Appendix 3

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Environmental Noise Assessment

Proposed Clay Extraction Pit
Lot 7, Toy Road, Bindoon

Reference: 14052815-01C

Prepared for:
BGC Brikmakers

Report: 14052815-01C

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1 INTRODUCTION

A clay extraction pit is proposed on part of Lot 7 on Pan 7148, Toy Road, Bindoon, WA 6502. The general locality of the proposed pit together with the closest noise sensitive receivers is shown in *Figure 1-1*.

This report has been prepared to assess the likely noise impacts from the pit to sensitive receivers and compares the predicted noise levels against the *Environmental Protection (Noise) Regulations 1997*. *Appendix A* contains a description of some of the terminology used throughout this report.

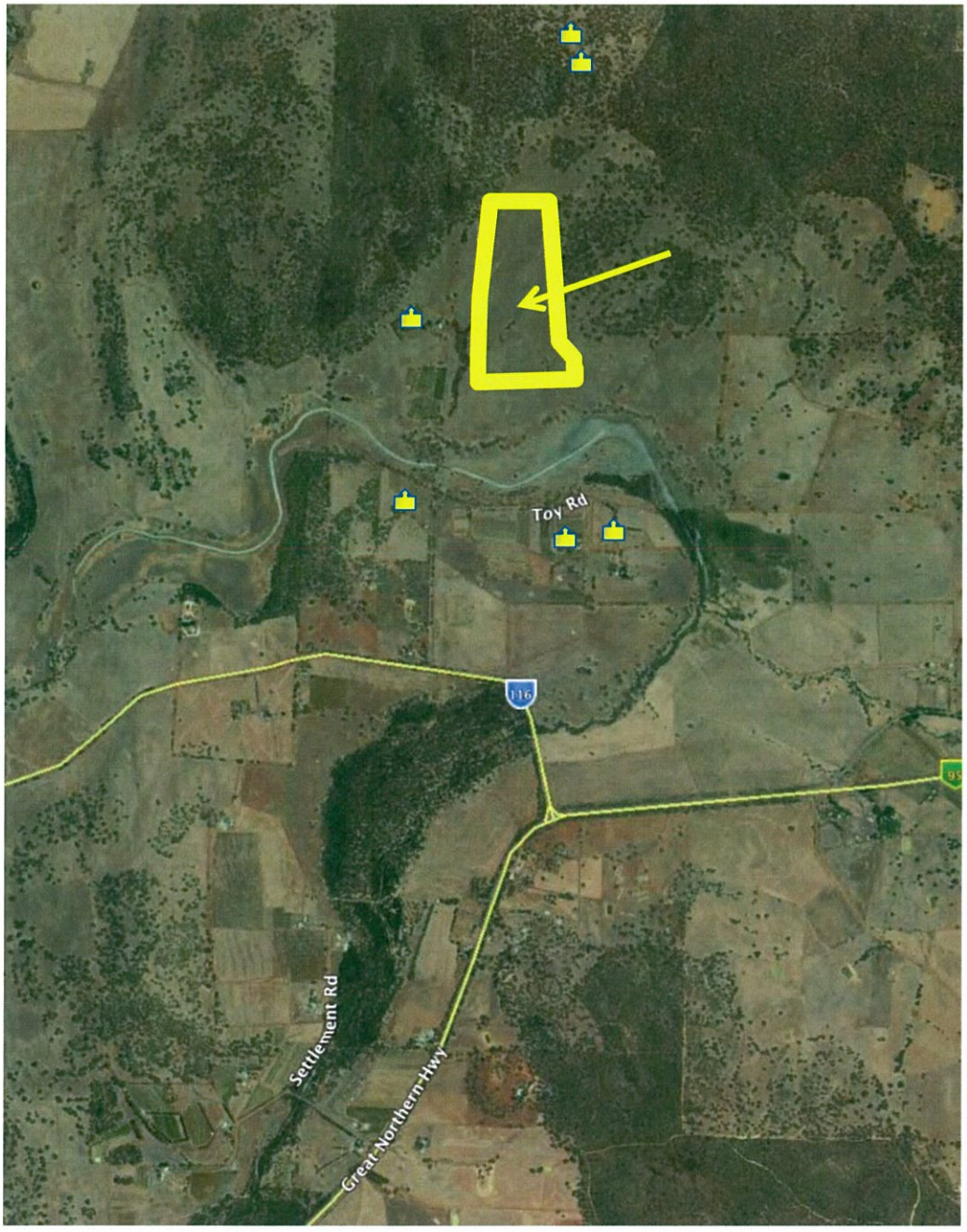


Figure 1-1 Project Locality and Sensitive Receivers

The excavation will be worked in two stages as shown in *Figure 1-2*. The pit will be managed to ensure that any machinery working on the pit floor will be working behind the pit face and perimeter bunding, where possible, will provide natural noise barriers to the nearest noise sensitive receivers. The pit face will be at least 3m high. Earth bunds will be placed at strategic locations around the site; that is along the west and south of the excavation area.

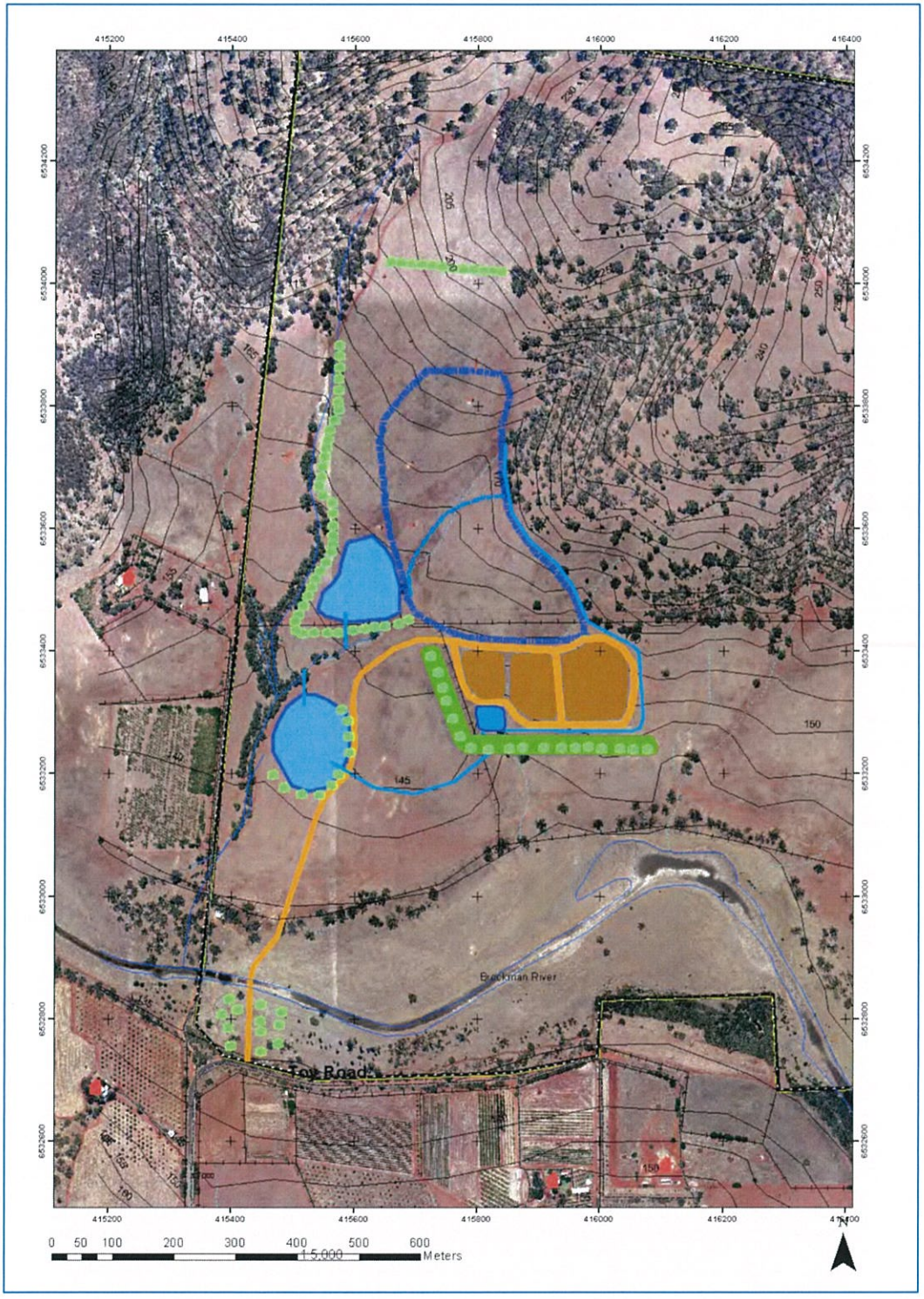


Figure 1-2 Pit Design and Stages

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".

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 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments for Intrusive Characteristics

Tonality	Modulation	Impulsiveness
+ 5dB	+ 5dB	+ 10dB

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

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

As it is proposed to only operate the pit between 7.00 am and 7.00 pm Mondays to Saturdays and therefore only the "Day" assigned levels apply. In addition, due to the nature of the works, in that there is no rock breaking or other impact sounds, it would be the L_{A10} level that would dictate compliance or otherwise with the criteria.

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 use	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

Due to the rural nature of the surrounding land, we have assumed the influencing factor at all sensitive premises to be 0 dB. Therefore it is the baseline assigned noise levels of *Table 2-2* that apply.

The noise from road trucks while on the access road to the pit would need to comply with the assigned levels, however, once they are on Toy Road, the Regulations would not apply to this noise source.

Construction noise associated with the development of the dams, pit access road, loading area and earth bunds are not required to comply with the assigned levels and are addressed through Regulation 13. It is assumed that these noise requirements will be detailed in the construction noise and vibration management plan that would be prepared for the proposal.

3 METHODOLOGY

Computer modelling has been used to predict the noise levels, under worst-case conditions, to each of the receiver locations. The software used was *SoundPLAN 7.3* with the CONCAWE algorithms 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 conditions utilised are shown in *Table 3-1* and reflect those specified in the *draft EPA Guidance for the Assessment of Environmental Factors No.8 Environmental Noise*. These conditions are considered the worst-case 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	Day (0700-1900)
Temperature (°C)	20
Humidity (%)	50
Wind Speed (m/s)	4
Wind Direction*	All
Pasquil Stability Factor	E

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

The EPA policy is 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

Digital topographical data was provided by BGC Brikmakers in 1-metre intervals. In addition, it is assumed that an earth bund is placed to the west of the pit areas, as shown in *Figures 4-2 and 4-3*. This bund height is assumed to be 5.0 m for Stage 1 of the operations and 7.5 m for Stage 2. It is also assumed that a 6.0 m high bund is placed on the west and south boundary of the loading area.

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, the surrounding ground has been assumed to be acoustically absorptive, which is representative of a rural location.

3.4 Sound Power Levels

The sound power data used for this assessment are shown below in *Table 3-2*. They are based on manufacturer's data, or if not available, measurements undertaken by Lloyd George Acoustics on similar equipment. In addition, the modelling assumes that the excavator will be located at natural ground level and the dozer and haul trucks on the pit floor, which is approximately 3 m below natural ground. In addition, the dozer, which is the dominant noise source, will be fitted with after-market noise suppression. From details provided by the engineering firm (Hush Pak) we would expect a reduction of 7 dB in overall noise levels from the dozer.

Table 3-2 Source Sound Power Levels

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	
Komatsu PC 450 Excavator	58	58	77	90	99	102	99	93	107
CAT 740 Haul Truck	62	72	101	99	99	102	100	93	108
Komatsu D375 Dozer (with hush kit)	59	81	85	88	100	99	96	92	104
Komatsu WA600 FEL	75	87	98	102	106	106	102	96	111
Truck moving at 25 km/h	67	77	86	94	95	94	92	86	100

Clay will be transported along the access road to Toy Road. It is assumed that there would be 16 truck movements in one hour. As the truck will be travelling at 25 km/h along the access road, the time that the truck will take to reach the stockpile area and return to Toy Road is approximately 140 seconds. Therefore, assuming 16 trucks, the noise from the trucks would be present for approximately 38 minutes in an hour. Therefore the L_{A10} level is relevant.

In determining the L_{A10} level from each truck movement, the noise level to the closest receiver was modelled assuming a truck travelling along the access road. The results of this modelling, together with the measured levels of a truck traveling at 25 km/h, is presented in *Figures 3-1 and 3-2*.

The predicted noise level from truck transportation was then incorporated into the overall noise level predictions. Based on the *Figure 3-2,* the overall L_{A10} noise level at the nearest sensitive receiver, assuming 16 trucks movements in one hour is calculated as L_{A10} 38.8 dB.

For the purposes of modelling, it has been assumed that all of the above equipment will be operating simultaneously. This, coinciding with worst-case wind conditions, is likely to be a rare occurrence and therefore the predictions are considered to be conservative.

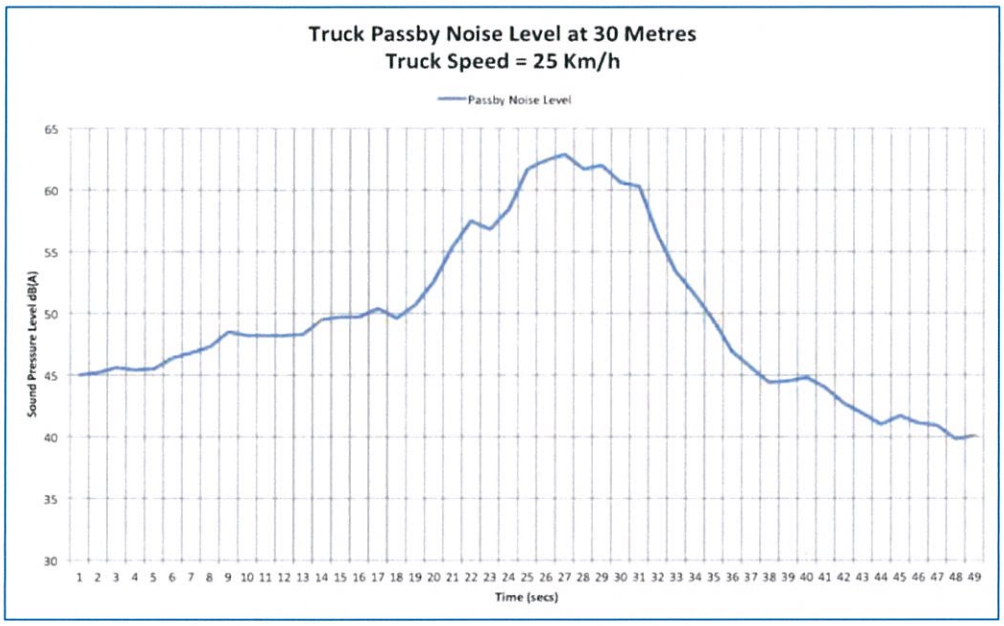


Figure 3-1 Truck Pass-by Measurement Used for The Calculations

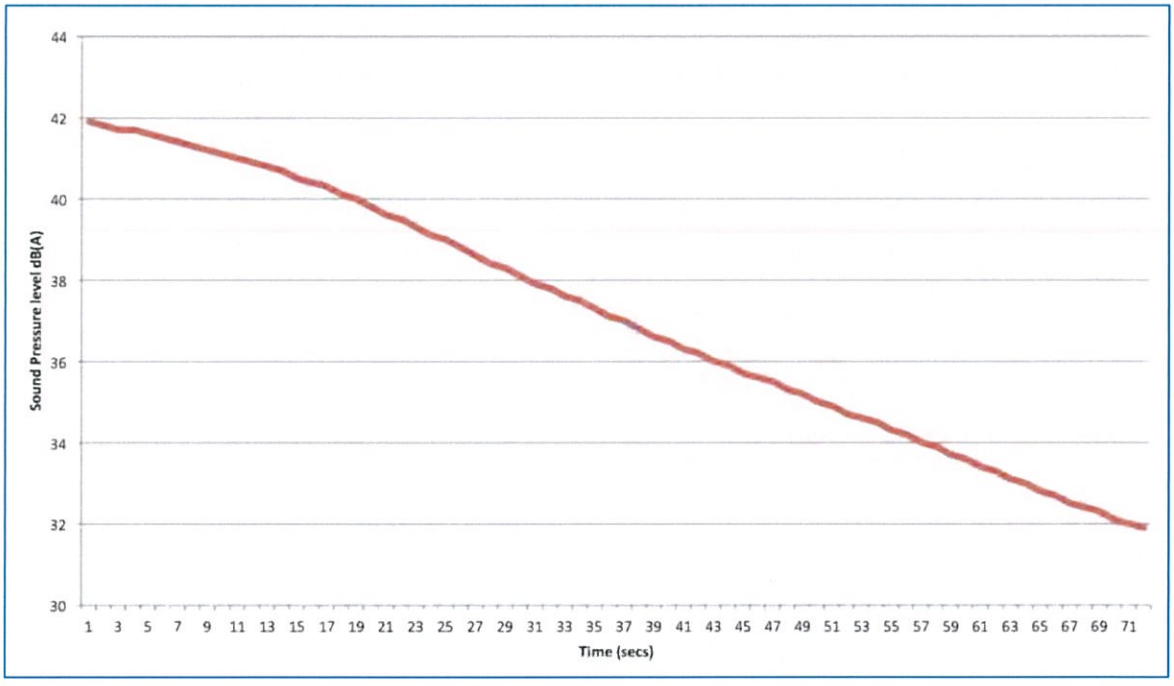


Figure 3-2 Predicted Noise Level at Closest Receiver from Single Truck Traveling Along Access Road

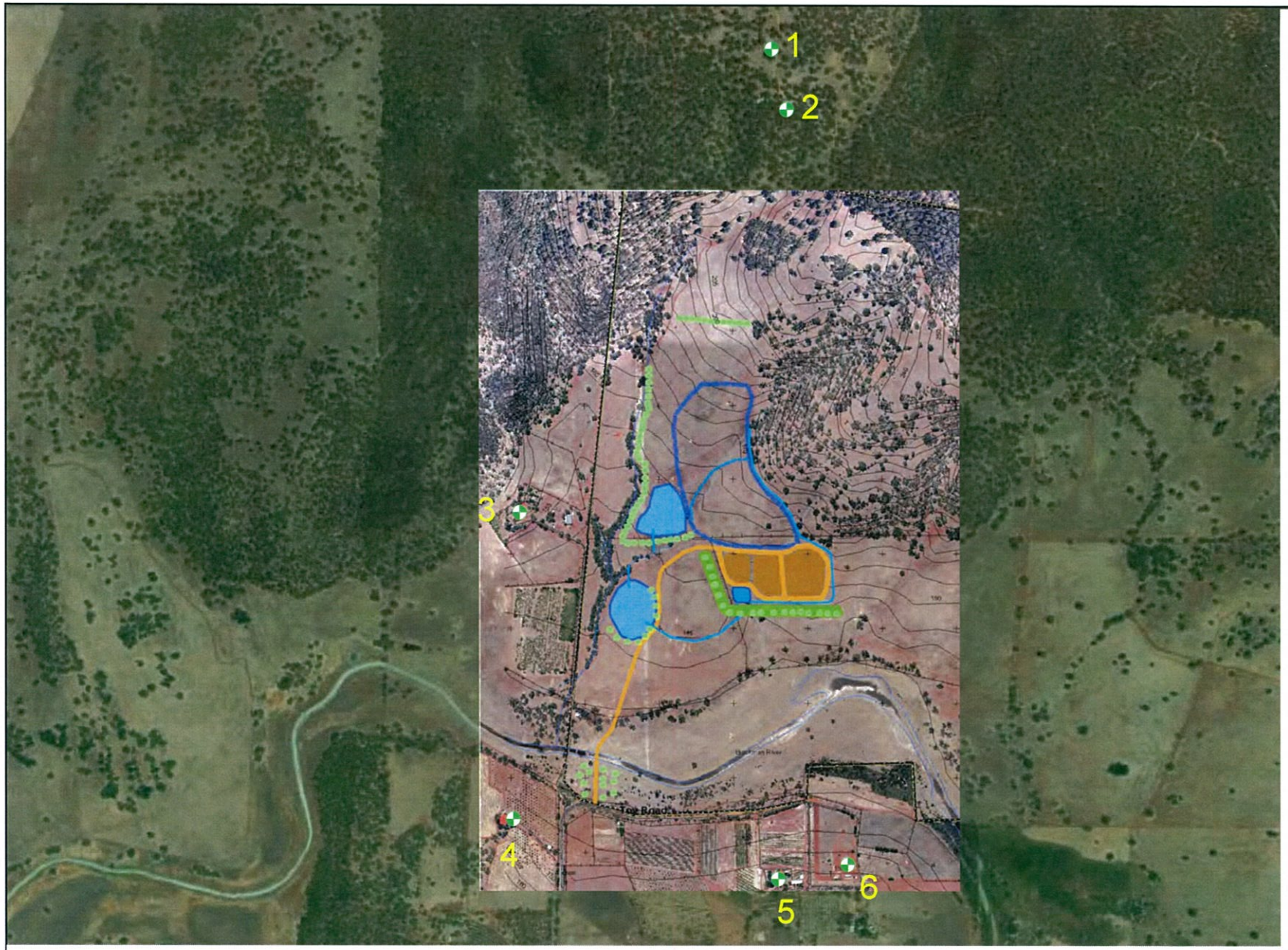
4 RESULTS

The predicted L_{A10} noise level to Receivers 1 to 6, as shown in *Figure 4-1*, for the pit development stages is provided below in *Table 4-1*. The predicted noise levels are also shown as contour lines in *Figures 4-2* and *4-3*.

Table 4-1 Predicted Noise Levels from Pit Operations

Location	Predicted Noise Level (L_{A10} dB) for each Stage		Comments
	1	2	
1	31	32	Complies with daytime assigned levels.
2	35	37	Complies with daytime assigned levels
3	44	44	Complies with daytime assigned levels
4	40	40	Complies with daytime assigned levels.
5	39	39	Complies with daytime assigned levels.
6	39	39	Complies with a daytime ssigned levels.

Figure 4-1



Signs and symbols

Sensitive receiver

N

Length Scale

0 50 100 200 300 400 500 m

Clay Extraction Pit - Lot 7 Toy Road, Bindoon
Location of Noise Sensitive Receivers

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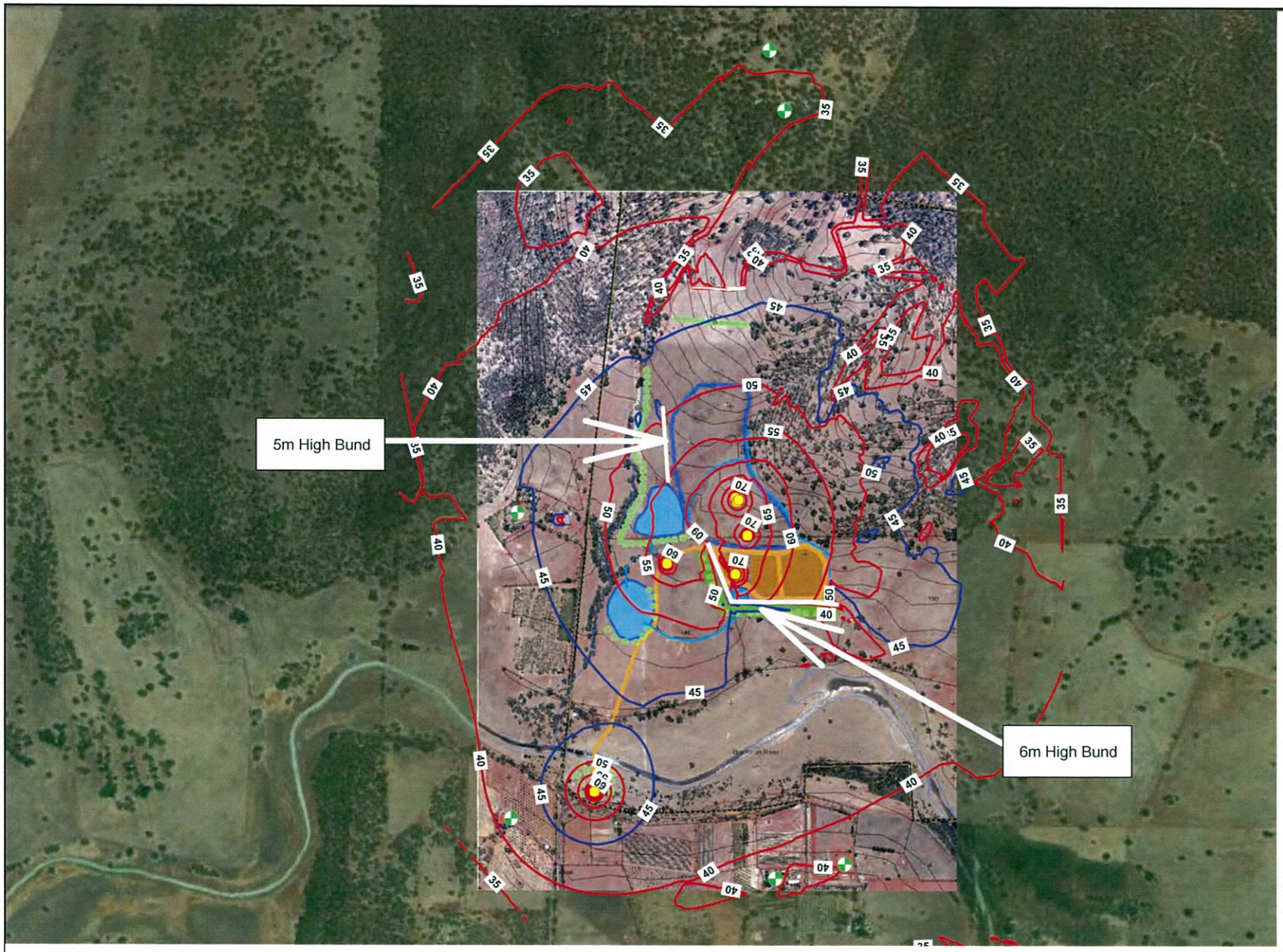
Figure 4-2



Signs and symbols

- Point source
- Sensitive receiver
- Compliance line
- Earth Bund

N

Length Scale

0 50 100 200 300 400 500 m

Clay Extraction Pit - Lot 7 Toy Road, Bindoon - Stage 1
Predicted L_{A10} Noise Levels - Assumes All Mobile Plant Operating and Wind from all Directions

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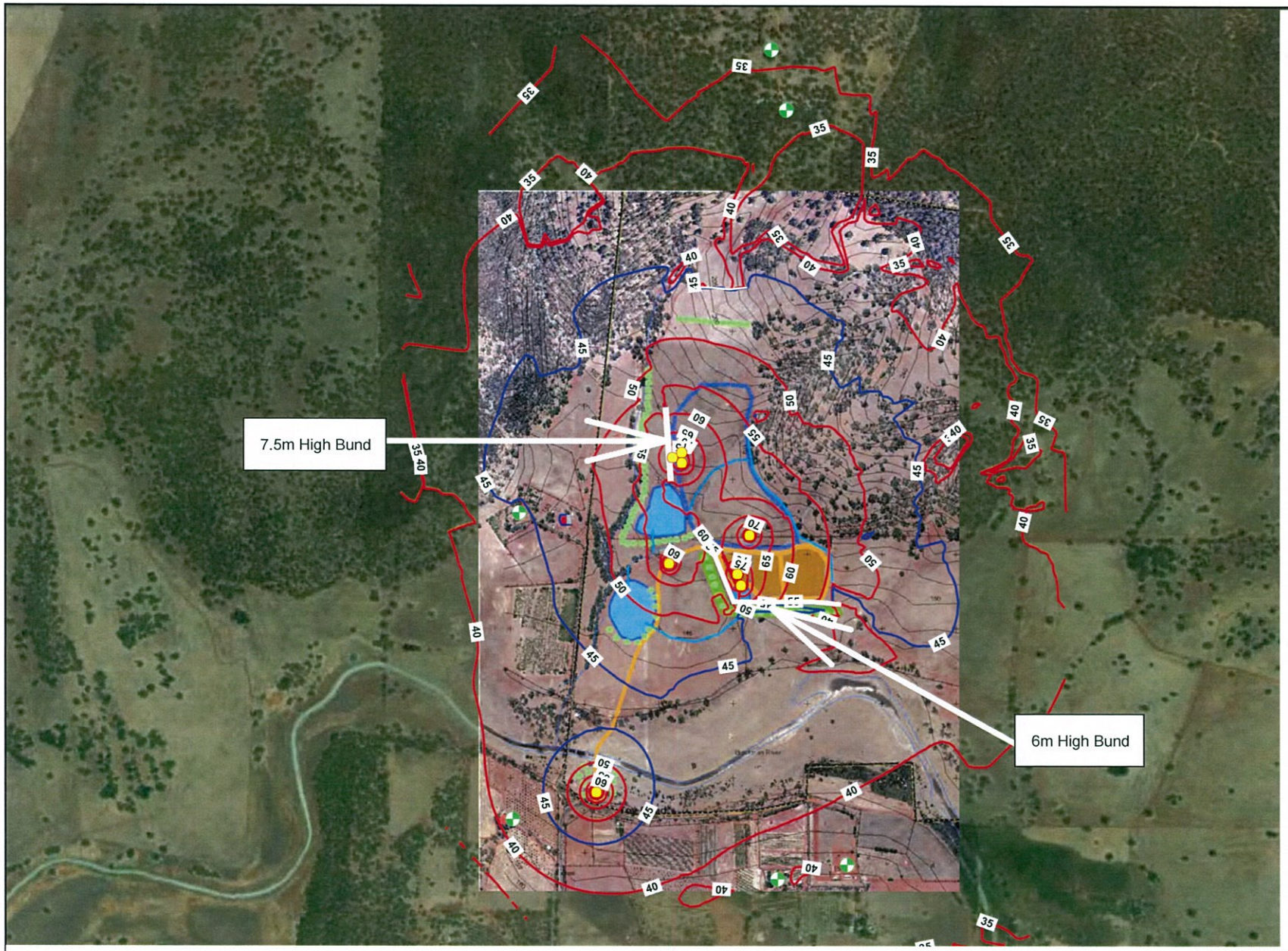
Figure 4-3



Clay Extraction Pit - Lot 7 Toy Road, Bindoon - Stage 2
Predicted L_{A10} Noise Levels - Assumes All Mobile Plant Operating and Wind from all Directions

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5 DISCUSSION

The results show that the proposed operations would comply with the Regulations at all noise sensitive receivers during the times 0700 to 1900 Monday to Saturday.

This assessment assumes that the following noise mitigation measures are in place:

- Noise suppression kit fitted to the dozer;
- 6.0 m high earth bund on the west and south boundaries of the loading area;
- Earth bund constructed north of the dam (as shown in *Figures 4-2 and 4-3*). The height of the earth bund would is assumed to be 5.0 m for Stage 1 and 7.5 m for Stage 2 of the operations;
- Trucks are to travel at low speed (25 km/h) while on the access road.

The most affected sensitive receiver is Receiver 3, located to the west of the pit. At this location the predicted noise level, assuming Stage 2, is L_{A10} 44 dB, which is compliant with the Regulations provided that there are no penalties for tonality. While earthmoving plant is inherently tonal in nature, the predictions show that there are a number of items of plant that are predicted to be at approximately the same noise level. This is shown in *Table 5-1*. In these circumstances, assuming all items of plant are operational, tonality is unlikely to be present. If an individual item is operating, which is likely to be tonal, it can be seen that even with a penalty of +5 dB, the noise from each individual item of plant is below L_{A10} 40 dB, so compliance would still be achieved.

Table 5-1 Noise Source Contribution at Most Affected Premises

Noise Source	Predicted Noise Level dB(A)
Excavator	40
Dump Truck 1	39
Dump Truck 2	36
Loader	34
Dozer	32

To ensure continuing compliance with the Regulations, the pit will need to be managed to ensure the pit face is running north-south. This provides maximum shielding of the sensitive receiver to west, from the plant on the pit floor.

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 time weighting as specified in AS1259.1-1990. 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 time weighting as specified in AS1259.1-1990. This is used when assessing the presence of modulation only.

L_{APeak}
This is the maximum reading in decibels using the A frequency weighting and P time weighting AS1259.1-1990.

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

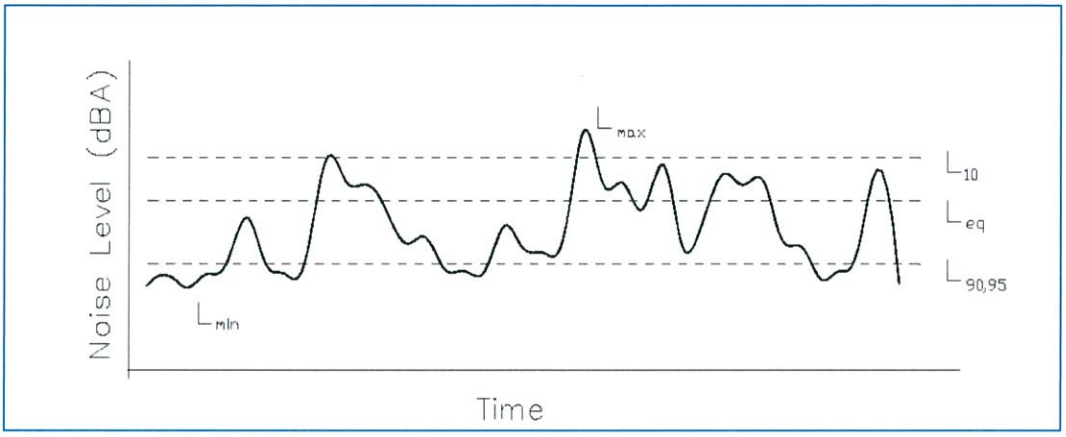
Representative Assessment Period
Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

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.

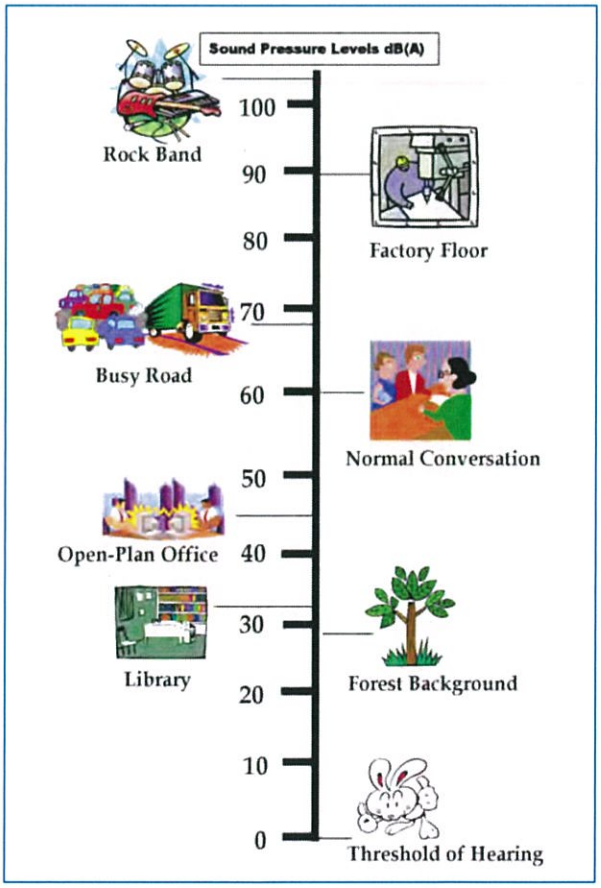
Ambient Noise
Means the level of noise from all sources, including background noise from near and far and the source of interest.

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.

Chart of Noise Level Descriptors



Typical Noise Levels



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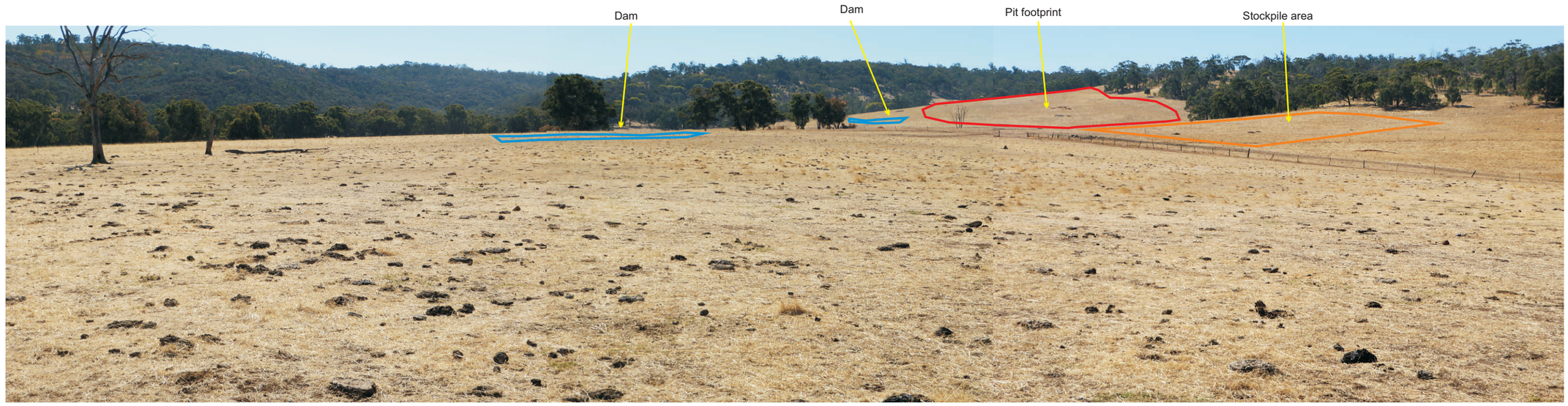
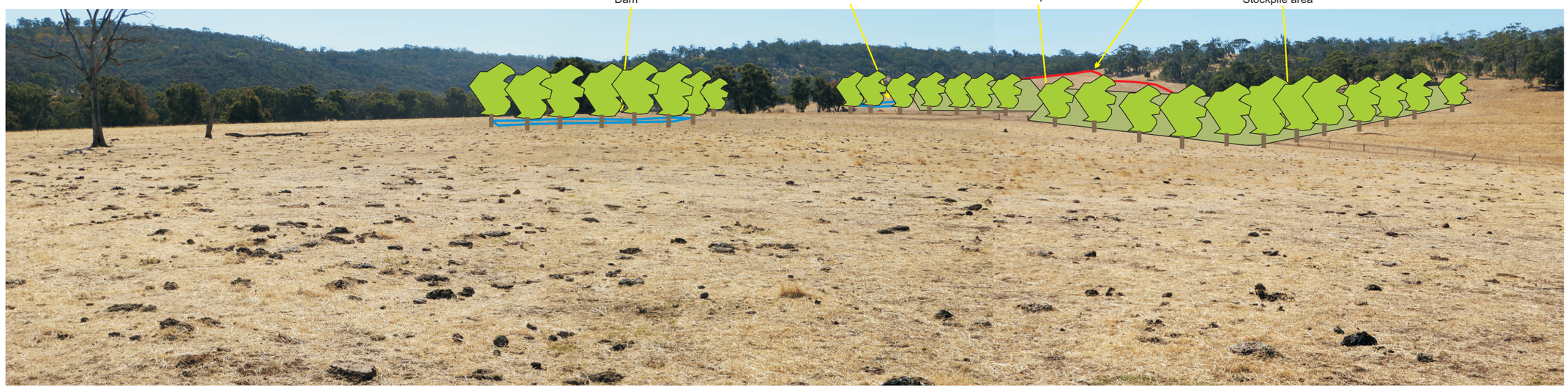


Proposed activities, taken with a telephoto lens from the south, near the yards

Top to be excavated at the start of each stage
and rehabilitated to minimise the length of time
of visual exposure.



Proposed activities, taken with a telephoto lens from the south from the south near the yards, with proposed bunding and tree belts placed on the photo at appropriate scale.

Proposed tree planting

Proposed bunding 5 - 8 metres high. covered by pasture/trees

Location of proposed dam. Note the actual water will not be visible from this distance

Proposed excavation area

View from Point F
See Figure 3S

BRIKMAKERS

VISUAL MANAGEMENT

PROPOSED CLAY EXCAVATION LOT 7. TOY ROAD, BINDOON	
PHOTOGRAPHS OF SITE	
Landform Research	January 2015
Scale See Plan	
	Figure 1S