Appendix 2.
Fountain Head Gold Project
Environmental Noise Assessment

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S5271C10

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sonus.

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EXECUTIVE SUMMARY

An environmental noise assessment has been conducted for the proposed Fountain Head Gold Project (the Project), located in the Pine Creek region of the Northern Territory.

This assessment has been based on information provided in the Notice of Intent and RFI for the Fountain Head Gold Project, which contain preliminary locations and equipment selections. Noise levels from these sources have been assessed at the nearest noise sensitive receiver in accordance with the Northern Territory Environment Protection Authority Guidelines.

The assessment criteria have been established based on the following:

- the Northern Territory Environment Protection Authority *Northern Territory Noise Management Framework Guideline*;
- Australian and New Zealand Environmental Conservation Council's (ANZECC) guidelines "*Technical Basis for Guidelines to Minimise annoyance due to Blasting Overpressure and Ground Vibration*"; and
- APA document "Standard conditions for works near APA Gas Transmission Pipelines.

The assessment criteria are summarised below:

Activity	Criterion
Operational Noise	35 dB(A)
Construction Noise	37 dB(A)
Blasting impact at sensitive receptor Airblast overpressure Ground vibration	 115 dB 5mm/s ppv
Blasting ground vibration at pipeline	20 mm/s ppv

Environmental noise from the Project has been predicted using the CONCAWE noise propagation model, which takes into account topography, ground absorption, air absorption and meteorological conditions. The predictions consider the worst-case situation of all operational and construction plant and equipment operating continuously and concurrently, and under meteorological conditions that are most conducive for the propagation of sound.

The noise level at the nearest noise sensitive receiver has been predicted to be 31 dB(A) for the worst case operating scenario. This level achieves all noise criteria summarised above.

Airblast overpressure and ground vibration levels from blasting activity have also been predicted. The predictions indicate that the airblast overpressure and ground vibration criteria will be achieved at all sensitive receivers. Further, the level of vibration at the Bonaparte Gas Pipeline will also achieve the relevant criterion.

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1 INTRODUCTION

An environmental noise assessment has been conducted for the proposed Fountain Head Gold Project (the **Project**). The assessment has been based on the following:

- the project description as described in the *Notice of Intent Fountain Head Gold Project* dated December 2019 (the **Notice of Intent**);
- information provided in the *Fountain Head Gold Project RFI*, version 1 (the **RFI**), provided to Sonus on 23 February 2021;
- background noise measurements conducted from 3 March 2020 to 10 March 2020; and,
- noise measurements and data for typical mining equipment from similar projects.

2 ASSESSMENT CRITERIA

The airborne noise component has been assessed against the criteria provided in the *Northern Territory Noise Management Framework Guideline* (the **Guideline**). The Guideline provides *Project Specific Assigned Noise Levels* for commercial and industrial activities, such as mining.

For overpressure and vibration from blasting, objective criteria have been determined based on the Australian and New Zealand Environmental Conservation Council's (ANZECC) guidelines "*Technical Basis for Guidelines to Minimise annoyance due to Blasting Overpressure and Ground Vibration*" (**ANZECC Guidelines**), and APA document "*Standard conditions for work near APA Gas Transmission Pipelines*" (**APA Guidelines**).

2.1 Operational Noise

The Guideline provides a method for determining the mandatory *project specific assigned noise level*. Where higher noise levels are predicted, noise mitigation strategies must be employed to reduce the overall noise level. The *project specific assigned noise level* has two components. Component A is the *project intrusiveness noise level* and Component B is the *project amenity noise level*. The *project specific assigned noise level* is the lower, or more onerous, of these two components.

The *project specific assigned noise level* is defined for the periods of day, evening and night. The day period is defined as any time between 7am and 6pm, Monday to Saturday, and between 8am and 6pm on Sunday and public holidays. The evening period is defined as any time between 6pm and 10pm, regardless of the day, and the night period is defined as all remaining times, that is between 10pm and 8am the following day if the following day is a Sunday or public holiday, and between 10pm and 7am the following day, for all other days.

The *project intrusiveness noise level* seeks to limit the intrusion a new noise source will have on the existing acoustic environment, taking into account the background noise level at the location. This level is defined as being 5 dB above the background noise level. Where very low background noise levels are measured, the Guideline imposes a minimum project intrusiveness level to be applied, as summarised in Table 1 below.

Table 1: Minimum background and project intrusiveness noise levels

Time of Day	Minimum assumed rating background noise level (dB(A))	Minimum project intrusiveness noise levels ($L_{Aeq,15min}$ dB(A))
Day	35	40
Evening	30	35
Night	30	35

In order to determine the *project intrusiveness noise levels*, background noise measurements were measured from 3 March 2020 to 10 March 2020. A noise logger was placed at an indicative location on the nearest residential property to the project site, as shown in Appendix A. Data were collected over a period of 1 week, and the resulting data were then analysed in order to determine the rating background noise levels during the day, evening and night. These data can be seen in Appendix B. The background measurements indicate that the area is exposed to relatively low levels during the day, with increased noise during the evening and night. This noise environment is indicative of an area with very low levels of traffic noise and noise dominated by insects at night. Table 2 shows the results of this monitoring process, as well as the resultant *project intrusiveness noise levels*.

Table 2: Background noise measurement data and project intrusiveness noise levels

Time of Day	Measured background noise level (dB(A))	Minimum assumed rating background noise level (dB(A))	Project intrusiveness noise levels ($L_{Aeq,15min}$ dB(A))
Day	28	35	40
Evening	32	30	37
Night	37	30	42

The *project amenity noise level* aims to prevent the creep in noise levels over time due to the successive application of an increase above the background noise level. The *amenity noise level* provides a recommendation to be achieved for the overall noise level of all industrial sources in an area. For a new project, the *project amenity noise level* is defined as being 5 dB(A) less than the maximum assigned *amenity noise level* for a location, to allow for the contribution from potential future industrial noise sources other than those produced at the subject site. The criteria corresponding to a residence in a rural area are summarised in Table 3 below.

Table 3: Maximum assigned and project amenity noise levels

Time of Day	Recommended maximum assigned amenity noise level ($L_{Aeq,15min}$ dB(A))	Maximum project amenity noise level ($L_{Aeq,15min}$ dB(A))
Day	50	45
Evening	45	40
Night	40	35

Based upon the lower of the *project intrusiveness* and *project amenity noise levels*, the *project specific assigned noise level* can be determined for each time period. The levels relevant to the project are shown in Table 4 below.

Table 4: Project specific assigned noise levels

Time of Day	Project intrusiveness noise level ($L_{Aeq,15min}$ dB(A))	Project amenity noise level ($L_{Aeq,15min}$ dB(A))	Project specific assigned noise level ($L_{Aeq,15min}$ dB(A))
Day	40	45	40
Evening	44	40	40
Night	46	35	35

2.2 Construction Noise

For typical construction projects, the ability to attenuate construction noise is more limited than during the operational phase because noisy equipment is often required to be located close to noise sensitive receivers. Therefore, it is common practice for construction noise to be assessed in a less onerous way than operational noise. For a mining project such as this, the line between construction (prior to ore processing) and operation can be blurred because the most significant noise sources used during construction (power generation, drilling, earth moving etc) are also used during the operational phase. Other noise sources during construction are hand tools and concrete trucks, which are not significant in the context of the overall noise.

In the Northern Territory, the Guideline recommends that construction activities be limited to standard hours, where noise cannot be sufficiently attenuated. Standard hours are defined as being between 7am and 7pm from Monday to Saturday, and between 9am and 6pm on Sundays and public holidays. Typically, all reasonable and practicable measures are taken to reduce construction noise, and activities that cannot be attenuated sufficiently are conducted during standard hours only, to protect against sleep disturbance.

The Guideline outlines objective noise criteria for construction activity, in relation to the background noise of the area. The noise level should not exceed the background noise level by more than 10 dB during standard hours, or more than 5 dB at all other times. It is noted that where the measured background noise level was lower than the minimum assumed rating background level, the minimum has been applied.

Table 5: Construction Noise Level Criteria

Time of Day	Measured background noise (L_{A90} dB(A))	Construction noise criteria (L_{Aeq} dB(A))
Standard hours	35	45
All other times	32	37

2.3 Blasting

For sensitive receptors, objective criteria for airblast overpressure and ground vibration from blasting are provided by Australian and New Zealand Environmental Conservation Council's (ANZECC) guidelines "*Technical Basis for Guidelines to Minimise annoyance due to Blasting Overpressure and Ground Vibration*" (**ANZECC Guidelines**).

For buried pipework, reference is made to the APA document "*Standard conditions for works near APA Gas Transmission Pipelines*" (**APA Guidelines**)

Airblast Overpressure

To minimise the annoyance and discomfort from airblast overpressure to persons at sensitive receivers, in this case the Grove Hill Hotel, the ANZECC Guidelines recommend:

- a maximum level for airblast overpressure is 115 dB (Lin, Peak).
- the level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but the level should not exceed 120 dB (Lin, Peak) at any time.

Ground Vibration

To minimise the annoyance and discomfort from ground vibration to persons at sensitive receivers, in this case the Grove Hill Hotel, the ANZECC Guidelines recommend:

- a maximum level for ground vibration of 5mm/sec (peak particle velocity (ppv)).
- the ppv level of 5mm/sec may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but the level should not exceed 10mm/sec at any time.

The ANZECC Guidelines also recommend restricting blasting to the hours of 9am to 5pm on Monday to Saturday, with no blasting activity on Sunday or public holidays.

For buried steel pipework, the APA Guidelines provide a recommended ground vibration limit of 20mm/s ppv measured at the pipeline.

2.4 Summary of Assessment Criteria

The noise and vibration criteria applied in the assessment for the Project are summarised in below:

Operational Noise

Day	40 dB(A)
Evening	40 dB(A)
Night	35 dB(A)

Construction Noise

Standard Hours	45 dB(A)
Outside Standard Hours	37 dB(A)

Blasting impacts at Sensitive Receptor

Airblast overpressure	115 dB
Ground Vibration (ppv)	5mm/s

Blasting impact on pipework

Ground Vibration (ppv)	20mm/s

3 NOISE PREDICTIONS

The nearest sensitive receiver is the Grove Hill Hotel (currently a residence) located approximately 5.5km east of the closest noise sources associated with the Project. The location of the receiver can be seen in Appendix A. Other sensitive receptors, being other residential locations, are significantly further away, upwards of 9km from the subject site.

3.1 Noise Prediction Model

The noise from the operation of the project has been modelled using the "Conservation of Clean Air and Water in Europe" (CONCAWE)[1] noise propagation model in the SoundPlan 8.2 noise modelling software. The CONCAWE propagation model has been widely accepted as an appropriate sound propagation model and takes into account the following factors:

- sound power levels and locations of sources;
- separation between noise sources and receivers;
- topography;
- influence of the ground;
- air absorption; and,
- meteorological conditions.

The CONCAWE system divides the range of possible meteorological conditions into six separate "weather categories", from weather category 1 to weather category 6. Weather category 1 provides "best-case" (i.e. lowest noise level) weather conditions for the propagation of noise, whilst weather category 6 provides "worst-case" (i.e. highest noise level) conditions, when considering wind speed, wind direction, time of day, and level of cloud cover. Weather category 4 provides "neutral" weather conditions for noise propagation.

For the purposes of comparison, weather category 1, 2 and 3 conditions are generally characterised by wind blowing from the receiver to the noise source during the daytime with little or no cloud cover. Category 4 conditions can be characterised by no wind and an overcast day, whilst no wind and a clear night sky

[1] The oil companies' international study group for conservation of clean air and water in Europe, "The propagation of noise from petrochemical complexes to neighbouring communities".

represents category 5 conditions. Category 6 conditions can be characterised by a clear night sky and wind blowing from the noise source to the receiver.

In the particular circumstances of the Project, the noise levels experienced at sensitive receivers in the vicinity of the proposed mine will be strongly influenced by the weather category. For example, significantly higher noise levels would be expected at sensitive receivers with a temperature inversion or wind blowing from the mine to the sensitive receiver (i.e. category 5 or 6 conditions) than with wind blowing from the sensitive receiver to the mine (i.e. category 1, 2, or 3 conditions).

Category 6 conditions have been used in the noise modelling to ensure a conservative approach. During more favourable weather conditions, noise levels at these sensitive receivers will be lower than those predicted by the noise model.

Other input assumptions of the noise model are as follows:

- Ground type : soft ground
- Relative humidity : 70%
- Receiver height : 1.5m above ground level
- Operating hours : all noise sources operating continuously during the day and night

3.2 Noise Sources

The main noise sources have been determined based upon the Notice of Intent and RFI documents for the Fountain Head Gold Project. The Notice of Intent and RFI detail the types of operational activities to be undertaken at the site, as well as indicative models of different pieces of equipment. Sound power levels for equipment similar to those proposed have been used to populate the noise model. The data used are summarised in Appendix C.

As a conservative approach, the noise from construction has been combined with operational noise for the purposes of this assessment. Therefore, concrete trucks and hand tools have been added to the noise prediction. The prediction is also based on all activity occurring simultaneously in a 15 minute period (the default assessment period of the Guideline).

The following activities are assumed to be operating within this period:

- Continuous operation of the following equipment for the entire period:
    - 3 1.5MW diesel generators;
    - 10 lighting towers
    - 2 mining drills;
    - 2 dozers;
    - 2 excavators;
    - Grader;
    - Water cart;
    - Forklift;
    - Crane;
    - 2 loaders;
    - Primary crusher;
    - Secondary crusher;
    - Tertiary Crusher;
    - Crushing screen;
    - Ball Mill;
    - 5 agitators;
    - 10 pumps;
    - Other processing plant equipment;
    - Conveyor belt system; and,
    - Dewatering pump.
- Construction activity including:
    - Continuous operation of hand tools, including 2 pneumatic items and 2 electric items;
    - The movement of a concrete truck about the site; and,
    - Spinning of the concrete agitator at a high speed.
- 12 light vehicles driving around the site;
- A bus arriving at the site with workers;
- 6 haul trucks driving between the pit and the ROM;
- 4 other trucks driving around the site; and,
- One delivery of fuel to the fuel store.

It has been assumed that all of the equipment is operating concurrently at ground level (rather than in a pit) as conservative assumptions. During operation, much of the mobile equipment is expected to be either not operating or located in the pit. This will result in a lower sound level than that presented in this assessment.

3.3 Predicted Noise Level

The noise level at the nearest sensitive receiver has been predicted using the CONCAWE noise propagation model for worst case meteorological conditions. Based upon the assumptions and conditions noted above, a noise level of 31 dB(A) has been predicted at the sensitive receiver. The noise contours for the predictions under the above conditions can be seen in Appendix D.

As this noise level is the combined noise from all operational and construction noise sources, a comparison has been made with the operational and construction noise criteria of the Guideline for all time periods of the day. The most onerous criterion is 35 dB(A) at night time and as the predicted level is below this criterion, the Guidelines will be achieved during operation and construction.

4 BLASTING

The relationship between the airblast overpressure and ground vibration from blasting for a given mine site is dependent on a number of variables specific to that site. While the magnitude of the airblast overpressure and ground vibration are expected to decrease with increasing distance from the blast and increase with increasing charge weight per delay, other variables such as particular source-receiver geometries, rock type and formation and the local geology of the site also influence the result of blasting. It is therefore common practice for the blasting specialist to design each blast to achieve the project criterion.

To provide some indication of the likely levels of ground vibration and airblast overpressure from blasting at the Grove Hill Hotel, predictions have been made using the ANZECC Guidelines and conservative (high noise and vibration) model inputs. For a charge weight per delay of 84kg, the level of vibration (peak particle velocity) is predicted to be less than 0.1mm/s (compared with the criterion of 5mms) and the airblast overpressure is predicted to be less than 90 dB (compared with the criterion of 115 dB).

In addition, consideration has been given to the level of ground vibration at the high-pressure Bonaparte Gas Pipeline. At the closest point, the pipeline is 370m from the pit crest to the east and 480m in the south. The level of ground vibration at the location of the pipework is predicted to be approximately 3 mm/s (compared with the criterion of 20mm/s).

5 CONCLUSION

An environmental noise and vibration assessment has been made of the Fountain Head Gold Project. Predicted noise and vibration levels have been compared with relevant criteria.

The comparison indicates that:

- The combined noise from construction and operation will achieve the criteria of the *Northern Territory Noise Management Framework Guideline.*
- The airblast overpressure and vibration from blasting will achieve the criteria of the Australian and New Zealand Environmental Conservation Council's (ANZECC) guidelines "*Technical Basis for Guidelines to Minimise annoyance due to Blasting Overpressure and Ground Vibration*".
- The vibration at the location of the Bonaparte Gas Pipeline from blasting will achieve the relevant criteria presented in the APA document "*Standard conditions for works near APA Gas Transmission Pipelines*".

APPENDIX A: PROJECT AREA AND NEAREST SENSITIVE RECEIVER

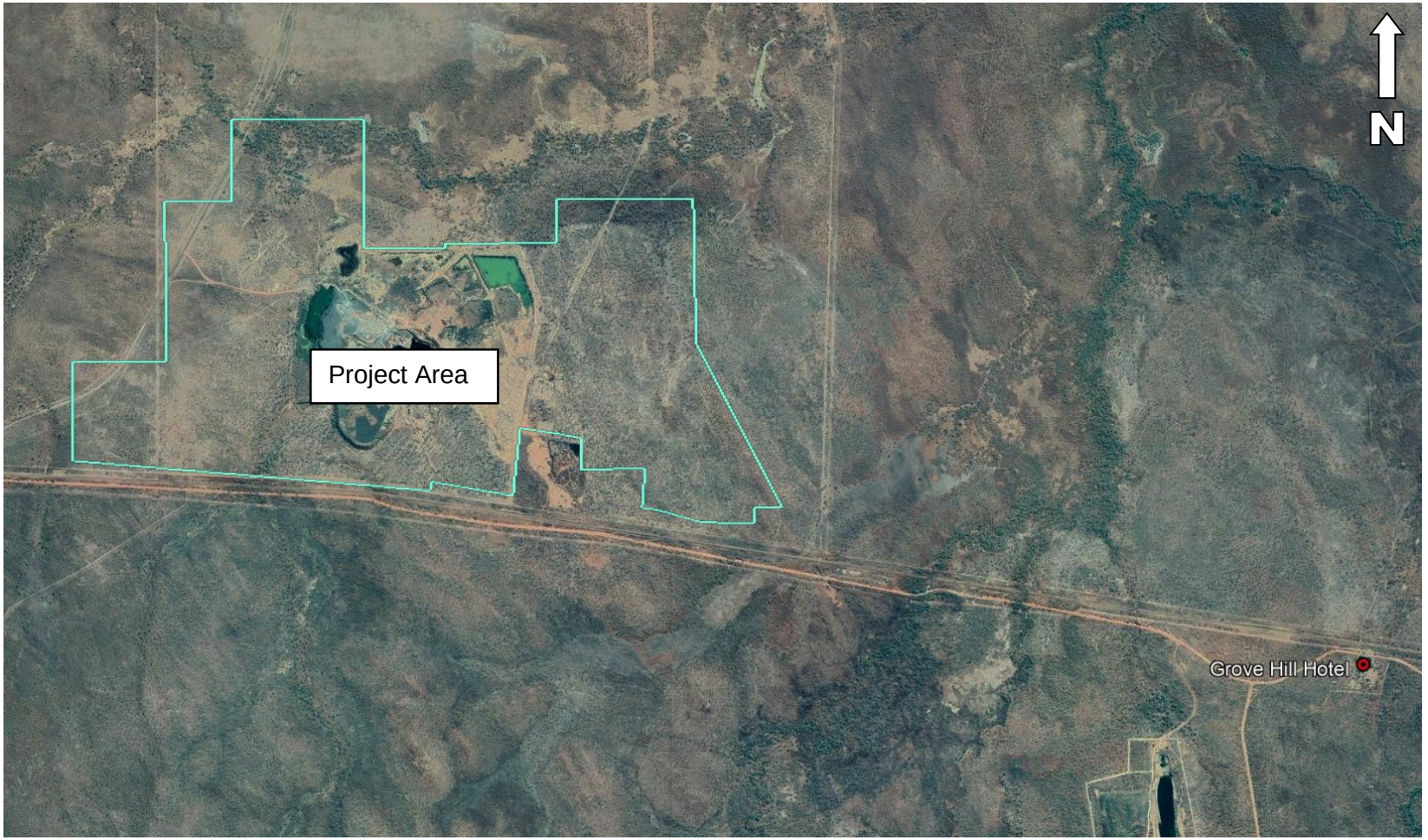

Figure A1: Project area and the nearest sensitive receiver

APPENDIX B: BACKGROUND NOISE LEVELS

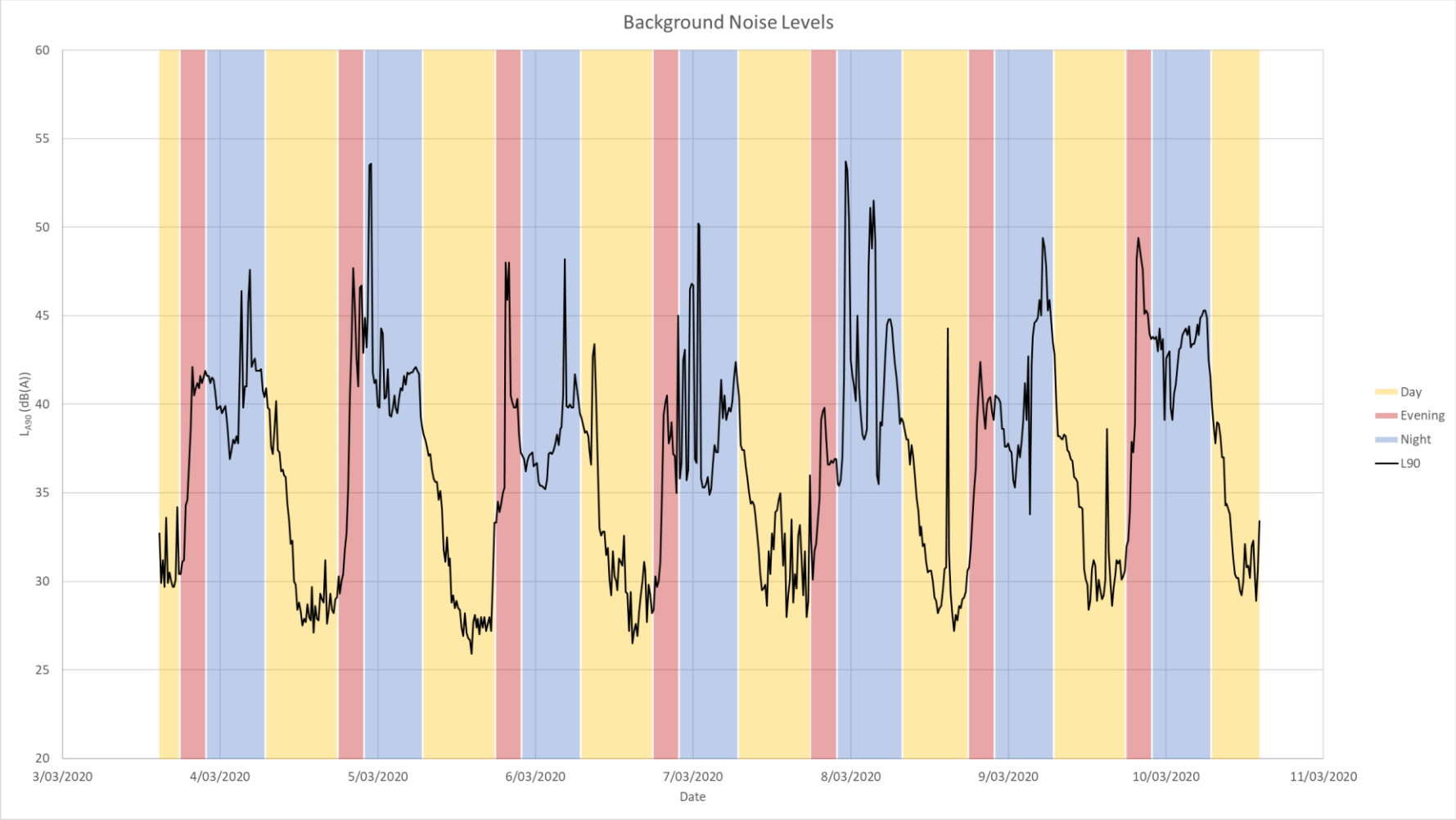

Figure B1: Results from noise logging period

APPENDIX C: MAIN NOISE SOURCES AND ASSOCIATED SOUND POWER LEVELS

Table C1: Main noise sources and associated sound power levels

Noise Source	Number of Items	Total SWL (dB(A))	SWL (dB(A)) by Octave Band Centre Frequency (Hz)						
			63	125	250	500	1000	2000	4000
Agitator	5	100	67	81	86	93	98	88	84
Ball Mill	1	107	87	94	98	100	101	98	97
Concrete Truck – Moving	1	102	79	86	88	96	97	97	89
Concrete Truck – Stationary	1	114	87	98	104	109	108	105	103
Crane	1	95	72	80	81	88	92	90	80
Crushing Screen	1	102	99	95	89	91	90	87	85
Dewatering Pump	1	111	90	98	100	104	106	106	100
Dozer	2	111	79	94	98	105	107	104	95
Excavator	2	117	81	99	102	108	110	112	111
Forklift	1	113	103	101	99	105	106	106	106
Fuel Delivery	1	105	88	97	99	96	99	97	93
Grader	1	107	78	90	94	100	103	103	94
Hand Tools – Electric	2	102	66	84	87	93	95	97	96
Hand Tools – Pneumatic	2	116	80	98	101	107	109	111	110
Haul Truck	6	115	98	105	105	110	110	107	100
Light Vehicles	12	106	89	97	99	100	99	97	93
Lighting Plant	10	100	63	86	92	95	94	92	90
Loader	2	108	73	97	102	99	101	101	94
Mining Drill	2	120	84	102	105	111	113	115	114
Primary Crusher	1	112	91	100	103	106	107	105	100
Process Plant	1	122	101	110	113	116	117	115	110
Pump	10	95	58	70	78	84	90	91	83
Secondary Crusher	1	112	91	100	103	106	107	105	100
Tertiary Crusher	1	112	91	100	103	106	107	105	100
Various Trucks	5	113	90	97	99	107	108	108	100
Water Cart	1	114	77	89	100	107	110	109	96
Power Generation									
1.5MW Diesel Generator	3	111	94	100	102	103	104	103	103

APPENDIX D: NOISE CONTOURS

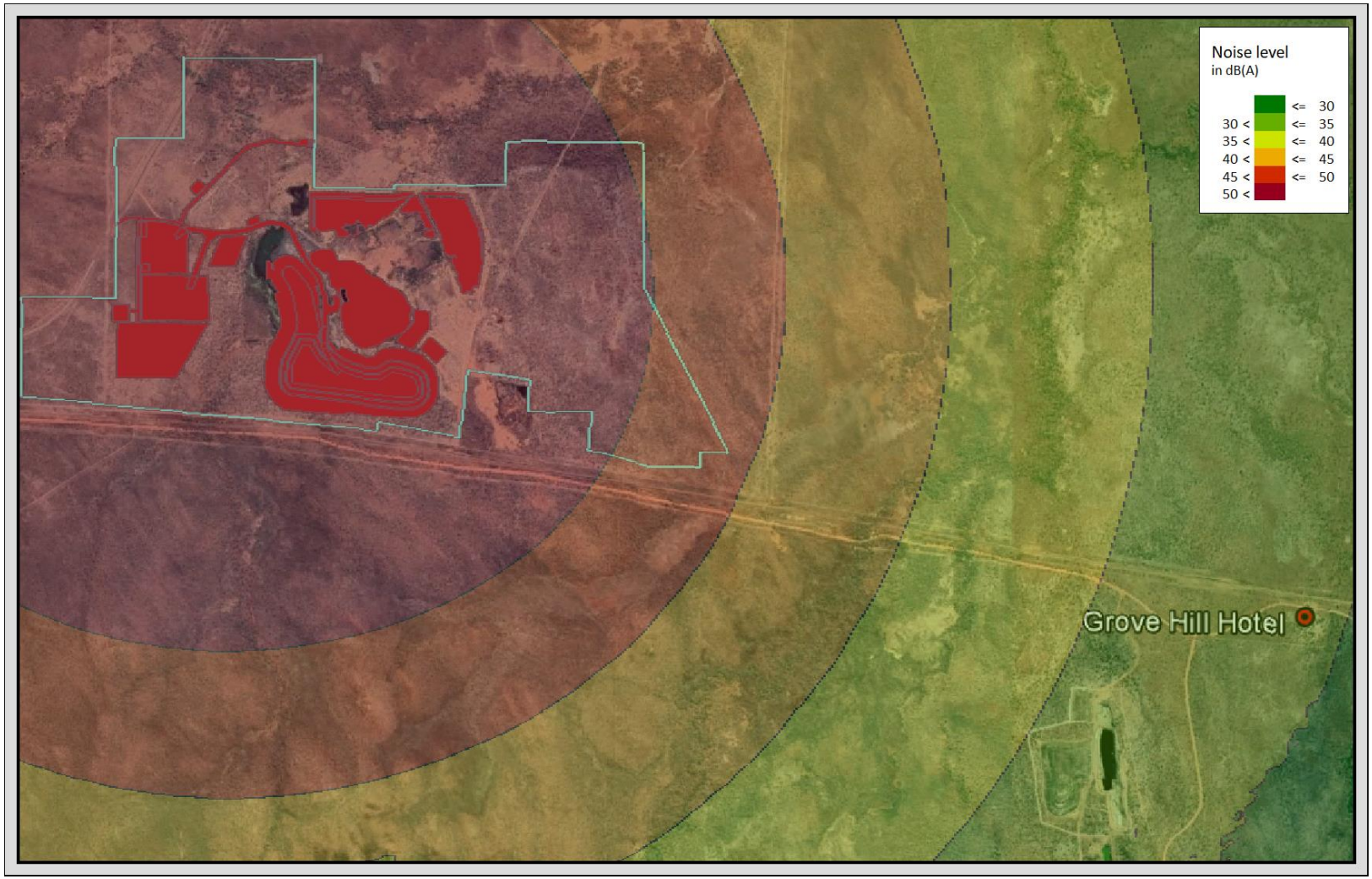

Figure D1: Noise contours for worst case conditions