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ENVIRONMENTAL NOISE IMPACT

DOUGLAS NORTH SUBSTATION

AT DOUGLAS PARK, NSW

REPORT NUMBER: **3629 REV A**

PREPARED FOR: BHP Billiton Illawarra Coal
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Report Status	**Prepared by:** Matthew Fishburn	**Approved by:** Stephen Gauld
Final		

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TABLE OF CONTENTS

1.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Olsen Environmental Consulting on behalf of BHP Billiton Illawarra Coal to investigate the environmental noise impact of their proposed Douglas North Substation located north of Douglas Park. This commission involves the following:

Scope of Work:

- Inspect the site and environs.
- Measure the background noise levels at critical locations and times.
- Establish the acceptable noise level criteria.
- Quantify noise emissions from the proposed Substation.
- Calculate the level of noise emission, taking into account ground absorption and distance attenuation.
- Prepare a site plan identifying the development and nearby noise sensitive locations.
- Provide reasonable and feasible recommendations for noise control (if necessary).
- Prepare an Environmental Noise Impact Report.

2.0 PROJECT DESCRIPTION & SUMMARY OF FINDINGS

Integral Energy supplies electricity to the majority of Sydney and surrounding suburbs. To sustain this service they have a number of Substations to convert high voltage electricity to a lower voltage supply. The transformers used for the conversion typically generate a low frequency 'hum' at 100 Hz.

A new substation is proposed along Morton Park Road in Douglas Park to be connected to the main Integral Energy power line. The proposed site is currently being used for rural purposes. One 66 / 11 kV transformer is proposed for the substation initially with a second identical transformer to be added in the future.

The new 66 / 11 kV substation will be constructed to enable power to be provided to BHP Billiton Illawarra Coal's underground mining operations in the surrounding area. Power from the nearby Douglas Park Switching Station will be directed to the proposed new substation along an existing 33 kV transmission line which is to be upgraded to 66 kV. The substation will convert 66 kV to 11 kV prior to it being transferred to the underground workings via cables located in a borehole approximately 200 metres south east of the substation.

The closest residences to the proposed substation are approximately 170 m south west of the site and approximately 270 m north east of the site along Morton Park Road, Douglas Park. The ambient noise at the nearest residences is dominated by traffic noise from the nearby Hume Highway during the day, evening and at night.

The predicted level of noise from the operation of the proposed Douglas North Substation is below the guidelines in the Environment Protection Authority's Industrial Noise Policy and considered acceptable at all existing nearby residences.

3.0 NOISE SURVEY INSTRUMENTATION

Noise level measurements and analysis were made with sound instrumentation as follows:

Table 3.1 Noise Instrumentation

Description	Model No.	Serial No.
Modular Precision Sound Analyser	B&K 2260	244 3406
Condenser Microphone 0.5” diameter	B&K 4189	244 0653
Acoustical Calibrator	B&K 4231	243 9033
Microphone Windscreen	Acoustically transparent foam	
Infobyte Noise Logger	iM3	39
Condenser Microphone 0.5” diameter	MK 250	3357
Microphone Windscreen	Acoustically transparent foam	

The **B&K 2260 Sound Analyser** is a real-time precision integrating sound level meter with octave and third octave filters, that samples noise at a rate of 10 samples per second. The B&K 2260 provides L_{eq}, L_1, L_{10}, L_{50} and L_{90} statistical data at 15 minute intervals (longer or shorter intervals optional) over the desired monitoring period. Results are normally downloaded to computer for rapid processing.

All instrument systems had been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 0.3 dB during attended measurements and within 1 dB for long-term measurements. No adjustments for instrument drift during the measurement period were warranted.

4.0 MEASURED AMBIENT NOISE LEVELS

In order to assess the severity of a possible environmental noise problem in a residential area it is necessary to measure the ambient background noise level at the times and locations of worst possible annoyance. The lower the background noise level, the more perceptible the intrusive noise becomes and the more potentially annoying.

The ambient L_{90} background noise level is a statistical measure of the sound pressure level that is exceeded for 90% of the measuring period (typically 15 minutes).

The Rating Background Level (RBL) is defined by the Department of Environment and Conservation as the median value of the (lower) tenth percentile of L_{90} ambient background noise levels for day, evening or night periods, measured over 7 days during the proposed days and times of operation (EPA, 2000).

The places of worst possible annoyance are residents along Morton Park Road, Douglas Park. These residences are shown on the attached Site Plan 3629 Figure 1. The times of worst possible annoyance will be from 1 am to 5 am when ambient noise levels are typically at their lowest.

Ambient L_{eq} and L_{90} background noise levels were measured at 120 Prices Road, Douglas Park (Location "A" shown on the attached Site Plan) over seven (7) days from Tuesday 3rd October, 2006 to Tuesday, 10th October, 2006. The nearest and most affected residences to the proposed substation along Morton Park Road and the ambient noise monitoring location are approximately equidistant from the dominant background noise source, the Hume Highway. The ambient noise levels are presented in the attached Figure 2 and also in Table 4.1 below.

Table 4.1 Existing Ambient Noise Levels

Noise Measurement Location	Time Period	Existing L_{eq} Noise Level	Rating Background Level
Location 'A' – 120 Prices Road, Douglas Park	Day (7am to 6 pm) Evening (6 pm to 10 pm) Night (10 pm to 7 am)	**59 dBA** **62 dBA** **59 dBA**	**51 dBA** **53 dBA** **39 dBA**

Meteorological conditions during the testing typically consisted of temperatures of 5 to 27 ^{o}C. Atmospheric conditions were ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor area.

5.0 ACCEPTABLE NOISE LEVELS

5.1 NSW Industrial Noise Policy

The Environment Protection Authority published their NSW Industrial Noise Policy (EPA, 2000) in January 2000. The Environment Protection Authority has since been amalgamated with a number of other State Government departments into the Department of Environment and Conservation (DEC). The Industrial Noise Policy is specifically aimed at assessing noise from industrial noise sources scheduled under the Protection of the Environment Operations Act 1997 (POEO, 1997).

The appropriate regulatory authority (DEC) may, by notice in writing given to such a person, prohibit the person from causing, permitting or allowing:

(a) any specified activity to be carried on at the premises, or
(b) any specified article to be used or operated at the premises,

or both, in such a manner as to cause the emission from the premises, at all times or on specified days, or between specified times on all days or on specified days, of noise that, when measured at any specified point (whether within or outside the premises,) is in excess of a specified level.

It is an offence to contravene a noise control notice. Prior to being issued with a noise control notice, no offence has been committed.

The Industrial Noise Policy provides a useful framework to assess noise emission from non-scheduled premises, whether that premises produces offensive or non-offensive noise.

The Protection of the Environment Operations Act 1997 defines “Offensive Noise” as noise:

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

  (i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

  (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulation.

The NSW Industrial Noise Policy will be used in this report in determining whether the level of noise is considered offensive or not.

5.2 Residential Receptor Noise Intrusiveness Criteria

The DEC states in Section 2.1 of its NSW Industrial Noise Policy (January 2000) that the L_{eq} level of noise intrusion from broad-band industrial noise sources may be up to 5 dBA above the L_{90} background noise level at the receptor without being considered offensive (EPA, 2000, Section 2.1).

The Rating Background Level in the area surrounding the proposed Douglas North Substation was 51 dBA during the daytime, 53 dBA in the evening and 39 dBA at night. Therefore the acceptable L_{eq} noise intrusiveness criteria for **broadband noise** in this area is;

- (51 + 5 =) 56 dBA during the day,
- (53 + 5 =) 58 dBA in the evening and
- (39 + 5 =) 44 dBA at night.

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Correction factors may be applied to the noise intrusiveness criteria to determine the project specific criteria.

The tonality and low frequency modifying factors are potentially applicable to the assessment and are presented in the attached Datasheet AC 500-9.

The Rating Background Level in the area surrounding the proposed Douglas North Substation was 51 dBA during the daytime, 53 dBA in the evening and 39 dBA at night. Therefore the acceptable L_{eq} noise intrusiveness criteria for **tonal and/or low frequency noise** in this area is;

- (51 + 5 – 5 =) 51 dBA during the day,
- (53 + 5 – 5 =) 53 dBA in the evening and
- (39 + 5 – 5 =) 39 dBA at night.

5.3 Residential Noise Amenity Criterion

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. Table 2.1 of the NSW Industrial Noise Policy provides a schedule of recommended L_{eq} industrial noise levels that under normal circumstances should not be exceeded. If successive developments occur near a residential area, each one allowing a criterion of background noise level plus 5 dBA, the ambient noise level will gradually creep higher.

Compliance with the Noise Amenity levels in Table 2.1 will limit ambient noise creep. For example in a rural residential area, the L_{eq} noise emission level may not exceed 50 to 55 dBA in the daytime (7 am to 6 pm), 45 to 50 dBA in the evening (6 pm to 10 pm) and 40 to 45 dBA during the night (10 pm to 7 am).

Wherever the existing L_{eq} noise level from industrial noise sources approaches or exceeds the Amenity criterion at a critical receptor location, the intrusive L_{eq} noise from the noise source in

question must be reduced to a level that may be as much as 10 dBA below the existing L_{eq} industrial noise level.

Similarly when the noise environment at a receptor location is dominated by traffic noise the amenity criterion for noise from the industry becomes $L_{eq,period(traffic)}$ minus 10 dB. In this case the noise environment surrounding the proposed substation is dominated by traffic noise from the Hume Highway.

The existing ambient L_{eq} noise level was measured to be 59 dBA during the day, 62 dBA during the evening and 59 dBA at night (From Table 4.1 above). Therefore applying Table 2.1 in conjunction with Table 2.2 of the NSW Industrial Noise Policy the amenity criteria is:

- (59 – 10 =) 49 dBA during the day,
- (62 – 10 =) 52 dBA in the evening and
- (59 – 10 =) 49 dBA at night.

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Correction factors may be applied to the noise intrusiveness criteria to determine the project specific criteria.

The tonality and low frequency modifying factors are potentially applicable to the assessment and are presented in the attached Datasheet AC 500-9.

Therefore the acceptable L_{eq} noise amenity criteria for **tonal and/or low frequency noise** in this area is:

- (49 – 5 =) 44 dBA during the day,
- (52 – 5 =) 47 dBA in the evening and
- (49 – 5 =) 44 dBA at night.

5.4 Project Specific Noise Criteria

When all the above factors are considered, we find that the most stringent noise criteria are:

- **49 dBA for broadband noise sources,** and **44 dBA for tonal noise sources** during the day,
- **52 dBA for broadband noise sources,** and **47 dBA for tonal noise sources** in the evening,
- **44 dBA for broadband noise sources,** and **39 dBA for tonal noise sources** at night.

These criteria apply at the most-affected point on or within the residential property boundary – or, if that is more than 30 metres from the residence, at the most-affected point within 30 metres of the residence.

6.0 DOUGLAS NORTH 66 / 11 KV SUBSTATION NOISE EMISSION

The main source of noise from the proposed Douglas North 66 / 11 kV Substation is the transformer that will operate continually throughout the day and night. The noise level from the transformer does not change appreciably from the day to the night and therefore the calculated noise level at night will be the worst-case scenario.

6.1 Measured Sound Power Levels

Noise surveys have been carried out by Day Design at a number of Integral Energy Substations around Sydney to determine the level and character of high voltage transformers. Typical sound power data have been used for the proposed transformers and a schedule of the sound power levels is given in Table 6.1 below.

Table 6.1 L_{eq} Sound Power Levels

Description	Sound Power Levels (dB) at Third Octave Band Centre Frequencies (Hz)							
	dBA	50 63 80	100 125 160	200 250 315	400 500 630	800 1k 1.25k	1.6k 2k 2.5k	3.15k 4k 5k
No 1 Transformer, 66 / 11kV, 10 MVA (proposed)	**75***	82 73 82	83 74 69	75 64 73	71 63 62	67 65 60	62 62 55	57 55 54
Typical Cooling Fan	**70****	65	60	64	65	66	63	61

*Noise levels have been taken from a typical transformer.

**Cooling fan noise level data have been taken from a typical fan manufacturer's data.

6.2 Calculated Noise Levels at Receptor Locations

The calculated L_{eq} noise levels at the nearest and most affected receptor locations are calculated as shown below in Table 6.2. The assessment point at each property is 30 metres away from the residential building towards the proposed substation.

Table 6.2 Calculated L_{eq} Noise Levels at Receptor Location

Receptor Location	Acceptable Level	Calculated Level	Tonal	Compliance
Location 'B' 170 m South West of the site along Morton Park Road, Douglas Park	44 dBA	28 dBA	No	Yes
Location 'C' 270 m North East of the site along Morton Park Road, Douglas Park	44 dBA	24 dBA	No	Yes

At a distance of approximately 170 metres, the calculated sound pressure level at the nearest receptor location to the proposed Douglas North Substation will be 28 dBA which is less than the annoyance criterion of 44 dBA at night and therefore acceptable.

From these above predictions, we conclude that the proposed Douglas North 66 / 11 kV Substation at Douglas Park will not require any specific noise control measures to comply with the noise guidelines recommended in the NSW Industrial Noise Policy.

7.0 NOISE IMPACT STATEMENT

Based on past noise emission measurements of a typical 66 / 11 kV transformer, our computations show that the calculated noise from the proposed Douglas North 66 / 11 kV Substation will be within the guidelines in the NSW Industrial Noise Policy at the nearest residential premises.

We are of the opinion that sound emitted from this development will not cause "offensive noise" as defined by the Protection of the Environment Operations Act 1997.

Matthew Fishburn, BE(Mech) Hons, MAAS

Consulting Acoustical Engineer
for and on behalf of Day Design Pty Ltd.

A.A.A.C. MEMBERSHIP
Day Design Pty Ltd is a member company of the Association of Australian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

Attachments:

- Figure 1 – Location Plan
- Figure 2 – Ambient Noise Survey
- Figure 3 – Site Plan
- AC 108-1 to 4 – Glossary of Acoustic Terms
- AC 500-9 – Modifying Factor Correction

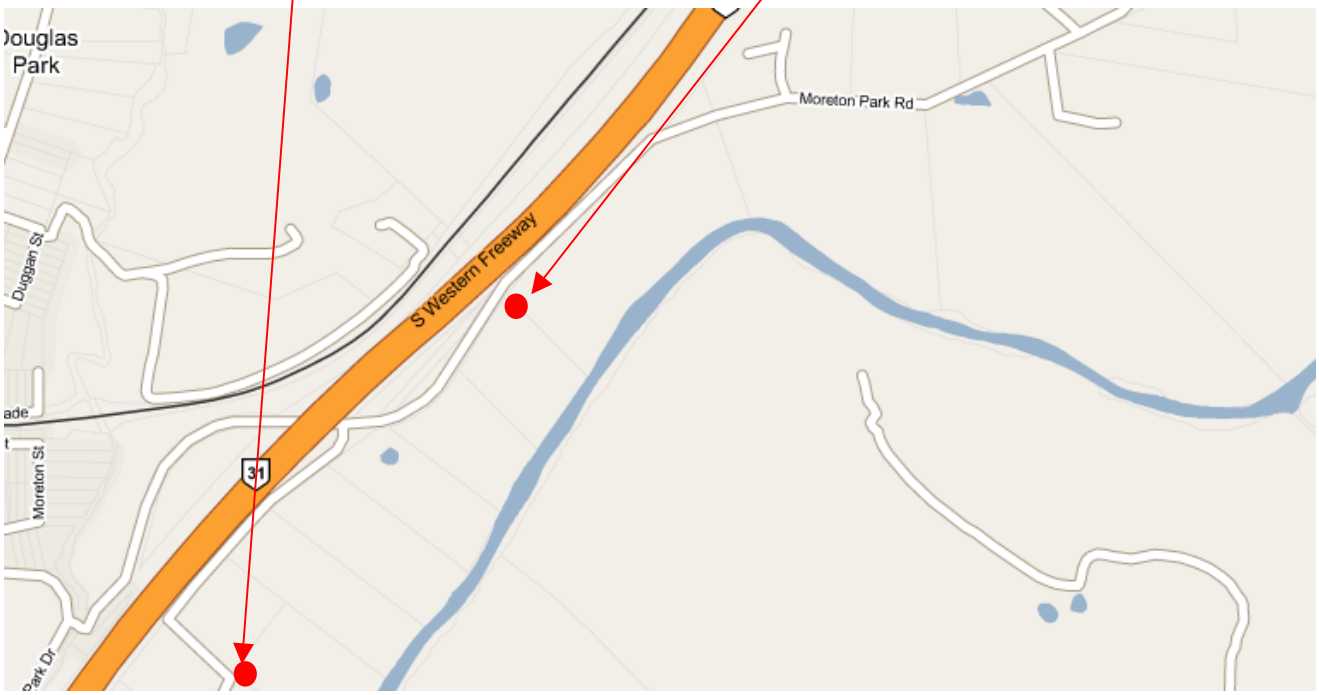
References:

- EPA, 2000, *Industrial Noise Policy*, NSW Environmental Protection Authority, Jan 2000.
- POEO, 1997, *Protection of the Environment Operations Act 1997*, Act No 156, 19 Dec.

DAY DESIGN	Douglas North Substation Site Location	3629 Figure 1

Douglas Park Switching Station

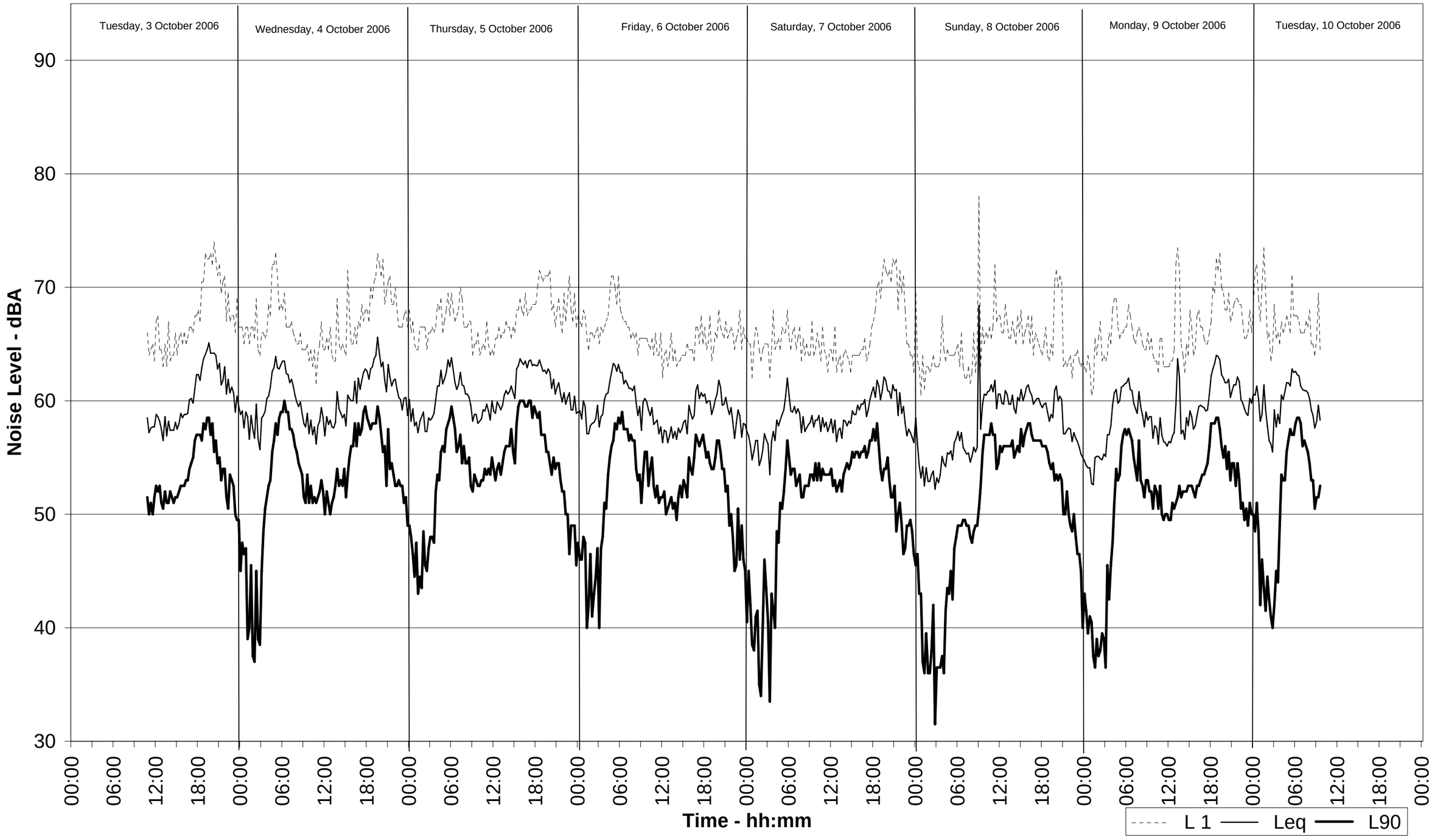
Douglas North Substation



Report 3629
Figure 2

Ambient Noise Survey

Located at 120 Prices Road, Douglas Park, NSW



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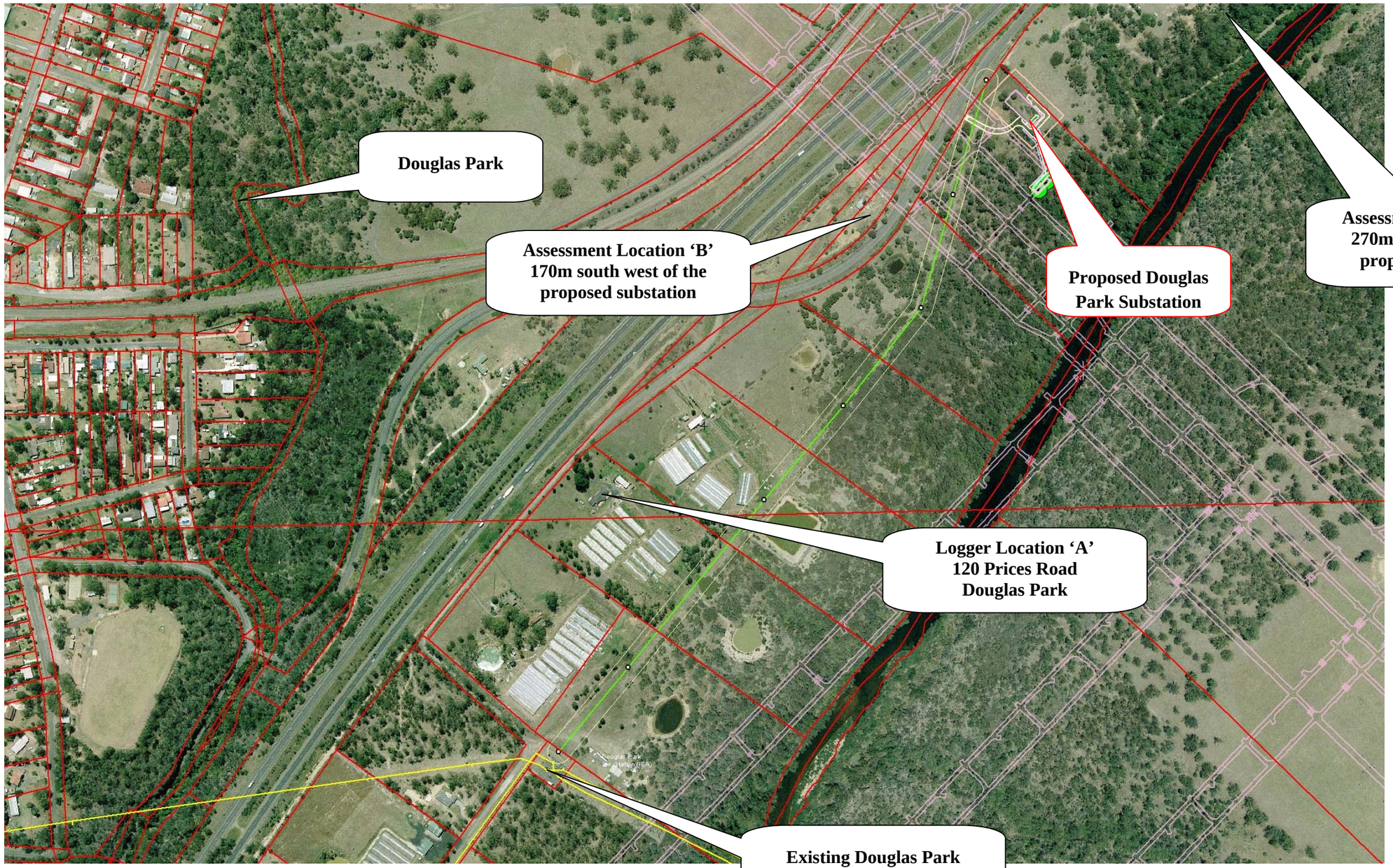

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Scale:
Project: 3629

Project:
DOUGLAS NORTH SUBSTATION

Drawing Description:
SURROUNDING AREA SITE PLAN

ACOUSTICAL – Pertaining to the science of sound, including the generation, propagation, effects and control of both noise and vibration.

AMBIENT NOISE – The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including road traffic, factories, wind in the trees, birds, insects, animals, etc..

AUDIBLE – means that a sound can be heard. However, there are a wide range of audibility grades, varying from "barely audible" to "just audible", "clearly audible" and "prominent". Chapter 83 of the NSW Environment Protection Authority – Environmental Noise Control Manual (1985) states:

"noise from a particular source might be offensive if it is clearly audible, distinct from the prevailing background noise and of a volume or character that a reasonable person would be conscious of the intrusion and find it annoying or disruptive".

It follows that the word "audible" in an environmental noise context means "clearly audible".

BACKGROUND NOISE LEVEL – Silence does not exist in the natural or the built-environment, only varying degrees of noise. The Background Noise Level is the average minimum dBA level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by cicadas, lawnmowers, etc. It is quantified by the L_{A90} or the dBA noise level that is exceeded for 90 % of the measurement period (usually 15 minutes).

- **Assessment Background Level (ABL)** is the single figure background level representing each assessment period – day, evening and night (i.e. three assessment background levels are determined for each 24hr period of the monitoring period). Determination of the assessment background level is by calculating the tenth percentile (the lowest tenth percent value) of the background levels (L_{A90}) for each period (Refer: NSW Industrial Noise Policy, 2000).
- **Rating Background Level (RBL)** as specified by the Environment Protection Authority is the overall single figure (L_{A90}) background noise level representing an assessment period (day, evening or night) over a monitoring period of (normally) three to seven days.

  The RBL for an assessment period is the median of the daily lowest tenth percentile of L_{90} background noise levels.

  If the measured background noise level is less than 30 dBA, then the Rating Background Level (RBL) is considered to be 30 dBA.

DECIBEL – The human ear has a vast sound-sensitivity range of over a thousand billion to one. The decibel is a logarithmic unit that allows this same range to be compressed into a somewhat more comprehensible range of 0 to 120 dB. The decibel is ten times the logarithm of the ratio of a sound level to a reference sound level. See also Sound Pressure Level and Sound Power Level.

Decibel noise levels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dBA, and another similar machine is placed beside it, the level will increase to 53 dBA, not 100 dBA. Ten similar machines placed side by side increase the sound level by 10 dBA, and one hundred machines increase the sound level by 20 dBA.

dBC – The dBC scale of a sound level meter is similar to the dBA scale defined above, except that at high sound intensity levels, the human ear frequency response is more linear. The dBC scale approximates the 100 phon equal loudness contour.

dBA – The human ear is less sensitive to low frequency sound than high frequency sound. We are most sensitive to high frequency sounds, such as a child's scream. Sound level meters have an inbuilt weighting network, termed the dBA scale, that approximates the human loudness response at quiet sound levels (roughly approximates the 40 phon equal loudness contour).

However, the dBA sound level provides a poor indication of loudness for sounds that are dominated by low frequency components (below 250 Hz). If the difference between the "C" weighted and the "A" weighted sound level is 15 dB or more, then the NSW Industrial Noise Policy recommends a 5 dBA penalty be applied to the measured dBA level.

EQUIVALENT CONTINUOUS NOISE LEVEL, L_{Aeq} – Many noises, such as road traffic or construction noise, vary continually in level over a period of time. More sophisticated sound level meters have an integrating electronic device inbuilt, which average the A weighted sound pressure levels over a period of time and then display the energy average or L_{Aeq} sound level. Because the decibel scale is a logarithmic ratio the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closely to the L_{Aeq} noise level.

FREE FIELD – This is a sound field not subject to significant reflection of acoustical energy. A free field over a reflecting plane is usually outdoors with the noise source resting on hard flat ground, and not closer than 6 metres to any large flat object such as a fence or wall; or inside an anechoic chamber.

FREQUENCY – The number of oscillations or cycles of a wave motion per unit time, the SI unit being the Hertz, or one cycle per second.

IMPACT ISOLATION CLASS (IIC) – The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation.

IMPACT SOUND INSULATION ($L_{nT,w}$) – Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ($L_{nT,w}$) is the sound pressure level at 500 Hz for a reference curve fitted to the measured octave band levels. Thus the lower $L_{nT,w}$ the better the impact sound insulation.

IMPULSE NOISE – An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

INTRUSIVE NOISE LEVEL, L_{Aeq} – The level of noise from a factory, place of entertainment, etc. in NSW is assessed on the basis of the average maximum noise level, or the $L_{Aeq\ (15\ min)}$. This is the energy average A weighted noise level measured over any 15 minute period.

LOUDNESS – The degree to which a sound is audible to a listener is termed the loudness. The human ear perceives a 10 dBA noise level increase as a doubling of loudness and a 20 dBA noise increase as a quadrupling of the loudness.

MAXIMUM NOISE LEVEL, L_{Amax} – The rms maximum sound pressure level measured on the "A" scale of a sound level meter during a noise survey is the L_{Amax} noise level. It may be measured using either the Fast or Slow response time of the meter. This should be stated.

NOISE RATING NUMBERS – A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the dBA level minus five.

NOISE – Noise is unwanted sound. Sound is wave motion within matter, be it gaseous, liquid or solid. “Noise includes sound and vibration”.

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient"

OFFENSIVE NOISE

(Reference: Dictionary of the Protection of the Environment Operations Act 1997).

"Offensive Noise means noise:

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

PEAK NOISE LEVEL, $L_{C\ peak}$ – The "Peak" level is the maximum instantaneous dBA sound pressure level. This is not an RMS level. It is an important descriptor for an impulsive noise wave front especially with regard to the assessment of Hearing Hazard due to impact noise.

PINK NOISE – Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, T_{60} – The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the T_{60}. The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT – αSound is absorbed in porous materials by the viscous conversion of sound energy to heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average α from 250 to 2000 Hz is termed the Noise Reduction Coefficient (NRC).

SOUND ATTENUATION – If an enclosure is placed around a machine, or a silencer is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 30 dBA, reduces the sound energy by one thousand times.

SOUND EXPOSURE LEVEL (SEL) – The total sound energy of a single noise event condensed into a one second duration or in other words it is an L_{eq} (1 sec).

SOUND PRESSURE LEVEL, L_p – The level of sound measured on a sound level meter and expressed in decibels, dB, dBA, dBC, etc.. $L_p = 20 \times \log (P/P_O)$ ... dB

where P is the rms sound pressure in Pascal and P_O is a reference sound pressure of 20 μPa.

L_p varies with distance from a noise source.

SOUND POWER LEVEL, L_W – The Sound Power Level of a noise source is an absolute that does not vary with distance or with a different acoustic environment.

$L_W = L_p + 10 \log A$ ... dB, re: 1pW,

where A is the measurement noise-emission area in square metres in a free field.

SOUND TRANSMISSION CLASS (STC) – An internationally standardised method of rating the sound transmission loss of partition walls to indicate the decibels of noise reduction of a human voice from one side to the other. (Refer: Australian Standard AS1276 – 1979)

SOUND TRANSMISSION LOSS – The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS1191 - 2002.

STATISTICAL EXCEEDENCE SOUND LEVELS, L_{A90}, L_{A10}, L_{A1}, etc. – Noise which varies in level over a specific period of time (usually 15 minutes) may be quantified in terms of various statistical descriptors:

The L_{A90} is the dBA level exceeded for 90 % of the time. In NSW the L_{A90} is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

The L_{A10} is the dBA level that is exceeded for 10 % of the time. In NSW the L_{A10} measured over a period of 10 to 15 minutes. It was until recently used to describe the average maximum noise level, but has largely been replaced by the L_{Aeq} for describing level-varying noise.

The L_{A1} is the dBA level that is exceeded for 1 % of the time. In NSW the L_{A1} may be used for describing short-term noise levels such as could cause sleep arousal during the night.

STEADY NOISE – Noise, which varies in level by 6 dBA or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1 1997)

WEIGHTED SOUND REDUCTION INDEX, R_w – This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 to 3,150 Hertz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999).

Internal partition wall $R_w + C$ ratings are frequency weighted to simulate insulation from human voice noise. The $R_w + C$ is always similar in value to the STC rating value. External walls, doors and windows may be $R_w + C_{tr}$ rated to simulate insulation from road traffic noise. This is normally a lower number than the STC rating value.

WHITE NOISE – White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.

Table 4.1 Modifying factor corrections

(See definitions in Section 4.2)

Factor	Assessment/ Measurement	When to apply	Correction[1]	Comments
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: **- 5 dB** or more if the centre frequency of the band containing the tone is above 400 Hz **- 8 dB** or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive **- 15 dB** or more if the centre frequency of the band containing the tone is below 160 Hz	5 dB[2]	Narrow-band frequency analysis may be required to precisely detect occurrence
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more	5 dB[2]	C-weighting is designed to be more responsive to low-frequency noise
Impulsive noise	A-weighted fast response and impulse response	If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB	Apply difference in measured levels as the correction, up to a maximum of 5 dB.	Characterised by a short rise time of 35 milliseconds (ms) and decay time of 1.5s
Intermittent noise	Subjectively assessed	Level varies by more than 5 dB	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	One event in any 24-hour period	0 to –20 dB(A)	The acceptable noise level may be increased by an adjustment depending on duration of noise. *(See Table 4.2)*
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10 dB(A)[2] (excluding duration correction)	

Notes:

1. *Corrections to be added to the measured or predicted levels.*
2. *Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range.*