delay or maximum instantaneous charge (kg)
- \( B \) = site exponent or attenuation rate

Ground vibration from blasting generally increases with an increase in charge mass and reduces with distance.

The following site constants have been assumed in this calculation\(^1\); however, seed hole analysis will be conducted within the Project to confirm site parameters:
- Site exponent (B) (attenuation rate) of 1.19; and
- Site constant (K) in the range 850.

The maximum instantaneous charge (MIC) has been calculated based on a separation distance of 10 km between the mine and the sensitive receptor at 18 000kg.

\(^1\) The site attenuation rate and site constant have been provided to ASK by John Heilig.
7.2.2 Airblast

In accordance with the criteria presented in Section 4.7.2, airblast pressure levels are to achieve 115 dBZ for nine out of ten blasts and not greater than 120 dBZ at any time. For blasting in an open-cut mine, the distance to the 120 dBZ $L_{\text{peak}}$ contour line from the blast can be calculated using the following formula:

$$D_{120} = (k \times h / \text{maximum (B, S)})^{2.5} \times m^{1/3}$$

Where:
- $D_{120}$ = distance to the 120 dBZ $L_{\text{peak}}$ contour (m)
- $k$ = a site constant determined from the ratio $S/B$ and $S/h$ which requires local calibration
- $h$ = hole diameter (mm)
- $B$ = burden (mm)
- $S$ = stemming height (mm)
- $M$ = charge mass (kg)

The site constant, $k$, has been assumed to be equal to 180 based on ASK’s experience with other mining projects.

The following blast information has been used for these calculations:
- Hole diameter ($h$) = 165mm to 251mm;
- Stemming height ($S$) = 4600 mm; and
- Burden ($B$) = 6000 mm.

The allowable maximum instantaneous charge (MIC) has been calculated based on a separation distance of 10 km between the mine and the sensitive receptor at greater than 20 000kg.

7.3 Assessment

The allowable MIC calculated based on vibration and airblast criteria have been determined at 18 000kg and greater than 20 000kg, respectively. The actual blast charge will be significantly less than these values and compliance with the nominated criteria will be readily achieved.
8. Conclusions

A noise and vibration impact assessment has been conducted for the proposed Vulcan Complex Project. The following comments are made regarding the assessment:

- Noise monitoring was conducted at four (4) sensitive receptor locations;
- A noise model has been developed for proposed mining activities for typical worst-case mining Year 2 to predict noise emission levels at nearby receptors; and
- Calculations have also been made to predict vibration and airblast levels due to blasting.

From this assessment, the following conclusions are made:

- Noise criteria for the mine have been proposed in Section 4.7.1, which includes outdoor noise limits at sensitive receptors of 40 dBA L_Aeq,adj,1hr in the day and evening and 35 dBA L_Aeq,adj,1hr in the night; and an indoor noise limit at sensitive receptors of 50 dBZ L_Eq,adj,1hr (and dBZ-dBA > 15 dB. Criteria may need to be adjusted for receptors near to existing mines as discussed in Section 6.5.2;
- Vibration criteria for the mine have been proposed in Section 4.7.2 in accordance with the relevant guidelines;
- As per the predicted noise levels under day ‘neutral’ and night ‘adverse’ meteorological conditions in Table 6.5 and Table 6.6, modelling has determined that under all conditions, all residential receptors are compliant with relevant limits;
- An assessment of low frequency noise impacts (Section 6.6) indicates that the low frequency noise criterion is compliant at all residential receptors;
- Since the predicted noise levels at sensitive receivers are well below the criteria it is proposed that noise monitoring programme is not required; and
- Based on the blasting parameters and calculations in Section 7, the ground vibration and airblast levels from blasting are predicted to be acceptable at sensitive receivers. Blast design and management of blast initiation will ensure that the vibration and airblast criteria are met.
References

AS1055: 2018 Acoustics – Description and measurement of environmental noise, Standards Australia.


# Appendix A  Glossary

<table>
<thead>
<tr>
<th>Parameter or Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>dB</strong></td>
<td>The decibel (dB) is the unit measure of sound. Most noises occur in a range of 20 dB (quiet rural area at night) to 120 dB (nightclub dance floor or concert).</td>
</tr>
<tr>
<td><strong>dBA</strong></td>
<td>Noise levels are most commonly expressed in terms of the 'A' weighted decibel scale, dBA. This scale closely approximates the response of the human ear, thus providing a measure of the subjective loudness of noise and enabling the intensity of noises with different frequency characteristics (e.g. pitch and tone) to be compared.</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>The number of vibrations, or complete cycles, that take place in one second. Measured in hertz (Hz), where one Hz equals one cycle per second. A young person with normal hearing will be able to perceive frequencies between approximately 20 and 20,000 Hz. With increasing age, the upper frequency limit tends to decrease.</td>
</tr>
<tr>
<td><strong>dB, dB(linear) or dBZ</strong></td>
<td>Noise levels are sometimes expressed in terms of the linear, Z or un-weighted decibel scale – they all take the same meaning. The value has no weighting applied to it and is the same as the dB level.</td>
</tr>
<tr>
<td><strong>Octave band</strong></td>
<td>Ranges of frequencies where the highest frequency of the band is double the lowest frequency of the band. The band is usually specified by the centre frequency, i.e. 31.5, 63, 125, 250, 500 Hz, etc.</td>
</tr>
<tr>
<td><strong>Day</strong></td>
<td>The period between 7am and 6pm.</td>
</tr>
<tr>
<td><strong>Evening</strong></td>
<td>The period between 6pm and 10pm.</td>
</tr>
<tr>
<td><strong>Night</strong></td>
<td>The period between 10pm and 7am.</td>
</tr>
<tr>
<td><strong>Free-field</strong></td>
<td>The description of a noise receiver or source location which is away from any significantly reflective objects (e.g. buildings, walls).</td>
</tr>
<tr>
<td><strong>Noise sensitive receiver or Noise sensitive receptor</strong></td>
<td>The definition can vary depending on the project type or location, but generally defines a building or land area which is sensitive to noise. Generally it includes residential dwellings (e.g. houses, units, caravans, marina), medical buildings (e.g. hospitals, health clinics, medical centres), educational facilities (e.g. schools, universities, colleges),</td>
</tr>
<tr>
<td><strong>L₁</strong></td>
<td>The noise level exceeded for 1% of the measurement period.</td>
</tr>
<tr>
<td><strong>L₁₀</strong></td>
<td>The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level.</td>
</tr>
<tr>
<td><strong>L₉₀</strong></td>
<td>The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.</td>
</tr>
<tr>
<td><strong>Lₑq</strong></td>
<td>The equivalent continuous sound level, which is the constant sound level over a given time period, which is equivalent in total sound energy to the time-varying sound level, measured over the same time period.</td>
</tr>
<tr>
<td><strong>Lₑq,1hour</strong></td>
<td>As for Lₑq except the measurement intervals are defined as 1 hour duration.</td>
</tr>
<tr>
<td><strong>Lₑq,adj,T</strong></td>
<td>The Lₑq adjusted for tonal or impulsive noise characteristics and with a measurement interval of 'T' duration (e.g. 15 minutes, 1 hour).</td>
</tr>
<tr>
<td><strong>Sound power level (Lₑw)</strong></td>
<td>The sound power level of a noise source is its inherent noise, which does not vary with distance from the noise source. It is not directly measured with a sound level meter, but rather is calculated from the measured noise level and the distance at which the measurement was undertaken.</td>
</tr>
</tbody>
</table>
Appendix B  Noise Monitoring Setup

Figure B.1  Noise Logger setup at Receptor 9
Figure B.2  Noise Logger setup at Receptor 12 (Luxor)
Figure B.3  Noise Logger setup at Receptor 13 (Cheeseboro)
Figure B.4  Noise Logger setup at Receptor 11 (Saraji Station Residence)
Appendix C  Noise Monitoring Results

Figure C.1  Graph of Noise Logging Results at Receptor 9
Figure C.2  24 Hour Noise Monitoring Results at Receptor 9

Figure C.3  Graph of Noise Logging Results at Receptor 12

Figure C.4  24 Hour Noise Monitoring Results at Receptor 12
Figure C.5  Graph of Noise Logging Results at Receptor 13

Figure C.6  24 Hour Noise Monitoring Results at Receptor 13
Figure C.7  Graph of Noise Logging Results at Receptor 11

Figure C.8  24 Hour Noise Monitoring Results at Receptor 11
Table C.1  Statistical Noise Levels at Receptor 9

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Noise Levels dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Maximum-Top 10%-(Average)-Bottom 10%-Minimum]</td>
</tr>
<tr>
<td></td>
<td>Day</td>
</tr>
<tr>
<td>$L_{\text{max}}$</td>
<td>80-64-(58)-53-47</td>
</tr>
<tr>
<td>$L_1$</td>
<td>65-58-(53)-49-43</td>
</tr>
<tr>
<td>$L_{10}$</td>
<td>57-52-(47)-43-38</td>
</tr>
<tr>
<td>$L_{eq}$</td>
<td>53-49-(44)-40-35</td>
</tr>
<tr>
<td>$L_{90}$</td>
<td>43-39-(35)-32-28</td>
</tr>
</tbody>
</table>

Table C.2  Statistical Noise Levels at Receptor 12

<table>
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<tr>
<th>Parameter</th>
<th>Noise Levels dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Maximum-Top 10%-(Average)-Bottom 10%-Minimum]</td>
</tr>
<tr>
<td></td>
<td>Day</td>
</tr>
<tr>
<td>$L_{\text{max}}$</td>
<td>92-74-(64)-53-47</td>
</tr>
<tr>
<td>$L_1$</td>
<td>73-61-(52)-44-36</td>
</tr>
<tr>
<td>$L_{10}$</td>
<td>61-48-(41)-36-32</td>
</tr>
<tr>
<td>$L_{eq}$</td>
<td>61-49-(41)-35-29</td>
</tr>
<tr>
<td>$L_{90}$</td>
<td>36-32-(28)-24-21</td>
</tr>
</tbody>
</table>

Table C.3  Statistical Noise Levels at Receptor 13

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Noise Levels dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Maximum-Top 10%-(Average)-Bottom 10%-Minimum]</td>
</tr>
<tr>
<td></td>
<td>Day</td>
</tr>
<tr>
<td>$L_{\text{max}}$</td>
<td>89-73-(64)-54-47</td>
</tr>
<tr>
<td>$L_1$</td>
<td>69-62-(54)-47-42</td>
</tr>
<tr>
<td>$L_{10}$</td>
<td>62-53-(47)-42-36</td>
</tr>
<tr>
<td>$L_{eq}$</td>
<td>57-52-(46)-41-33</td>
</tr>
<tr>
<td>$L_{90}$</td>
<td>50-46-(37)-28-24</td>
</tr>
</tbody>
</table>

Table C.4  Statistical Noise Levels at Receptor 11

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Noise Levels dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Maximum-Top 10%-(Average)-Bottom 10%-Minimum]</td>
</tr>
<tr>
<td></td>
<td>Day</td>
</tr>
<tr>
<td>$L_{\text{max}}$</td>
<td>96-81-(66)-55-47</td>
</tr>
<tr>
<td>$L_1$</td>
<td>90-61-(53)-45-38</td>
</tr>
<tr>
<td>$L_{10}$</td>
<td>63-47-(42)-37-33</td>
</tr>
<tr>
<td>Parameter</td>
<td>Noise Levels dBA [Maximum-Top 10%-(Average)-Bottom 10%-Minimum]</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>$L_{eq}$</td>
<td>75-51-(43)-37-32 52-45-(39)-33-26 58-46-(40)-35-23</td>
</tr>
<tr>
<td>$L_{90}$</td>
<td>51-36-(32)-29-26 42-38-(35)-31-22 45-41-(36)-31-20</td>
</tr>
</tbody>
</table>
Appendix D  Model Source Locations

Figure D.1  Year 2 Equipment Locations in Noise Model (Note: Equipment shown as blue dots, truck paths shown as red lines and receivers shown as yellow dots)
Appendix E  Predicted Noise Contours
Year 2 Noise Contours
Day - Neutral

Date: 25/03/2020
Drawn By: PJ
Prepared For: Mining & Energy Technical Services Pty Ltd

Noise Levels Leq (1 hour)
Free Field dB(A)
Ground Contour Calculation Height = 1.8m

- = 20
- = 25
- = 30
- = 35
- = 40
- = 45
- = 50
- = 55

Signs and Symbols
+ Point receiver

Vulcan Complex Project
Project Number: 0210

Figure E.1
Vulcan Complex Project
Project Number: 0210

Figure E.2

Year 2 Noise Contours
Night - Adverse

Date: 25/03/2020
Drawn By: PJ
Prepared For: Mining & Energy Technical Services Pty Ltd

Noise Levels Leq (1hour)
Free Field dB(A)
Ground Contour Calculation Height = 1.8m

- 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55

Signs and Symbols
+ Point receiver

W:\197401\0210 - Vulcan Complex Project\Model\0210 Model\Sheet E2.agi