Appendix A
Background Noise Survey and Environmental Noise Assessment (Lloyd George Acoustics)

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Background Noise Survey

#391 Boomerang Road, Oldbury

Reference: 20075607-01.docx

Prepared for:
Hanson

Association of Australasian Acoustical Consultants

Report: 20075607-01.docx

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Date:	Rev	Description	Prepared By	Verified
03-Aug-20	0	Issued to Client	Olivier Mallié	Terry George

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1 INTRODUCTION

Lloyd George Acoustics was engaged to record and assess background noise levels at the site of the proposed sand extraction operations in Oldbury, refer *Figure 1-1*.

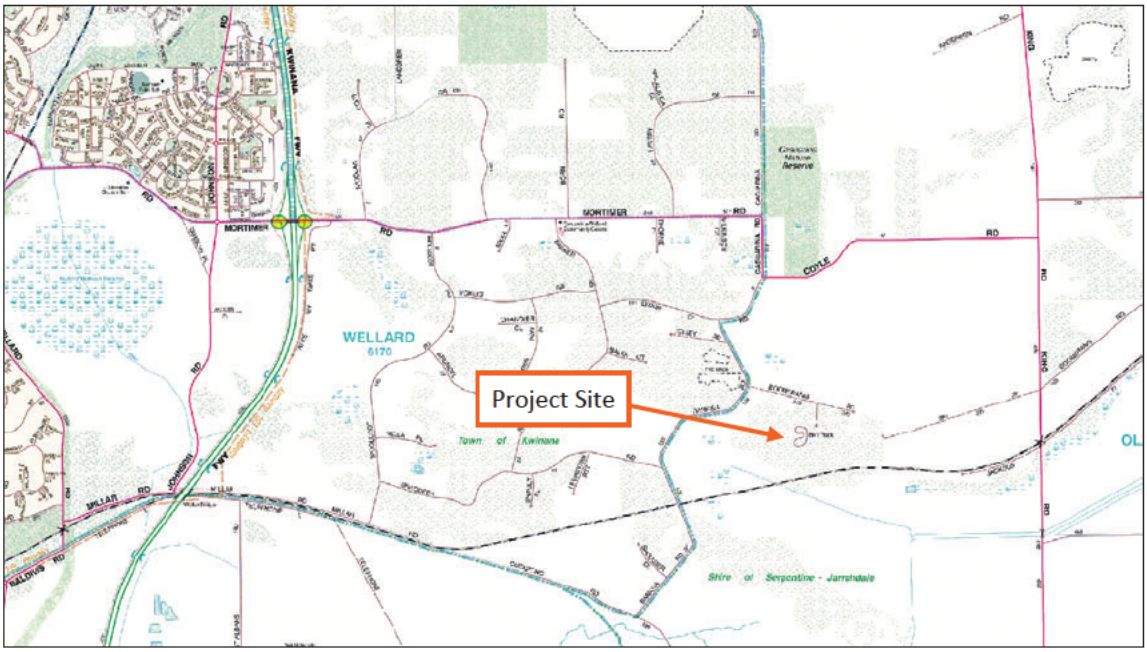


Figure 1-1 Project Locality

Appendix A contains a description of some of the terminology used throughout this report.

2 METHODOLOGY

Background noise monitoring was undertaken between the 17 and 24 of July 2020 to characterise the existing noise levels at the proposed sand excavation site. The noise logger was located on the north side of the property at #391 Boomerang Road, approximately 35 metres from the edge of Boomerang Road, refer *Figure 2-1*.

Table 2-1 also provides the coordinates of the logger location, with *Figure 2-2* showing a photograph of the logger setup. It is noted that a separate system was also setup on location for internal testing purposes only.

Table 2-1 Noise Logger Details

Logger S/N	Description	Easting (MGA94, Zone 50)	Northing (MGA94, Zone 50)
DUO 10747	#391 Boomerang Road, Oldbury	395353	6429459

Under the Regulations, there are certain requirements that must be satisfied when undertaking measurements and are defined in Regulations 19, 20, 22 and 23 and Schedule 4. In undertaking the measurements, these have been satisfied, specifically noting the following:

- The noise data loggers used was a 01dB DUO (S/N 10747).
- The equipment holds current laboratory certificates of calibration that are available upon request. The equipment was also field calibrated before and after and found to be within +/- 0.5 dB.
- The microphone was fitted with a standard wind screen.
- The microphone was at least 1.2 metres above ground level and at least 3.0 metres from reflecting facades (other than the ground plane).

The logger was setup to record the overall A-weighted, Slow, noise levels and audio.

Meteorological conditions at the time of the survey were obtained from the Bureau of Meteorology's Jandakot Aerodrome site. It is noted this weather station is located 18 kilometres north of the site, however it was selected as it is approximately the same distance from the coast line, and therefore considered to be subjected to similar conditions.

Figure 2-1 Noise Monitoring Location

Figure 2-2 Noise Logger Setup

3 RESULTS

The 30-minute logged noise data over the duration of the survey is graphed on *Figure 3-1*, and shows the L_{90}, L_{10} and L_{max} noise levels for the duration of the survey. Also shown is the averaged wind speed recorded at the Bureau of Meteorology's Jandakot Aerodrome station.

From the time history data on *Figure 3-1*, it can be seen that the noise levels recorded generally follow a day-night pattern, whereby night-time noise levels are lower than during the day.

Given the proposed hours of operations of the sand excavation operations, the focus of the data analysis was on the daytime period (7am-7pm). Background noise levels generally ranged between 30-40 dB L_{A90} throughout the survey period, with 25 dB L_{A90} being the lowest, recorded on 23 July around 7am. Early in the morning, noise levels are generally dominated by roosters crowing and wildlife noises. On 19 July between 10-12am and again on 21 July between 4-6pm, some machinery was used on the property near the logger, resulting in noise levels up to 50 dB L_{A90} over these 2-hour periods. Background noise levels are noted to then drop to 35 dB L_{A90} and below for the rest of the day after these events.

Given the location of the logger and local surroundings, it is noted the L_{A10} noise levels were mostly affected by local noise sources such as rooster crowing and local wildlife. However, 30-minute L_{A10} noise levels below 40 dB were frequently recorded around 6pm, with 32 dB L_{A10} and 33 dB L_{A10} being the lowest levels recorded on Sunday 19 July at 6.30pm and 8am on Thursday 23 July respectively. For reference, the spectral data in the form of 30-minute L_{Aeq} levels in 1/3 octave bands for both these time periods are shown on *Figure 3-2*. From the data, it can also be seen that the afternoon of 22 July resulted in the lowest consecutive L_{A10} noise levels, with levels ranging between 44-49 dB over several hours.

For reference, at night (10pm-7am), background noise levels between 25-27 dB L_{A90} were consistently recorded, with 22 dB L_{A90} being the lowest, recorded on 22 July around 3am. The first night between 17-18 July is an exception, where some aircraft noise and loud cars were recorded, resulting in background noise levels closer to 30 dB L_{A90}. Rooster crowing and wildlife noises were also present in the data for most nights.

With regard to the L_{Amax} noise levels, the following noise sources were noted as resulting in levels over 60 dB L_{Amax}:

- Gunshot / bird scaring cartridge fired in the vicinity of the logger resulting in a L_{Amax} event of 109 dB (18 July around noon),
- Sporadic heavy vehicle traffic along Boomerang Road and light aircraft fly-over resulting in noise levels up to 63 dB L_{Amax},
- Local bird noises close to the microphone resulting in L_{Amax} noise levels over 60 dB(A).

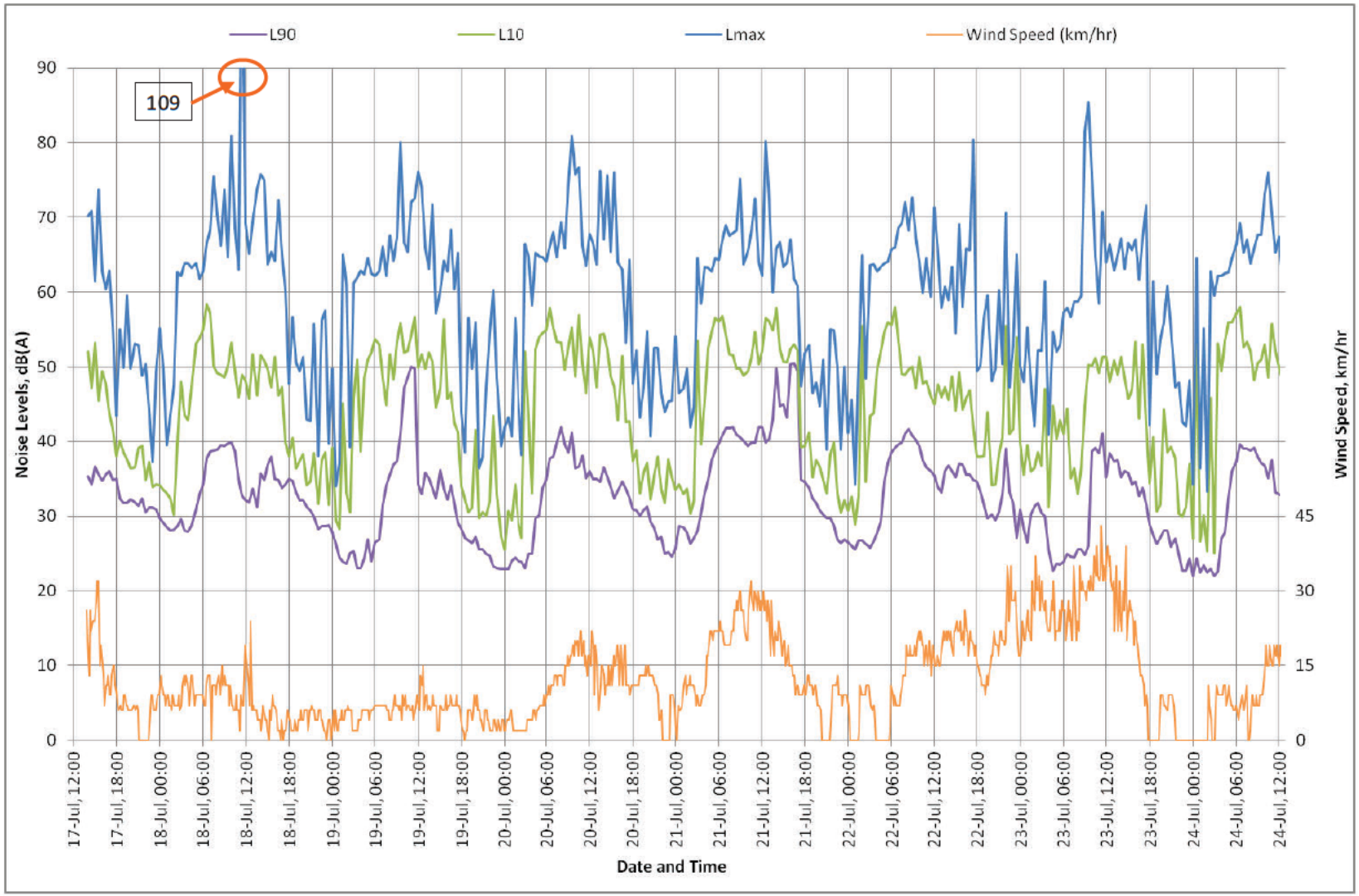


Figure 3-1 Background Noise Levels at #391 Boomerang Road

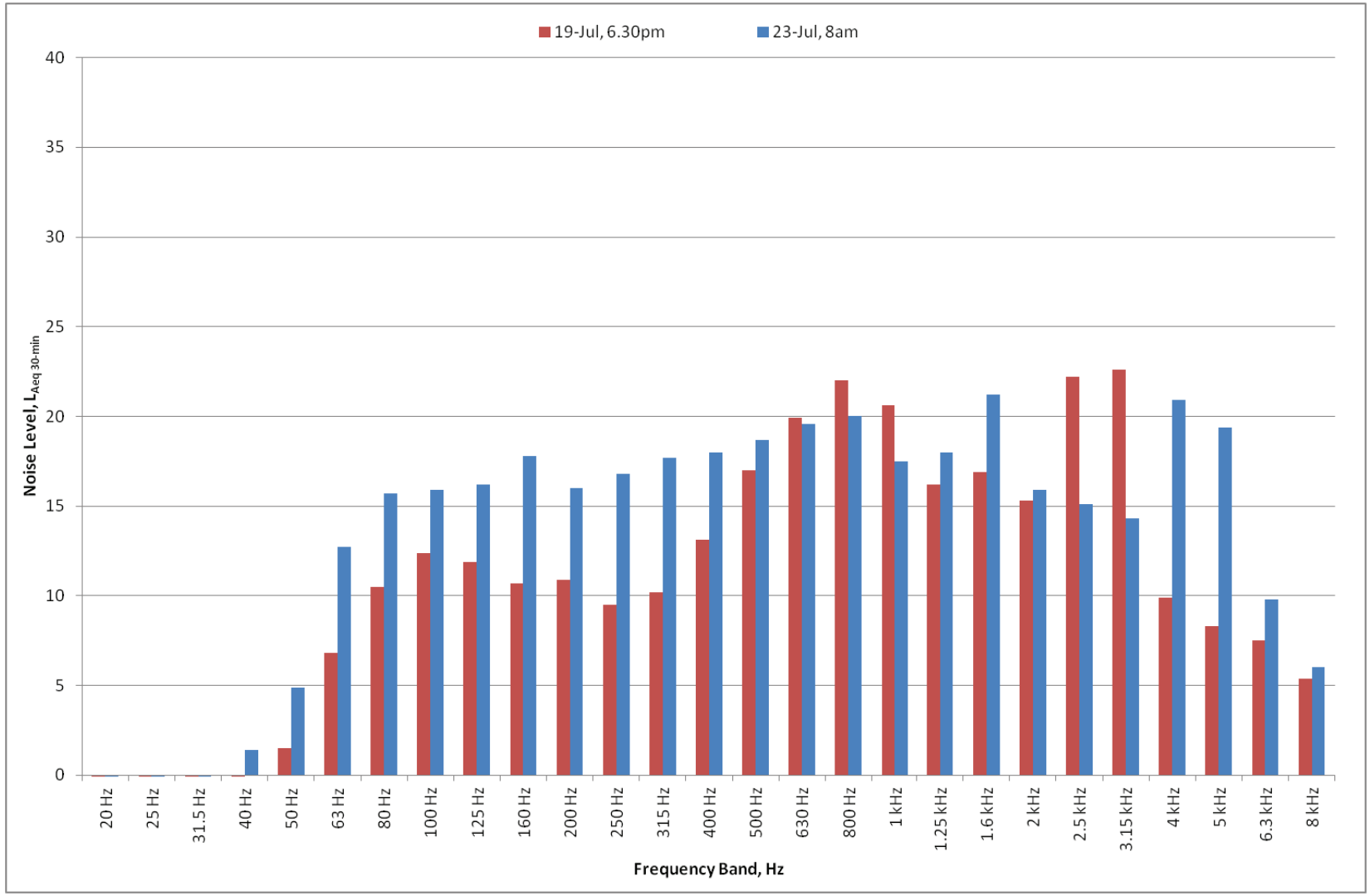


Figure 3-2 Spectral Data for Lowest 30-minute Daytime Noise Levels

4 DISCUSSIONS

The background noise levels recorded are somewhat typical of a rural residential setting located away from major transport corridors.

As noted, the local noise environment near the logger location has been affected by local noise sources such as roosters and machinery noises. Without those local extraneous noise sources present, background noise levels in the order of 25 dB L_{A90} and 35 dB L_{A10} are expected during the daytime, which would apply at the other sensitive receivers further east along Boomerang Road.

In addition, as there are no major transport corridors, or commercial or industrial land uses nearby, the background noise levels contain mostly mid to high frequency noise, as is shown on *Figure 3-2*. Therefore, low frequency noise emitted from mobile equipment or the like on the proposed sand excavation site are not likely to be masked by background noise, such that tonal characteristics will likely be audible above background.

Appendix A

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Pressure Level (L_p)
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}
This is the noise level in decibels, obtained using the A frequency weighting and the S (Slow) time weighting as specified in IEC 61672-1:2002. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}
This is the noise level in decibels, obtained using the A frequency weighting and the F (Fast) time weighting as specified in IEC 61672-1:2002. This is used when assessing the presence of modulation only.

L_{APeak}
This is the greatest absolute instantaneous sound pressure in decibels using the A frequency weighting as specified in IEC 61672-1:2002.

L_{Amax}
An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}
An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}
An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise
An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road
Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road

Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type}\ A_{100} + \%\ \text{Type}\ A_{450}) + \frac{1}{20}(\%\ \text{Type}\ B_{100} + \%\ \text{Type}\ B_{450})$$

where:

% Type A_{100} = the percentage of industrial land within a100m radius of the premises receiving the noise

%TypeA_{450} = the percentage of industrial land within a 450m radius of the premises receiving the noise

% Type B_{100} = the percentage of commercial land within a100m radius of the premises receiving the noise

%TypeB_{450} = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period

Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

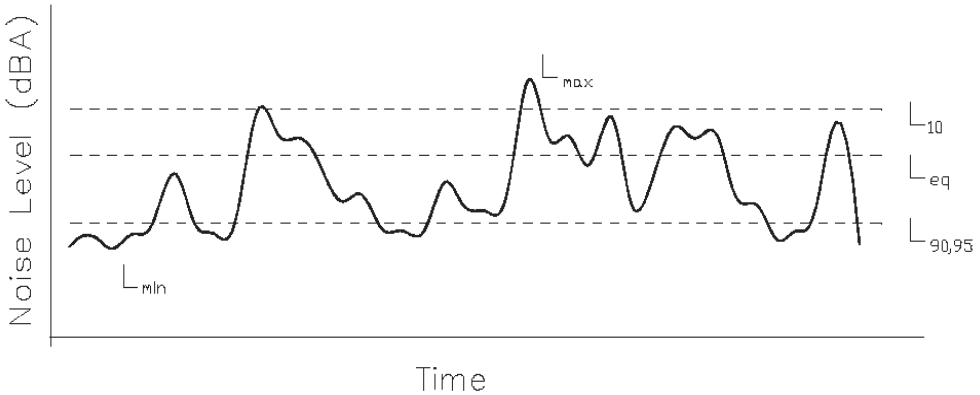
Background Noise

Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

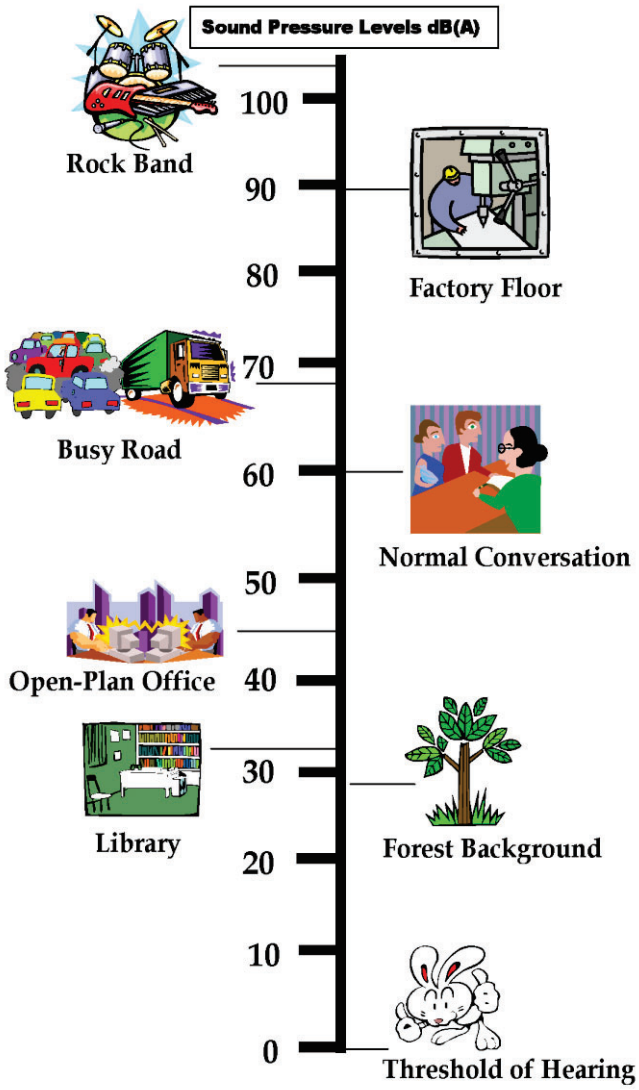
Ambient Noise

Means the level of noise from all sources, including background noise from near and far and the source of interest.

Chart of Noise Level Descriptors



Typical Noise Levels



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Environmental Noise Assessment

Sand Extraction Pit
Lots 300 & 301 Boomerang Road & Lot 6 Banksia Road, Oldbury

Reference: 9061279-01B.docx

Prepared for:
Hanson

Association of Australasian Acoustical Consultants

Report: 9061279-01B.docx

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Date:	Rev	Description	Prepared By	Verified
14/03/19	A	Issued as final	Daniel Lloyd	Terry George
21/02/20	B	Amended Phase 2 noise control strategy	Olivier Mallié	Daniel Lloyd

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Appendices

1 INTRODUCTION

Hanson Australia is proposing to develop a sand extraction pit on Lots 300 &301 Boomerang Road and Lot 6 Banksia Road, Oldbury, Western Australia. The location and outline of the project is shown in *Figures 1-1 and 1-2*.

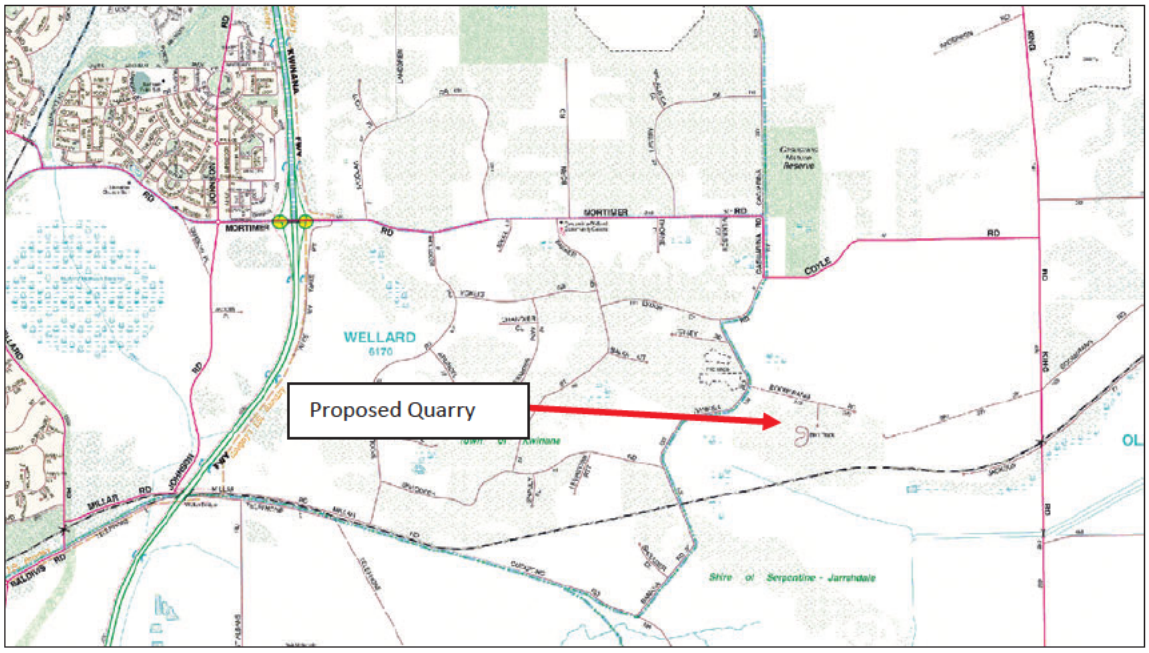


Figure 1-1 Project Locality

Figure 1-2 Quarry Extents

This assessment predicts the likely noise impacts from the quarry and compares the results against the *Environmental Protection (Noise) Regulations 1997*.

The quarry plant will consist of a mobile screen and front-end loader. Trucks will arrive on site via Boomerang Road and will be loaded with sand. It is expected that between two and four trucks per hour will access the quarry.

The quarry floor will be at an RL (ground level) of 18.0 metres and will start from the southeast corner of the site working towards the northwest corner. Three phases have been assessed. These being:

- Phase 1 - Quarry face in southeast corner;
- Phase 2 - Quarry face at middle of site; and
- Phase 3 - Quarry face at northwest of site (Final).

Appendix A contains a description of some of the terminology used throughout this report.

2 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

i. tonality;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

A "…noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard prescribed under regulation 7 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	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 (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial	All hours	60	75	80
Industrial	All hours	65	80	90

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

As there are no major or secondary roads, or commercial/industrial land uses adjacent to the noise sensitive premises surrounding the proposed quarry, the influencing factor has been calculated as 0 dB. Therefore the baseline assigned levels would be used in this assessment.

In addition, as there are no other industries in the immediate vicinity, the noise from the proposed quarry would not be considered to '*significantly contribute'* to the existing noise environment.

It must be noted the assigned noise levels above apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces. Given the close proximity of existing buildings and fences, the noise emissions were assessed at a point 1 metre away from building facades and a -2 dB adjustment was made to the predicted noise levels to account for reflected noise.

It is noted the assigned noise levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as *a period of time of not less than 15 minutes, and not exceeding 4 hours*, which is determined by an *inspector* or *authorised person* to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission. An *inspector* or *authorised person* is a person appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Environment Regulation. Acoustic consultants or other environmental consultants are not appointed as an *inspector* or *authorised person*. Therefore, whilst this assessment is based on a 4 hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

Under regulation 3, nothing in the Regulations applies to the following noise emissions –

(a) noise emissions from the propulsion and braking systems of motor vehicles operating on a road;

(b) noise emissions from a safety warning device, other than a reversing alarm, fitted to a motor vehicle operating on a road;

if every reasonable and practicable measure has been taken to reduce the effect of the noise emission consistent with providing an audible warning to people;

(c) noise emissions from –

(i) a reversing alarm fitted to a motor vehicle, mobile plant, or mining or earthmoving equipment; or

(ii) a startup or movement alarm fitted to plant,

if

(iii) it is a requirement under another written law that such an alarm be fitted; and

(iv) it is not practicable to fit an alarm that complies with the written law under which it is required to be fitted and emits noise that complies with these Regulations;

3 METHODOLOGY

Computer modelling has been used to predict noise levels at each nearby receiver. The advantage of modelling is that it is not affected by background noise sources and can provide the noise level for various weather conditions and operating scenarios if necessary.

The software used was *SoundPLAN 8.1* with the CONCAWE algorithms selected. These algorithms have been selected as they include the influence of wind and atmospheric stability. Input data required in the model are:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

3.1 Meteorological Information

Meteorological information utilised is provided in *Table 3-1* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 3-1 Modelling Meteorological Conditions

Parameter	Night (1900-0700)	Day (0700-1900)
Temperature (°C)	15	20
Humidity (%)	50	50
Wind Speed (m/s)	3	4
Wind Direction*	All	All
Pasquil Stability Factor	F	E

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

It is generally considered that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

3.2 Topographical Data

Topographical data was based on that provided by Rocla Quarry Products, which is from the Department of Land Information (DLI). The contours are in 1-metre intervals and cover the noise sensitive premises of concern.

3.3 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). In this instance, as it is a rural location, a value of 1.0 has been used as an average across the study area.

3.4 Source Sound Levels

The sound power levels used in the modelling are provided in *Table 3-2*.

Table 3-2 Source Sound Power Levels

Description	Frequency (Hz)								Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	
Komatsu WA600 FEL	74	86	97	101	105	105	101	95	**110**
Mobile Screen	110	69	76	79	86	95	97	94	**106**
	110	82	85	80	91	97	96	92	
	110	80	77	84	92	99	96	91	
Truck Moving on site	106	93	90	93	92	96	94	84	**106**
	108	89	92	90	90	94	96	91	
	105	94	91	92	93	95	95	87	

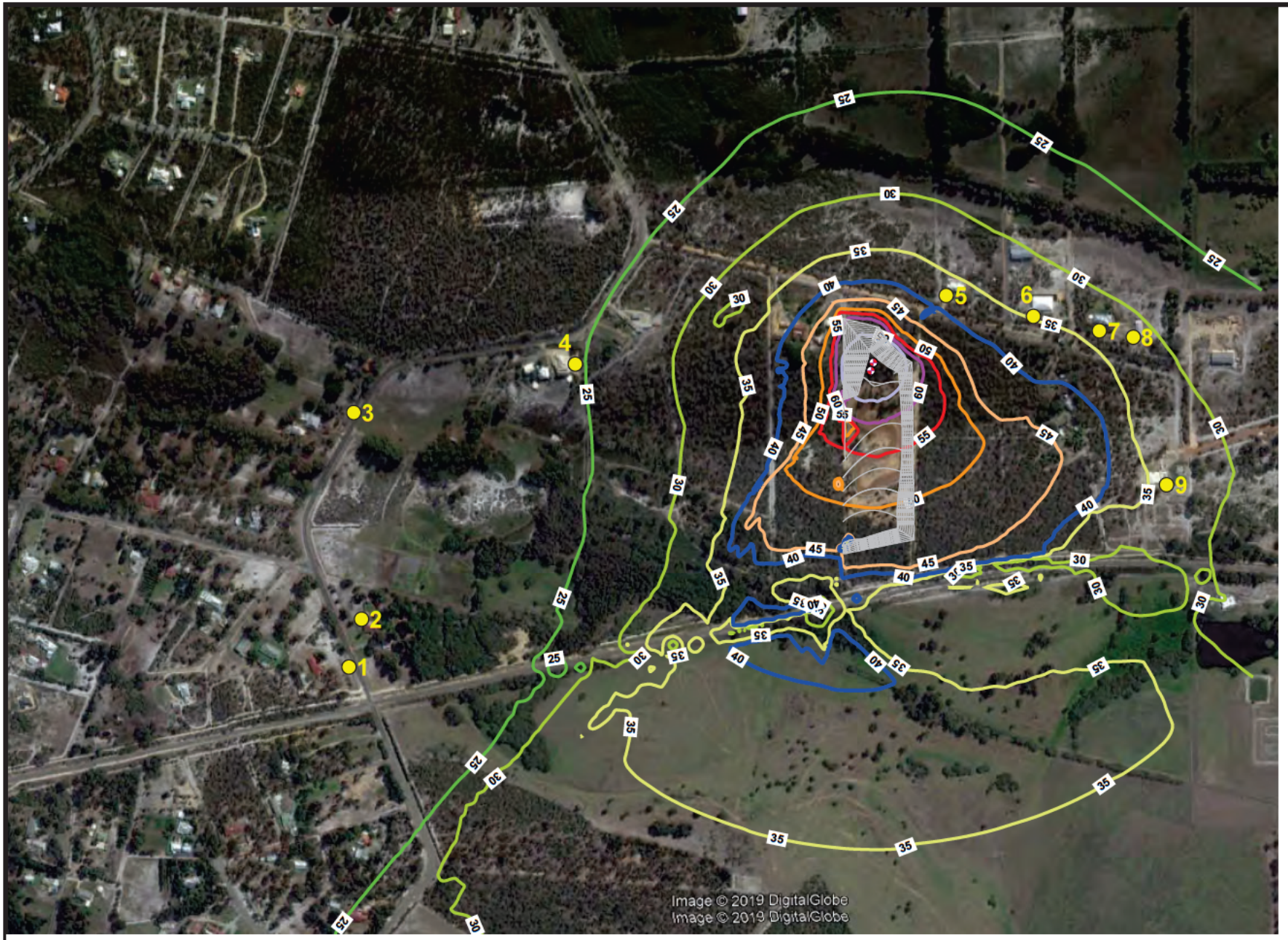
With regards to the above, please note the following:

- Source of data was from measurements undertaken at a similar sized quarry operation;
- The front-end loader and screen will be operating for more than 10% of the time and represents the L_{A10} noise level. The truck movements will be present for less than 10% of the time and represents the L_{A1} noise level; and
- Location of screen and loader is at the quarry face as shown in the noise contour maps.

4 RESULTS

The results of the noise modelling for each of the three extraction phases are presented in *Figures 4-1 to 4-3* and for the truck movements in *Figure 4-4*.

Figure 4-1



Hanson Australia - Proposed Quarry at Lots 300 & 301 Boomerang Rd and Lot 6 Banksia Rd, Oldbury
Predicted L_{A10} Noise Levels from Phase 1 Quarry Operations
Wind from All Directions

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Figure 4-2

Hanson Australia - Proposed Quarry at Lots 300 & 301 Boomerang Rd and Lot 6 Banksia Rd, Oldbury
Predicted L_{A10} Noise Levels from Phase 2 Quarry Operations
Wind from All Directions

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Figure 4-3

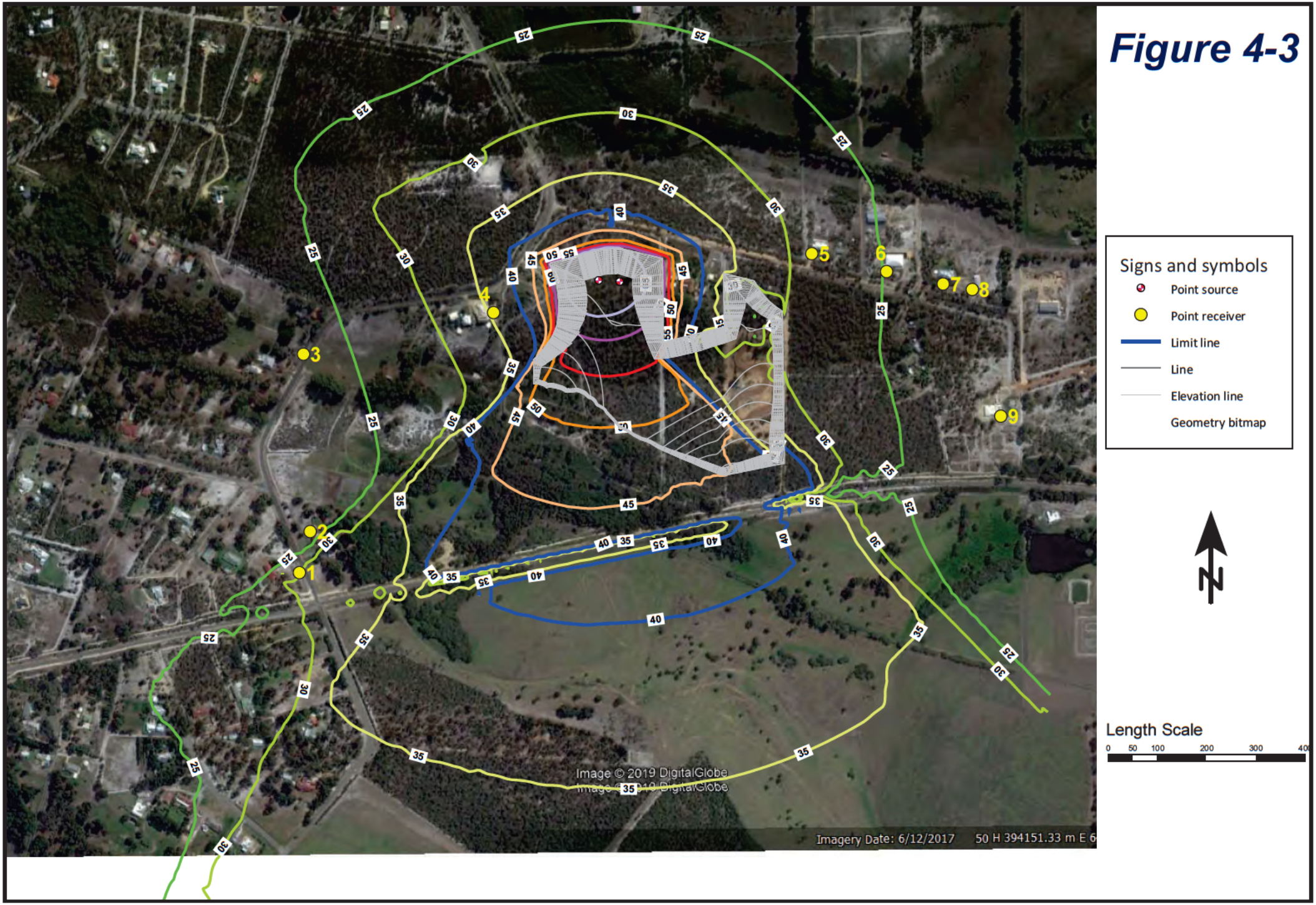
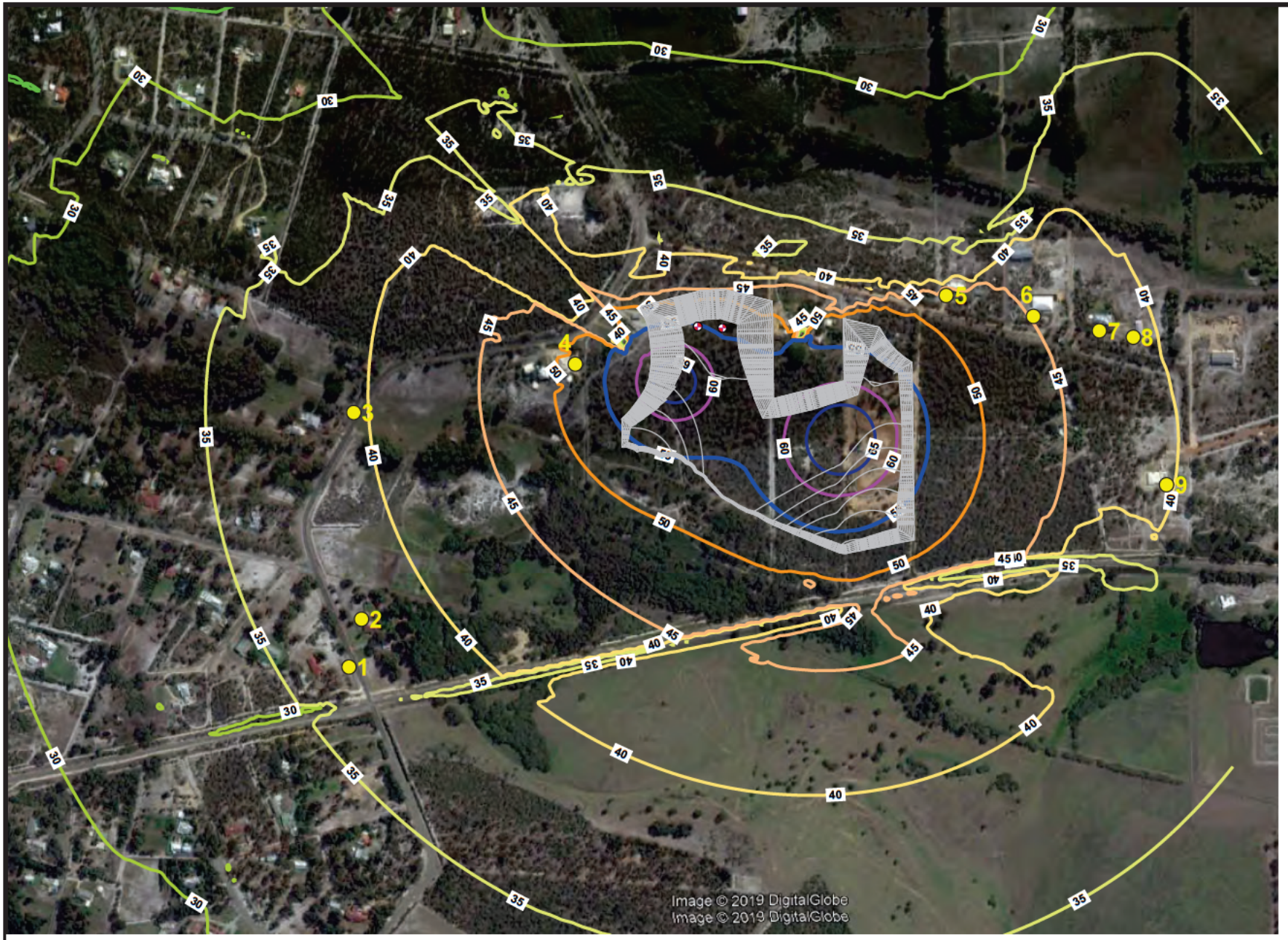

Signs and symbols
Point source
Point receiver
Limit line
Line
Elevation line
Geometry bitmap
Length Scale
0 50 100 200 300
Image © 2019 DigitalGlobe
Imagery Date: 6/12/2017

Figure 4-4



Hanson Australia - Proposed Quarry at Lots 300 & 301 Boomerang Rd and Lot 6 Banksia Rd, Oldbury
Predicted L_{A1} Noise Levels from Truck Movements
Wind from All Directions

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5 ASSESSMENT

There were no noise sources that are considered to be modulating or impulsive, however tonality is likely to be present. As it is considered that the tonality cannot be practicably removed, the predicted L_{A10} noise levels in *Figures 4-1 to 4-3* have been adjusted by +5 dB in accordance with *Table 2-1*.

During the initial phase of the operations (Phase 1), the operations are close to the eastern face of the pit to provide sufficient a barrier effect to ensure compliance with the Regulations during the operating times of 7.00 a.m. to 7.00 p.m. Monday to Saturday.

As the plant moves west into Phase 2, this barrier effect is diminished and therefore compliance is no longer achieved and assuming the quarry face runs straight across the site, the barrier effect from the quarry walls is insufficient to achieve compliance with the Regulations and an exceedance of up to 5 dB is likely during downwind conditions.

As the quarry moves into the final phases (Phase 3), the initial phases are likely to result in some (2 dB) exceedance of the Regulations however as the plant moves north, the barrier effect from the pit walls is enhanced and compliance is then achieved fairly quickly.

The L_{A1} noise levels, shown in *Figure 4-4*, are from the truck movements. This shows compliance with the assigned levels during the daytime period, when the truck is at the closest point to the nearest noise sensitive receiver. In reality, as the truck is moving, the noise will diminish quickly as the truck moves further away from the receiver.

6 RECOMMENDATIONS

To achieve compliance with the Regulations during the daytime period, a 5 dB reduction is required to the overall L_{A10} noise level when the project reaches Phase 2. To achieve this, the barrier effect of the quarry walls needs to be increased and this can be achieved by ensuring Phase 2 is developed so as to retain most of the Phase 1 western pit face, effectively creating a noise bund to the east of Phase 2. This is illustrated on *Figure 6-1* next page with the thick green line showing the section of the pit face to be retained.

Figure 6-1

Hanson Australia - Proposed Quarry at Lots 300 & 301 Boomerang Rd and Lot 6 Banksia Rd, Oldbury
Predicted L_{A10} Noise Levels from Phase 2 Quarry Operations with East Pit Face Retained
Wind from All Directions

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Appendix A

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)
Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}
This is the noise level in decibels, obtained using the A frequency weighting and the S (Slow) time weighting as specified in IEC 61672-1:2002. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}
This is the noise level in decibels, obtained using the A frequency weighting and the F (Fast) time weighting as specified in IEC 61672-1:2002. This is used when assessing the presence of modulation only.

L_{APeak}
This is the greatest absolute instantaneous sound pressure in decibels using the A frequency weighting as specified in IEC 61672-1:2002.

L_{Amax}
An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}
An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}
An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise
An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road
Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road
Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}) + \frac{1}{20}(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450})$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a 100m radius of the premises receiving the noise

$\%\ \text{Type A}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a 100m radius of the premises receiving the noise

$\%\ \text{Type B}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period
Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise
Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise
Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise
Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Peak Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

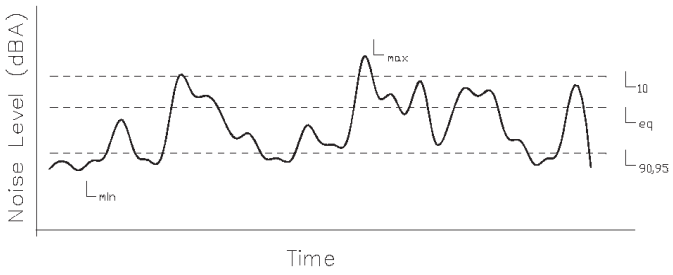
RMS Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Chart of Noise Level Descriptors



Typical Noise Levels