



Project No: 10547

Noise Impact Assessment Northbank Enterprise Hub Tomago, NSW

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Appendix A Work Practices for Construction Noise Control

1.0 INTRODUCTION

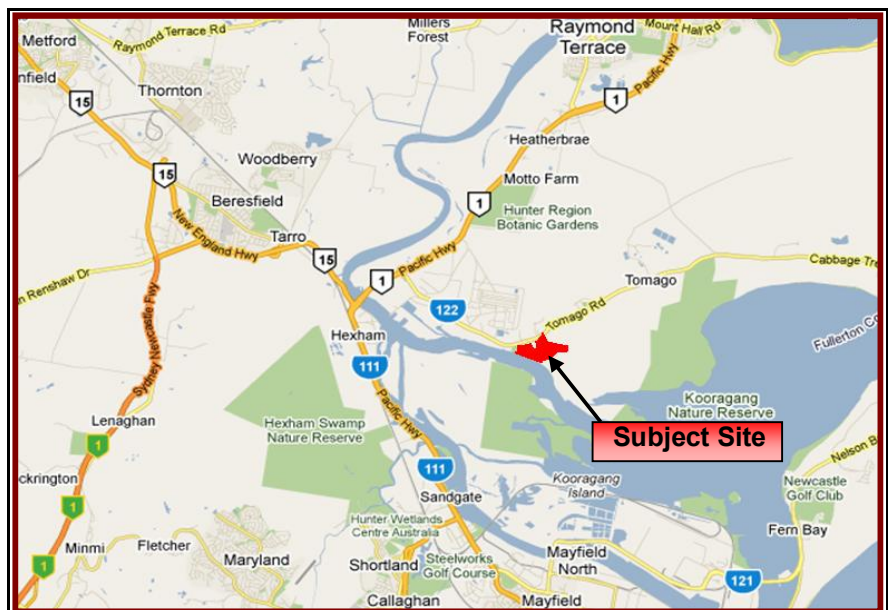
This report provides the results and findings of a noise impact assessment of the proposed Northbank Industrial Hub at Tomago NSW.

The Minister for Planning has confirmed that the proposal is a major project to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies. This assessment has been undertaken as part of an Environmental Assessment (EA) of the proposal. The following NSW Department of Environment and Climate Change and Water (DECCW) documents provide noise criteria and guidelines for the assessment methodology:

1. *NSW Industrial Noise Policy (INP, 2000)*;
2. *Environmental Noise Control Manual (ENCM, 1994)*;
3. *Interim Construction Noise Guideline (ICNG, 2009)*;
4. *Environmental Criteria for Road traffic Noise (ECRTN, 1999)*.

Figure 1 shows the location of the subject site.

FIGURE 1
Location of the subject site.



2.0 DESCRIPTION OF TERMS

This section of the report aims to convey an understanding of several commonly used acoustical terms. Various terms are explained in plain language and the effects of certain atmospheric phenomena on noise propagation are discussed. Noise level percentiles are explained with the aid of a diagram of a hypothetical noise signal.

The descriptions in this section are not formal definitions of the terms. Formal definitions may be found in AS1633-1985 Acoustics . Glossary of terms and related symbols.

2.1 General Terms

Sound Power Level

The amount of acoustic energy (per second) emitted by a noise source. Usually written as L_w or L_{W} , the Sound Power Level is expressed in decibels (dB) and cannot be directly measured. L_w is usually calculated from a measured sound pressure level.

Sound pressure Level

The noise level, in decibels (dB), heard by our ears and/or measured with a sound level meter. Written as L_p , the sound pressure level generally decreases with increasing distance from a source. Noise levels are often written as dB(A) rather than dB. The A-weighting is a correction applied to the measured noise signal to account for the ear's ability to hear sound differently at different frequencies. The A-weighted sound pressure level therefore represents the measured (or predicted) noise level as it would be heard by the typical human ear.

Temperature Inversion

An atmospheric state in which the air temperature increases with altitude. Sound travels faster in warmer air than in cold air, so that during an inversion the top of a sound wave will move faster than the bottom. This bends (refracts) sound back towards the ground. The result is a trapping of sound energy near the ground and an increase in noise levels. Similarly, daytime air temperatures typically reduce with altitude (approximately 1-2 °C/100m called the adiabatic lapse rate) and sound refracts upward slightly. The result is slightly reduced noise levels compared with a uniform or neutral atmosphere.

Wind Shear

A moving air mass will experience a friction drag at the ground in much the same way as a lava flow will flow quickly on top and all over the lava beneath which must drag along the ground. This increasing wind speed with altitude is called wind shear.

For a sound wave travelling down wind, the top of the wave moves faster than the bottom and the wave bends towards the ground. However, for a wave travelling into the wind the top of the wave is slowed down more than the bottom is and the wave bends upwards. **Figure 2** shows several examples of how atmospheric effects can bend sound waves.

FIGURE 2
Sound refraction under temperature inversions and wind gradients.

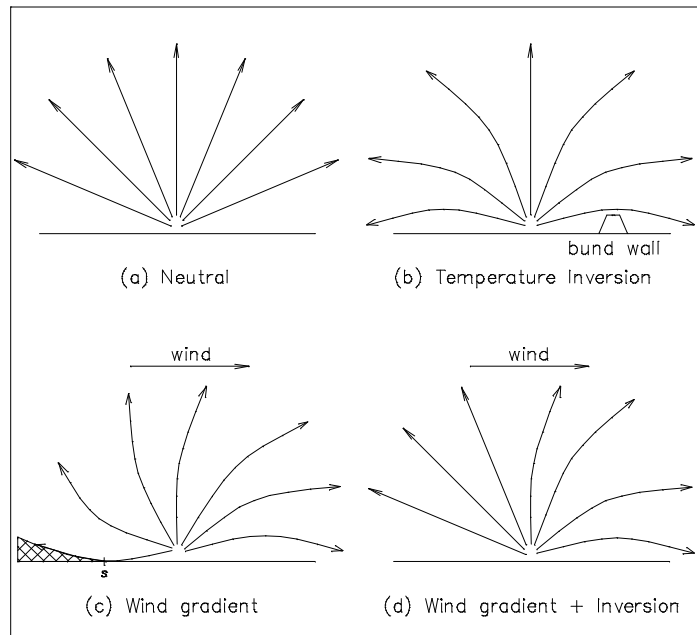


Figure 2 shows that sound rays can be refracted over a barrier (usually a bund wall or small hill) during a temperature inversion, increasing noise levels in the shadow zone.

Neutral Atmospheric Conditions

An atmosphere that is at a temperature of approximately 23°C from ground level to an altitude of 200m or more. There are no fluctuations in density or humidity and no wind. Such conditions rarely occur, as temperature will usually vary with altitude and there is always movement in various directions in different layers of the atmosphere.

Prevailing Atmospheric Conditions

Atmospheric conditions (with regards to potential effects on noise propagation) which are characteristic of the study area. These will typically include seasonal wind directions and velocities. Temperature inversions will be included as prevailing if they occur, on average, for more than 2 nights per week in winter.

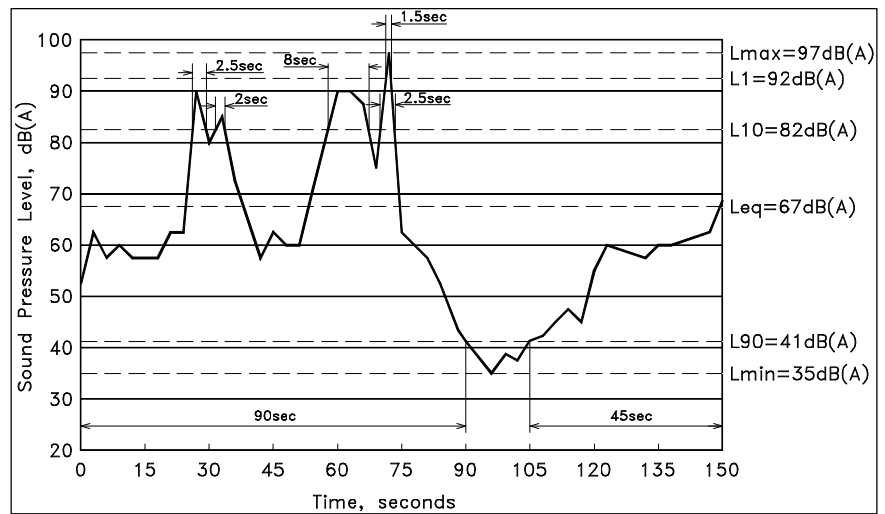
Adverse Atmospheric Conditions

Adverse conditions will include simultaneous winds and temperature inversions, even if the inversions occur for less than 2 nights per week in winter. This represents the worst case scenario for potential noise enhancement due to atmospheric effects.

2.2 Noise Level Percentiles

A noise level percentile (L_n) is the noise level (SPL) in decibels which is exceeded for $n\%$ of a given monitoring period. Several important L_n percentiles will be explained by considering the hypothetical time signal in **Figure 3**.

FIGURE 3
Hypothetical time-trace of
150-second sound signal.



The signal in Figure 3 has a duration of 2.5 minutes (ie 150 seconds) with noises occurring as follows:

- The person holding the instrument is standing beside a road and hears crickets in nearby grass at a level of around 60 dB (A);
- At about the 30 second mark a motorcycle passes on the road, followed by a car;
- At 60 seconds a truck passes;
- After the truck passes it sounds its air horn at the 73 second mark;
- The crickets are startled into silence as the truck fades into the distance;
- All is quiet until 105 seconds when the crickets slowly start to make noise, reaching full pitch by 120 seconds;
- The measurement stops at 150 seconds, just when an approaching car starts to become audible.

L_{A1} Noise Level

Near the top of Figure 3, there is a dashed line at 92 dB(A). A small spike of 1.5 sec duration extends above this line at around 73 seconds. Since 1.5 sec is 1% of the signal duration (150 seconds), the L₁ (or L_{A1} to signify A-weighting) noise level of this sample is 92 dB(A). The L₁ percentile is often called the *average peak noise level* and is used by the NSW Department of Environment and Conservation (DEC) as a measure of potential disturbance to sleep.

L_{A10} Noise Level

The dashed line at 82 dB(A) is exceeded for four periods of duration 2.5 sec, 2 sec, 8 sec and 2.5 sec, respectively. The total of these is 15 sec, which is 10% of the total sample period. Therefore, the L_{A10} noise level of this sample is 82 dB(A). The L_{A10} percentile is called the *average*

maximum noise level and has been widely used as an indicator of annoyance caused by noise.

L_{A90} Noise Level

In similar fashion to L_{A1} and L_{A10} , Figure 3 shows that the noise level of 41 dB(A) is exceeded for 135 seconds ($90 + 45 = 135$). As this is 90% of the total sample period, the L_{A90} noise level of this sample is 41 dB(A). The L_{A90} percentile is called the *background noise level*.

L_{Aeq} Noise Level

Equivalent continuous noise level. As the name suggests, the L_{Aeq} of a fluctuating signal is the continuous noise level which, if occurring for the duration of the signal, would deliver equivalent acoustic energy to the actual signal. L_{Aeq} can be thought of as a kind of *average noise level*. Recent research suggests that L_{Aeq} is the best indicator of annoyance caused by industrial noise and the DEC *NSW Industrial Noise Policy* (INP) takes this into consideration.

L_{Amax} and L_{Amin} Noise Levels

These are the maximum and minimum SPL values occurring during the sample. Reference to Figure 3 shows these values to be 97 dB(A) and 35 dB(A), respectively.

3.0 THE PROPOSAL

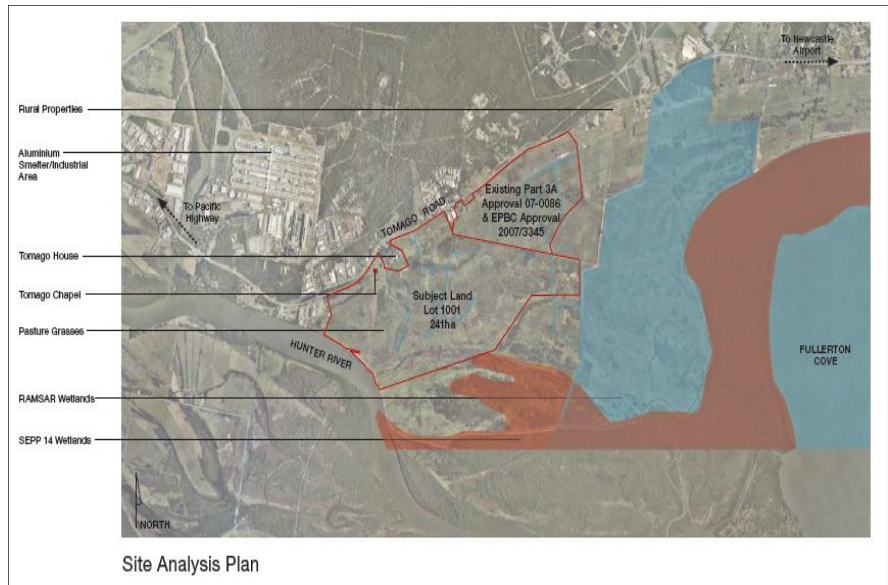
The main objective of the proposed subdivision is to enable a large integrated industrial and business park that will encourage significant investment into the Port Stephens Local Government Area by offering business and employment opportunities.

The proposed subdivision has been designed to be integrated with the adjoining approved industrial subdivision to the north east. The site is well located within an area characterised by both established and approved industrial development. The site is located in close proximity to the Port of Newcastle and major transport route the Pacific Highway enabling access to Maitland and Sydney.

The Lower Hunter Regional Strategy includes the subject site within ~~the~~ employment lands, which are nominated to provide an opportunity for economic growth by promoting business and employment opportunities. The Lower Hunter Regional Strategy identifies a need for a continued supply of industrial land in order to support the regional economy, and provide business and employment opportunities for the growing population. The use of the subject land for industrial and business park purposes is consistent with both the Lower Hunter Regional Strategy as

well as the land use zoning of the site. Figure 4 shows the subject site and surrounding built and environmental features.

FIGURE 4
Subject site and surrounding features.



3.1 Hours of Operation

Being a substantial industrial development, it is considered in this assessment that all future businesses on the site would seek approval to operate 24 hours per day.

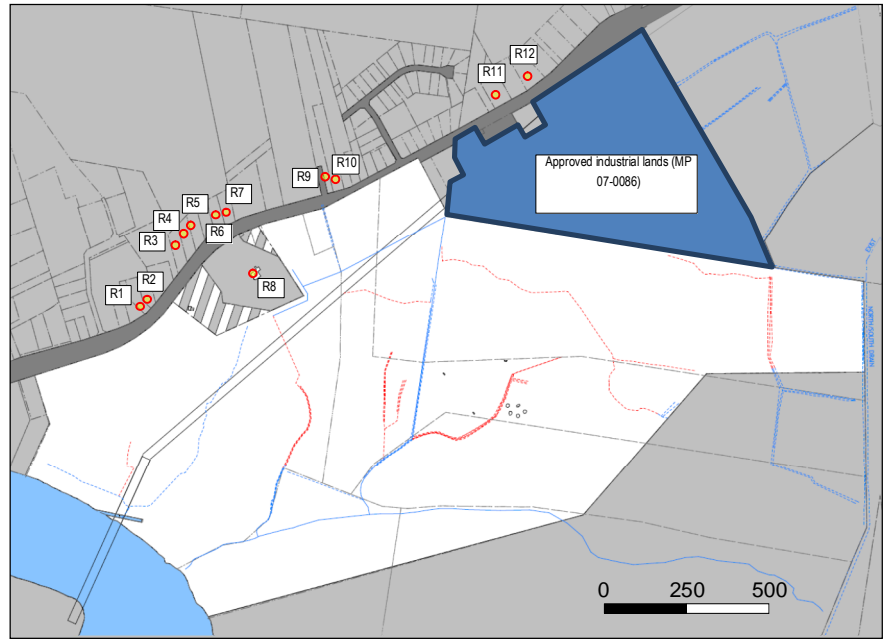
3.2 Residential Receivers

Several residences are located on School Road, Tomago Road and Graham Drive to the north of the site. Several dilapidated and unoccupied residences on the project site are to be demolished.

The historic Tomago House function centre also contains an occupied manager's residence and is surrounded on three sides by the project site.

The locations of the project site and the nearest (occupied) residences are shown in **Figure 5**. The shaded section is part of the previously approved Northbank Enterprise Hub (formerly WEPL Investments) subdivision adjoining the subject site and is not included in this assessment.

FIGURE 5
Project site and residential receivers.



4.0 THE EXISTING ENVIRONMENT

The existing meteorological and acoustic environments have been studied as part of this EA. The acoustical climate has been quantified at two representative residential locations around the project site.

4.1 Meteorology

The atmospheric conditions most relevant to noise assessments are temperature inversions, gentle winds (indicative of possible wind shear) and relative humidity. Meteorological data from the Bureau of Meteorology's Nobbys Head station were analysed to determine dominant wind directions in the 0-3 m/s category. The following data are the most significant with respect to noise propagation:

- Extremes of relative humidity (RH) are rarely experienced. For modelling purposes, a value of 70% RH was adopted;
- Mild temperature inversions are likely to occur on at least 20-25% of nights in winter. An inversion strength of +3°C/100m was adopted in the noise models for night time activities (as per procedures in the INP, Appendix C).
- Gradient winds are predominantly south-easterly in summer and north-westerly in winter. A wind speed of 3m/s (at 10m above ground level) from each of these directions was modelled to determine the noise impact under each of these prevailing wind conditions.

Typical calm daytime conditions of no wind, 70% RH and -1°C/100m vertical temperature gradient (ie, dry adiabatic lapse rate, DALR) was also modelled to represent daytime noise levels under calm conditions.

4.2 Ambient Noise Levels

Ambient noise monitoring was conducted at 175 Tomago Rd (immediately east of the site) and 308 Tomago Rd (R11 in Figure 5) during the period 22-28 October 2007. Further noise monitoring was conducted during 23-28 November 2010 in a vacant paddock (302 Tomago Road) between R11 and R12 in Figure 5. Noise levels were recorded for 15 minute statistical intervals over the entire measurement period using Svan 949 Environmental Noise Loggers in accordance with the relevant DECC guidelines and AS 1055-1997 Acoustic Description and Measurements of environmental noise. Periods of adverse weather conditions were excluded from the data as per the procedures outlined in Appendix B of the INP.

Background noise levels were calculated from the measured data using the tenth percentile method as specified in the INP. These are referred to as Rating Background Levels+ (RBL). Existing L_{Aeq} and L_{A90} (Rating Background levels, RBL) levels are summarised in **Table 1**.

TABLE 1
Measured ambient noise levels (Oct 2007/Nov 2010).

Location	L_{Aeq} , period			L_{A90} , period		
	Day	Eve.	Night	Day	Eve.	Night
175 Tomago Rd (Oct '07)	57	55	53	38	33	30
308 Tomago Rd (Oct '07)	57	53	52	40	32	30
302 Tomago Rd (Nov '10)	59	57	53	44	36	31

The contribution of existing industrial and transport noise sources to the measured ambient L_{Aeq} levels is estimated as follows:

175 Tomago Road

No industrial noise sources observed nearby and no industrial noise audible during deployment or retrieval of noise logger. Noise levels at this site are dominated by traffic on Tomago Road.

308 Tomago Road

Slight industrial noise audible to the west, but not dominant. Noise levels at this site are also dominated by traffic on Tomago Road.

302 Tomago Road

Road construction works were occurring on Tomago Road for the duration of the survey. Noise levels at this site were therefore not representative and the October 2007 data from 308 Tomago Road will be adopted for receivers in this area. Monitoring was not conducted near R10 as noise from an adjoining industry would not be representative of other receivers and similarly, construction of Energy Australia infrastructure near R2 precluded these receivers from noise monitoring.

5.0 NOISE CRITERIA

This section derives construction, operational and traffic noise criteria from the relevant OEH guidelines. The construction and operational criteria for assessment of future industrial occupants of the site are based on measured background levels at 308 Tomago Road as shown in Table 1 above. These levels are:

Day	40 dB(A), L ₉₀
Evening	32 dB(A), L ₉₀
Night	30 dB(A), L ₉₀

5.1 Construction Noise

Construction activities on the site will initially involve earthworks to fill a portion of the site, and to construct roads, easements, drainage infrastructure etc. Once the site has been established, each prospective industrial occupier on the site would prepare an acoustic assessment to ensure compliance with the governing criteria and recommendations established in this document.

Construction noise criteria established for the approved industrial site which adjoins the project site on the east (Project Approval 07_0086) will be reviewed, along with relevant construction criteria for the current proposal and future industrial occupants.

5.1.1 Adjoining Development

Spectrum Acoustics established construction noise criteria for the approved industrial subdivision in 2007 by reference to the OEH (then DECCW) guideline applicable at that time. The relevant portion of the 2007 acoustic assessment is reproduced below.

Recommended construction noise criteria vary depending on construction duration, as outlined in Section 157 of the DECC Environmental Noise Control Manual (ENCM) and reproduced below:

- *Construction period less than 4 weeks:
L_{A10} level restricted to background (L_{A90}) + 20dB*
- *Construction period more than 4 weeks but less than 26 weeks:
L_{A10} level restricted to background (L_{A90}) + 10dB*

DECC recommends construction during daytime hours only. For construction periods longer than 26 weeks, a construction noise criterion of background (L_{A90}) + 5dB is usually adopted.

*Construction activities (including land-fill and building construction) are expected to take longer than 6 months and the criterion of 'daytime background level + 5dB' or **43 dB(A), L₁₀** would apply.*

5.1.2 Current Development

The OEH (then DECCW) released an *Interim Construction Noise Guideline* (ICNG) in 2009. The essential difference between the old and new guidelines are summarised in Table 2.

TABLE 2
Comparison of previous and interim guidelines.

Previous guideline	Interim guideline
Recommended standard hours	
Monday to Friday 7am to 6pm Saturdays 8am to 1 pm No work on Sundays or public holidays	No change from previous
Choice of assessment method	
No choice – only numeric criteria given	Choice of either qualitative assessment for projects under three weeks, or quantitative assessment for major projects
Noise levels	
Noise goal	Noise management level
0 to 4 weeks Background + 20 dB(A)	Short-term infrastructure maintenance Qualitative assessment – apply work practices in checklist at all times of day Major construction projects Recommended standard hours: Background + 10dB(A) and L_{Aeq} 75dB(A) Outside recommended standard hours: Background + 5dB
5 to 26 weeks Background + 10 dB(A)	
Greater than 26 weeks Background + 5 dB(A)	
Guidance on work practices	
No guidance	Extensive list of options for work practices, based on world-wide review of best approaches
Examples on applying guideline	
No examples	Six case studies based on real-life projects. Also worked examples throughout the guideline.
Ground-borne noise levels	
No guidance	Evening internal level L_{Aeq} 40 dB(A) Night internal level L_{Aeq} 35 dB(A)

The main difference in Table 2 relevant to the current project is the introduction of a construction noise management level+ rather than a noise goal+. For normal daytime activities, the management level under the ICNG is background + 10dB. Based on the daytime background level of 40 dB(A) at 308 Tomago Road, the construction noise management level is **50 dB(A), L_{10}** .

Night time construction activities are permissible under the ICNG but it needs to be demonstrated that the activity is necessary for reasons other than convenience. Any proposal for night time construction must therefore be well supported and noise emissions must not exceed the night time operational criterion of **35 dB(A), $L_{eq}(15\text{minute})$** .

5.2 Operational Noise

In setting operational noise goals for a particular project, the INP considers both Amenity and Intrusiveness criteria. The former is set to limit continuing increase in noise from industry, whilst the latter is set to minimise the intrusive impact of a particular noise source. The following Intrusiveness criteria were established for the adjoining approved development.

Intrusiveness Criteria:

45dB(A) L_{eq} (15 min)	Day (7am – 6pm)
37dB(A) L_{eq} (15 min)	Evening (6pm – 10pm)
35dB(A) L_{eq} (15 min)	Night (10pm – 7am)

The above criteria are applicable for individual occupiers of the Project site.

Residences near the Project site are defined as Suburban in Section 2.2.1 of the INP. Table 2.1 of the INP recommends the following Acceptable Noise Levels (ANL). These ANLs are the amenity criteria applicable to the cumulative level of noise from all industrial sources.

Amenity Criteria:

55dB(A) L_{eq} (period)	Day (7am – 6pm)
45dB(A) L_{eq} (period)	Evening (6pm – 10pm)
40dB(A) L_{eq} (period)	Night (10pm – 7am)

Amenity criteria for an individual occupier of the site may be modified in accordance with table 2.2 of the INP (which is partially reproduced below as **Table 3**) depending on the total industrial noise level at the time.

TABLE 3

Modification to ANL's to account for existing industrial noise.

(Source: INP, Table 2.2)

Total existing L_{Aeq} noise level from industrial sources, dB(A)	Maximum L_{Aeq} noise level for noise from new sources alone, dB(A)
≥ Acceptable noise level plus 2	Existing level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 3
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

5.3 Cumulative Noise

Cumulative noise emissions from the subject site and all nearby existing and approved industrial noise sources should not exceed the recommended industrial noise levels (ANL) quoted in Section 5.2 above as amenity criteria and reproduced below.

Cumulative Noise Criteria (Industrial sources):

55dB(A) L_{eq} (period)	Day (7am – 6pm)
45dB(A) L_{eq} (period)	Evening (6pm – 10pm)
40dB(A) L_{eq} (period)	Night (10pm – 7am)

5.4 Sleep Disturbance

Initial earthworks associated with development of the site are expected to occur during normal daytime working hours. It is likely, however, that future occupiers of the site could operate 24 hours per day, and it is necessary to assess the potential for impact noises to cause disturbance to residents' sleep during night time hours. OEH considers that a $L_{A1(1 \text{ minute})}$ level, effectively the maximum (L_{max}) noise level over a 15-minute assessment period, should generally not exceed the night time background noise level by more than 15 dB (Ref. ENCM). Based on the measured background level of 30dB(A), L_{90} the sleep disturbance criterion is 45dB(A), L_{max} .

The ENCM is an old document, however, and more recent findings referenced in the DECCW's *Environmental Criteria for Road Traffic Noise* (ECRTN, Appendix B3) lead to the following conclusions (p29):

- *Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions.*
- *One or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect health and wellbeing significantly.*

Since the main objective of this assessment is to determine potential noise impacts on amenity, rather than on health and wellbeing, it is conservatively assumed from the above conclusions that disturbance to sleep may be minimised by ensuring that internal maximum noise levels do not exceed 50 dB(A). It is also accepted by OEH, and generally, that the noise loss through an open window to the centre of a room is 10 dB. The maximum acceptable external noise level is therefore **60 dB(A), L_{max}** which is the sleep disturbance criterion included in Consent Condition 3.26 of Project Approval 07_0086 for the adjoining development.

5.5 Traffic Noise

Noise from vehicle movements on public roads is subject to criteria in the NSW *Environmental Criteria for Road Traffic Noise* (ECRTN). The ECRTN recommends various criteria based on the functional categories of roads applied by the Roads and Traffic Authority (RTA).

The RTA differentiates roads based on a number of factors including traffic volume, heavy vehicle use, through or local traffic, vehicle speeds and applicable traffic management options. Vehicles accessing the site would do so via Tomago Road, which is accessed from the Pacific Highway to the west and Masonite Road and Nelson Bay Roads to the east.

Since the Pacific Highway and Nelson Bay Road are arterials, this assessment will only consider potential traffic noise impacts at residences along Tomago Road, which is a collector road with lower noise criteria. **Table 4** below shows the noise criteria relevant to traffic on collector roads extracted from Table 1 of the ECRTN. For the assessment of traffic noise, the day time period is from 7am to 10pm, whilst night is from 10pm to 7am.

TABLE 4
Road traffic noise criteria.

Situation	Recommended Criteria, $L_{eq}(1 \text{ hour})$	
	Day (7am - 10pm)	Night (10pm - 7am)
13. Landuse developments with potential to create additional traffic on collector roads	60 dB(A)	55 dB(A)

The ECRTN also advises that, where criteria are already exceeded:

“In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.”

Potential traffic noise from the project site will be assessed against the above criteria, taking previously calculated traffic noise levels from the adjoining approved development into account.

6.0 ASSESSMENT METHODOLOGY

6.1 Site Construction Noise

Construction would first involve depositing and levelling fill material over a four-stage process. The four stages are illustrated in **Figure 6** and would involve the fill volumes and truck movements as shown in **Table 5**.

TABLE 5

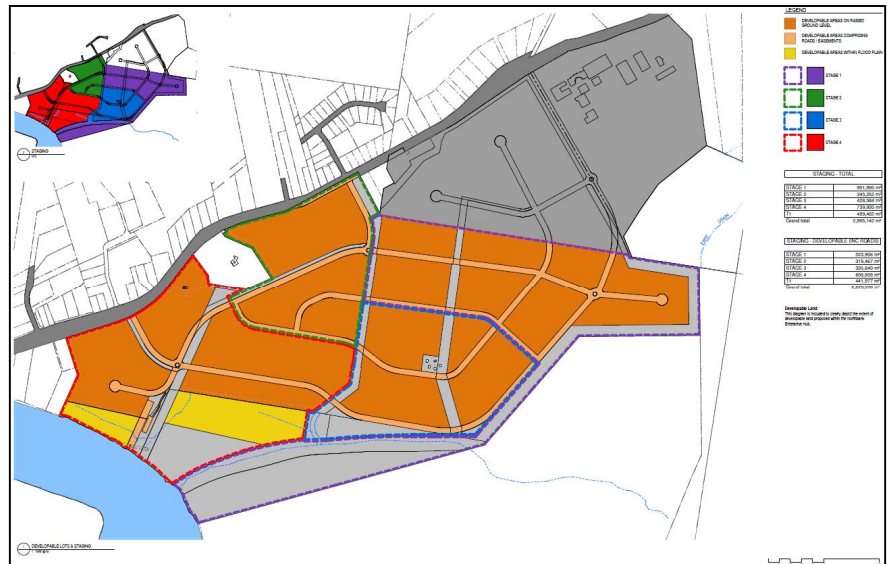
Construction (landfill) stages – fill volumes and truck movements

Stage	Duration	Fill volume (m3)	Truck Movements
Stage 1	18 months	1 577 110	105 140
Stage 2	18 months	594 752	39 650
Stage 3	18 months	815 173	54 270
Stage 4	18 months	741 677	49 316
TOTAL	72 months	3.7 million	248 376

Earthworks would involve the use of road-going tip-trucks delivering fill and then levelling with a small tracked dozer (CAT D8 or similar). The dozer would also be used to spread a sand ridge on the northern site frontage over the site. A typical sound power level of 108 dB(A) was used for the tip-trucks and 113 dB(A) for the dozer. Road construction works would typically require the use of the above equipment plus a grader (106 dB(A)) and roller (113 dB(A)).

FIGURE 6

Construction (landfill) Stages



An area incorporating the receivers shown in Figure 5 was digitised into the Environmental Noise Model (ENM v3.06) software to model noise emissions from the site. The above noise sources were entered as points and the point calculation mode was used to determine noise levels at the assessed receivers.

Noise modelling was undertaken for the atmospheric conditions defined in the assessment for the adjoining site, as described below:

Calm . 20⁰C, 70% R.H., no wind (neutral atmospheric),

South East wind - 20⁰C, 70% R.H., 3m/s wind from the south east, and

North West wind - 20⁰C, 70% R.H., 3m/s wind from the north west,

6.2 Operational Noise

No information is available on activities or operating hours for future potential occupiers of the site. The assessment of operational noise uses the ENM model to establish limiting noise emission level that would produce a level equal to the operational noise criterion at the nearest residential receiver, for day, evening and night time operation. Acceptable noise level zones within the site are calculated in this way and presented graphically for ease of reference.

6.3 Cumulative Noise

The noise contributions from existing and approved industrial developments were determined from either predicted/measured noise levels or (if these were not available) from approved noise criteria. These noise contributions were added together and compared with the cumulative noise criteria in Section 5.3 of this report.

6.4 Sleep Disturbance

As with the operational noise assessment described above, the assessment of sleep disturbance uses the ENM model to establish the maximum noise emission level that would produce a level equal to the sleep disturbance criterion at the nearest residential receiver.

6.5 Traffic Noise

The potentially most affected residences with regard to traffic noise are near the site or on Tomago Road. Existing (as at 2007) traffic numbers on Tomago Road and proposed traffic numbers to be generated by the approved adjoining project during the landfill stage were sourced from the Traffic Management Plan prepared by Mark Waugh Pty Limited, dated June 2007 and a Project Design Note also by Mark Waugh Pty Limited (MWPL), dated September 2008.

Traffic numbers that would potentially be generated by the subject site were sourced from the Traffic Assessment Report prepared by TPK & Associates Pty Ltd (October 2011). Projected traffic noise levels from the adjoining approved development will be used as the basis for assessing potential future traffic noise levels from the subject site.

7.0 NOISE IMPACT ASSESSMENT

7.1 Site Construction Noise

The ENM noise model was utilised in point calculation mode to determine construction noise levels (covering all four landfill stages) at the three receivers closest to the site (R1, R8 and R10 in Figure 5). Construction activities (dominated by the dozer on site spreading fill material and

associated truck movements) were modelled at the nearest points to each receiver. The results of the point calculations for the four modelled scenarios are shown in **Table 5**. Inversion conditions have been modelled for completeness but are normally not considered for daytime activities.

TABLE 5
Predicted construction noise levels dB(A), L₁₀(15minute).

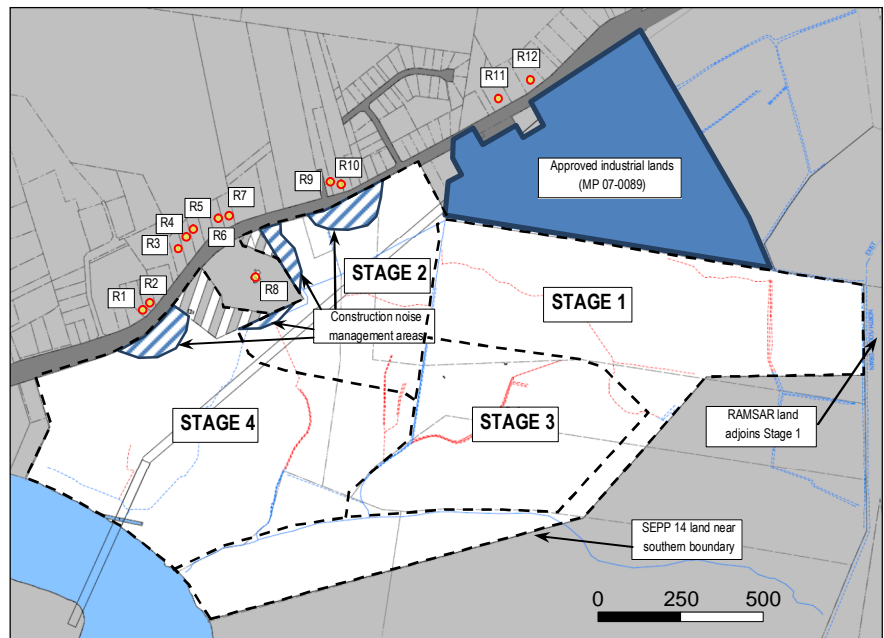
Location	Meteorological Condition				Criterion ¹
	Distance, m	Neutral	SE wind	NW wind	
R1	60	56	58	53	50
R8	90	53	55	53	50
R10	60	56	58	53	50

¹ Daytime Management Level since construction activities are generally only approved for daytime hours of 7am-6pm.

The results in Table 5 show that the construction noise management level of 50 dB(A) will be exceeded when activities are close to residences. The Management Level is not a preclusive criterion, however, and simply defines a level at which some form of noise management must be applied.

Figure 6 defines areas where management measures should be applied to construction works (including internal road construction). The set-back distance from residential receivers is approximately 180m.

FIGURE 6
Construction noise management areas and landfill stages.



Noise reduction and minimisation practices and methods are detailed in the ICNG, and are reproduced in **Appendix A**.

7.1.1 Stage 1

All on-site vehicular movements and landfill works associated with Stage 1 would occur outside the Noise Management Areas, indicating that noise reduction and minimisation practices and methods will not be required for this stage.

7.1.2 Stage 2

On-site vehicular movements and landfill works associated with Stage 2 would occur within the Noise Management Areas near R9/R10 and R8 at some time. Noise reduction and minimisation practices and methods should be implemented during this stage.

It is recommended that the ICNG noise reduction and minimisation practices and methods reproduced in Appendix A should be incorporated, as appropriate, in a Construction Noise Management Plan for this construction phase.

7.1.2 Stage 3

All on-site vehicular movements and landfill works associated with Stage 3 would occur outside the Noise Management Areas, indicating that noise reduction and minimisation practices and methods will not be required for this stage.

7.1.2 Stage 4

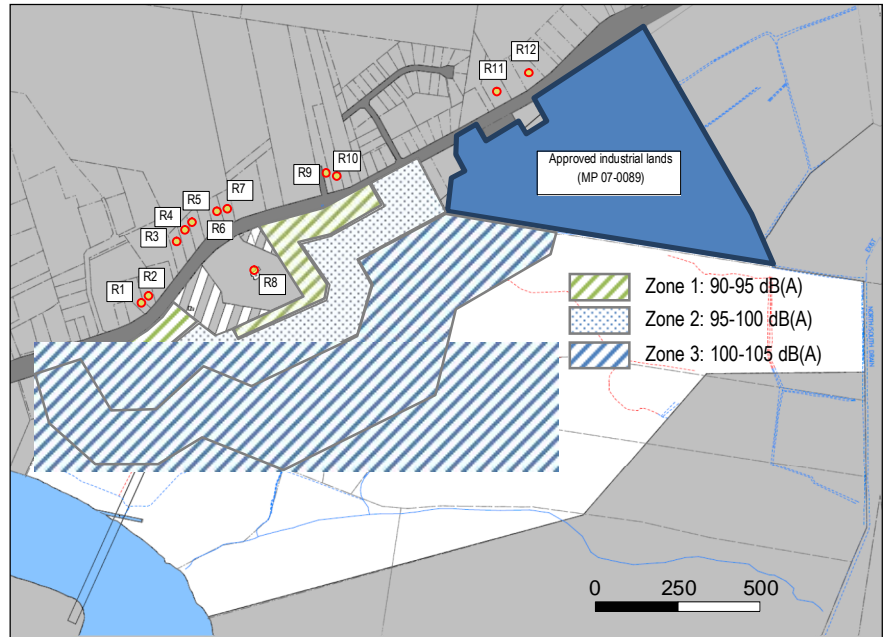
On-site vehicular movements and landfill works associated with Stage 4 would occur within the Noise Management Areas near R1/R2 at some time. Noise reduction and minimisation practices and methods should be implemented during this stage.

It is recommended that the ICNG noise reduction and minimisation practices and methods reproduced in Appendix A should be incorporated, as appropriate, in a Construction Noise Management Plan for this construction phase. A single CNMP would be prepared for Stages 2 and 4.

7.2 Operational Noise

Figure 7 shows acceptable operational noise emissions (equivalent point source sound power levels) from individual industries within the project site to achieve compliance with the night time intrusiveness criterion at residential receivers, considering up to five separate industries operating within each of the three noise emission zones. For evening operations, the values in Figure 7 may be increased by 2 dB and for daytime only operations, 10 dB may be added. Modelling was conducted for all meteorological conditions discussed in Section 4.1.

FIGURE 7
Operational noise emission zones to achieve night time noise criterion.



7.3 Cumulative Noise

Noise emission levels from the proposal are taken as being equal to the noise criteria in Section 5.2, based on the noise emission zones in Figure 7. These are the same criteria included in Consent Condition 3.26 of Project Approval 07_0086 for the adjoining development to the east and will be adopted as noise emission levels from that site.

Spectrum Acoustics personnel have previously conducted several noise assessments and noise monitoring in the vicinity of the project site for Tomago Aluminium (TA), the major industrial noise source in the area. The most recent noise contour modelling conducted by Spectrum Acoustics for TA in 2005 is reproduced in **Figure 8**.

Figure 8 shows the 45 dB(A) noise contour extending approximately 300m beyond the eastern site boundary of TA. This level was confirmed at the time by attended measurements in the McIntyre Road industrial estate. Attended night time measurements in School Road near R4 (see Figure 7 above) recorded industrial noise levels of 32 dB(A) from TA, with industrial noise levels not measurable during the day due to elevated traffic noise levels. Since TA is a relatively constant noise source, the level of 32 dB(A) will be assumed to be constant during the day, evening and night time periods.

Cumulative industrial noise levels at a typical receiver (R4) are summarised in **Table 6**.

FIGURE 8
Operational noise emission contours for Tomago Aluminium.
(Spectrum Acoustics 2005)

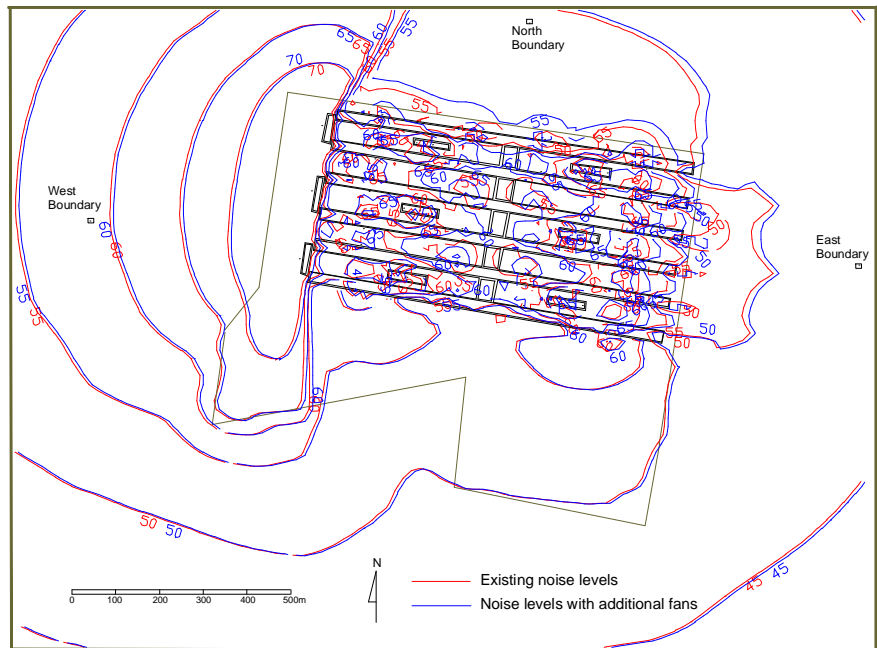


TABLE 6
Cumulative noise levels
(dB(A), $L_{eq}(15min)$)

Project/Industry	Day	Evening	Night
Northbank Enterprise Hub	45	37	35
Adjoining Development	45	37	35
Tomago Aluminium	32	32	32
TOTALS	48	40	39
CRITERIA	55	45	40

The above results show that the proposed development could operate simultaneously with other approved and existing industries in the area without causing cumulating noise criteria to be exceeded.

7.4 Sleep Disturbance

Since the sleep disturbance criterion of 60 dB(A) is 25 dB greater than the night time operational noise criterion, limiting maximum noise levels can be approximated by adding 25 dB to the noise emission zones in Figure 7. Many industrial impact noises involve metal on metal contact with maximum levels of 115 dB(A) or more. Such events should not be approved to occur within Zone 1 unless adequate noise attenuation is incorporated to reduce impact noise levels to below 115 dB(A).

7.5 Traffic Noise

The traffic noise assessment for the adjoining approved development, conducted by Spectrum Acoustics, included correlation of (then) existing traffic noise levels with existing peak hour traffic volumes and calculation of future traffic noise levels based on projected traffic volumes provided by the traffic consultant (Mark Waugh Pty Ltd). The projected traffic volumes and corresponding noise levels for the fully occupied approved development provide a starting point for assessment of traffic noise generated by the current proposal.

Projected traffic volumes and noise levels at the most impacted receiver for the approved adjoining development are summarised in **Table 7**.

TABLE 7

Peak hour traffic volumes and noise levels for adjoining approved development.

Project Stage	AM peak volume	Noise dB(A), L _{eq}	PM peak volume	Noise dB(A), L _{eq}
Stage 1 – WesTrac	265	--	265	--
Stage 2 – Industrial Subdivision	503	--	599	--
Stage 3 – Industrial Subdivision	678	--	807	--
TOTALS	1446	65.7	1671	66.3

The traffic noise levels in Table 7 are above the daytime recommended traffic noise criterion in Table 4 and therefore additional traffic noise that may be generated by the current proposal should not increase these levels by more than 2 dB in accordance with the ECRTN.

Although the future traffic generation by the completed development is uncertain, it is likely that the large number of truck movements associated with the extensive landfill activities would produce the highest traffic noise levels.

Table 2 Potential Traffic Generations, Additional Areas of the TPK traffic assessment report (October 2011) quotes 301 vehicle movements between the subject site and the Pacific Highway during the AM and PM peaks based on a distribution of 85% of all vehicles movements connecting with the highway.

It is reasonable to assume that the composition of these vehicle movements (ie, heavy vehicle percentage) would increase slightly, compared with those considered in the earlier assessment of the approved development. The potential noise increase in traffic noise level will therefore be estimated from doubling the proportionate increase in traffic movements (ie, 602, rather than 301 vehicle movements) as shown in **Table 8**.

TABLE 8

Cumulative peak hour traffic noise levels from the adjoining approved development and the Subject site.

Project Stage	AM peak volume	Noise dB(A), L _{eq}	PM peak volume	Noise dB(A), L _{eq}
Approved development	1446	65.7	1671	66.3
Proposed dev't (Stage 1)	602	--	602	--
Total traffic volume	2048	--	2273	--
Percentage increase	42%	--	36%	--
Noise level increase	--	1.5	--	1.3
TOTAL potential noise level	--	67.2	--	67.6

The projected traffic noise level increase during Stage 1 earthworks is below the 2 dB increase recommended in the ECRTN.

The traffic noise level increases during Stages 2-4 would be slightly lower than that for Stage 1.

7.6 Impacts on Migratory Birds

Figure 6 shows that Stage 1 of the project adjoins RAMSAR lands to the east of the site. It is a requirement of OEH that potential noise and vibration impacts on migratory bird populations be considered. There would be negligible vibration levels from both construction and operation activities, although Table 5 and extrapolation of the operational noise zones in Figure 7 suggest possible construction noise levels of up to 55-60 dB(A) and operational noise levels of up to 60-65 dB(A) in the RAMSAR lands. These noise levels will be considered in the context of noise studies at Sydney Airport which sought effective methods to remove unwanted bird colonies.

An article in the University of Sydney Science Alliance newsletter (September 2007) detailed the progress made by researchers aiming to reduce bird strikes at Sydney Airport by using ecological principles. Professor Dickman of USyd claims a better result with these methods than sending airport workers out to check what birds are around and then shooting them. Professor Dickman notes that habitat around Sydney Airport is attractive to birds with the coast, nearby bushland and freshwater wetlands in abundance. Ecological control methods include controlling food sources (dispersing schooling fish), locking garbage bins, remaining vigilant to birds' migratory habits, mowing surrounding grasses to 20cm and netting the banks of local wetlands to stop a lot of species from coming in.

It may be inferred from the above study that birdlife of all kinds thrives close to Sydney Airport (a major noise source), to the point where methods are needed to scare or encourage birds to move to safer, more distant locations. The noise level within 500m of Sydney Airport (at ground level) would regularly exceed the maximum level of 65 dB(A) likely to emanate from the project site.

Another relevant study presented at the 2001 Third Joint Annual Meeting of the Bird-Strike Committee-USA/Canada (2001) by Aimee Hutchinson of Birds Australia looked at the effectiveness of gas scare guns in dispersing birds near Sydney Airport. The study consisted of installing gas guns at 100m spacing along the seawall of runway 16L/34R. The guns were detonated in sequence every 10 minutes from 6:45 to 7:45 am for a week and bird dispersion rates/directions and number counts were compared with the weeks prior to and after the study. A pertinent finding was that birds in flight showed a greater aversion response than birds on the ground and most of the response was displayed by birds within 150m of the gas guns. This suggests that birds nesting greater than 150m from a series of gas guns fired regularly may not be particularly disturbed by the noise (and it is noted that gas gun noise levels are over 90 dB(A) at this distance). The study recommended the permanent placement of gas guns at Sydney Airport, so even this source of very high noise levels would need to occur constantly in the hope of dislodging the nearby bird colonies.

The above findings and the general proximity of Hunter wetland bird colonies to existing industry and infrastructure suggest that these existing colonies may be subjected to, and tolerant of, much higher man-made noise levels than those predicted to be emitted from the Tomago development. Regarding natural noise sources: maximum noise levels from within a bird colony itself; nearby birds such as galahs; frogs and insects such as crickets and cicadas would regularly exceed 65-70 dB(A) at the site of a nesting bird within the wetland habitat. Thunder claps are also known to be extremely loud but are not known to overly disrupt bird colonies (although other non-noise disturbance may result from an approaching storm).

These considerations suggest that 65 dB(A) is a relatively low level of noise impact compared with what might currently be experienced by birds within the RAMSAR lands, and is certainly much less than the level of noise that would be experienced by established bird colonies near coastal airports. It is unlikely that migratory bird colonies would be disturbed within the RAMSAR lands.

9.0 CONCLUSION

An assessment of the proposed Northbank Industrial Hub (industrial subdivision) at Tomago has been conducted.

The assessment has defined areas within the site within 180m of residences where noise management practices should be applied. Work practices for construction noise management, as contained in the DECCW *Interim Construction Noise Guideline* have been included as an appendix to this report.

Noise modelling has resulted in the definition of zones within the development defining limits on operational noise emissions to ensure compliance with night time operational noise criteria at all residential receivers. Values in these zones can be adjusted to give limiting noise emissions for daytime and evening operations and sleep disturbance.

The assessment has found that cumulative noise levels from the project and other existing/approved industries in the area are not expected to exceed the cumulative industrial noise criteria.

Introduction of projected traffic volume generated by the subdivision (Stage 1 construction works as the worst case) would not increase total traffic noise levels at the most affected residence by more than the 2 dB increase recommended in the DECCW *Environmental Criteria for Road Traffic Noise*.

Consideration of studies conducted at Sydney Airport highlighting the difficulties in removing unwanted bird colonies using gas guns (not to mention the aircraft noise itself) suggest that noise levels of up to 65 dB(A) from the project site are unlikely to disturb bird colonies within the adjoining RAMSAR lands.

We conclude that the project could proceed without impacting on the acoustical amenity of nearby residents, provided the recommendations in this report are adopted. Noise emission levels would also be far too low to significantly disturb migratory bird colonies within the adjoining RAMSAR lands.

10.0 REFERENCES

Environment Protection Authority (EPA). *Environmental Criteria for Road Traffic Noise* (ECRTN, 1999), Sydney.

Environment Protection Authority (EPA). *NSW Industrial Noise Policy* (INP, 2000), Sydney.

State Pollution Control Commission (SPCC). *Environmental Noise Control Manual* (ENCM, 1994).

APPENDIX A

WORK PRACTICES FOR CONSTRUCTION NOISE CONTROL (Ref: ICNG, Chapter 6)

Strategy 1 Universal work practices

Many complaints about construction noise are due to preventable activities at any time of day or night.

Work practices at any time of day

- Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways to minimise noise.
- Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.
- Include in tenders, employment contracts, subcontractor agreements and work method statements clauses that require minimisation of noise and compliance with directions from management to minimise noise.
- Avoid the use of radios or stereos outdoors where neighbours can be affected.
- Avoid the overuse of public address systems.
- Avoid shouting, and minimise talking loudly and slamming vehicle doors.
- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Develop a one-page summary of approval or consent conditions that relate to relevant work practices, and pin it to a noticeboard so that all site operators can quickly reference noise information.
- Workers may at times need to discuss or negotiate practices with their managers.

Additional work practices at night

- Avoid the use of equipment which generates impulsive noise.
- Minimise the need for reversing or movement alarms as described in Table 7.
- Avoid dropping materials from a height.
- Avoid metal-to-metal contact on equipment.
- Schedule truck movements to avoid residential streets if possible.
- Avoid mobile plant clustering near residences and other sensitive land uses.
- Ensure periods of respite are provided in the case of unavoidable maximum noise level events.

Strategy 2 Consultation and notification

The community is more likely to be understanding and accepting of noise if the information provided is frank, does not attempt to understate the likely noise level, and if commitments are firmly adhered to.

Notification before and during construction

- Provide, reasonably ahead of time, information such as total building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. For works outside standard hours, inform affected residents and other sensitive land use occupants between five and 14 days before commencement.
- Provide information to neighbours before and during construction through media such as letterbox drops, meetings or individual contact. In some areas, the proponent will need to provide notification in languages other than English. A website could also be established for the project to provide information.
- Use a site information board at the front of the site with the name of the organisation responsible for the site and their contact details, hours of operation and regular information updates. This signage should be clearly visible from the outside and include after hours emergency contact details.
- Maintain good communication between the community and project staff.
- Appoint a community liaison officer where required.
- For larger projects consider a regular newsletter with site news, significant project events and timing of different activities.
- Provide a toll-free contact phone number for enquiries during the works.
- Facilitate contact with people to ensure that everyone can see that the site manager understands potential issues, that a planned approach is in place and that there is an ongoing commitment to minimise noise.

Complaints handling

- Provide a readily accessible contact point, for example, through a 24 hour toll-free information and complaints line.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area (for larger projects), time of verbal response and timeframe for written response where appropriate.

Strategy 3 Plant and equipment

In terms of both cost and results, controlling noise at the source is one of the most effective methods of minimising the noise impacts from any construction activities.

Use quieter methods

- Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting such as penetrating cone fracture. The suitability of alternative methods should be considered on a case-by-case basis.
- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric-controlled units where feasible and reasonable. Where there is no electricity supply, use an electrical generator located away from residences.
- Examine and implement, where feasible and reasonable, alternatives to transporting excavated material from underground tunnelling off site at night. For example, stockpile material in an acoustically treated shed at night and load out the following day.

Use quieter equipment

- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine. For example, rubber wheeled tractors can be less noisy than steel tracked tractors.
- Noise labels are required by NSW legislation for pavement breakers, mobile compressors, chainsaws and mobile garbage compactors. These noise labels can be used to assist in selecting less noisy plant.
- Pneumatic equipment is traditionally a problem – select supersilenced compressors, silenced jackhammers and damped bits where possible.
- When renting, select quieter items of plant and equipment where feasible and reasonable.
- When purchasing, select, where feasible and reasonable, the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to plant to reduce noise.

Operate plant in a quiet and efficient manner

- Reduce throttle setting and turn off equipment when not being used.
- Examine and implement, where feasible and reasonable, the option of reducing noise from metal chutes and bins by placing damping material in the bin.

Maintain equipment

- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.
- Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.
- For machines with enclosures, check that doors and door seals are in good working order and that the doors close properly against the seals.
- Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.
- Ensure air lines on pneumatic equipment do not leak.

Strategy 4 On site

Barriers and acoustic sheds are most suited to longer-term fixed works, as in these cases the associated cost is typically outweighed by the overall time savings.

Location of plant

- Place as much distance as possible between the plant or equipment and residences and other sensitive land uses.
- Restrict areas in which mobile plant can operate so that it is away from residences and other sensitive land uses at particular times.
- Locate site vehicle entrances away from residences and other sensitive land uses.
- Carry out noisy fabrication work at another site (for example, within enclosed factory premises) and then transport to site.

Alternatives to reversing alarms

- Avoid use of reversing alarms by designing site layout to avoid reversing, such as by including drive-through for parking and deliveries.
- Install where feasible and reasonable less annoying alternatives to the typical 'beeper' alarms taking into account the requirements of the Occupational Health and Safety legislation; examples are smart alarms that adjust their volume depending on the ambient level of noise and multifrequency alarms that emit noise over a wide range of frequencies.
- In all circumstances, the requirements of the relevant Occupational Health and Safety legislation must be complied with. For information on replacing audible warning alarms on mobile plant with less annoying alternatives, see Appendix C.

Maximise shielding

- Reuse existing structures rather than demolish and reconstruct.
- Use full enclosures, such as large sheds, with good seals fitted to doors to control noise from night-time work.
- Use temporary site buildings and materials stockpiles as noise barriers.
- Schedule construction of permanent walls so that they can be used as early as possible as noise barriers.
- Use natural landform as a noise barrier – place fixed equipment in cuttings, or behind earth berms.
- Note large reflecting surfaces on and off site that might increase noise levels, and avoid placing noise-producing equipment in locations where reflected noise will increase noise exposure or reduce the effectiveness of mitigation measures.

Strategy 5 Work scheduling

Scheduling noisy work during periods when people are least affected is an important way of reducing noise impact.

Provide respite periods

- Consult with affected schools to ensure that noise-generating construction works in the vicinity of affected school buildings are not scheduled to occur during examination periods, unless other arrangements (such as relocation to an alternative location) acceptable to the affected schools can be made.
- Where night work near residences cannot be feasibly or reasonably avoided, restrict the number of nights per week and/or the number of nights per calendar month that the works are undertaken, in consultation with residents who will be most affected.

Schedule activities to minimise noise impacts

- Organise work to be undertaken during the recommended standard hours where possible.
- Schedule work to avoid times when there are special events, such as international sporting competitions, if the construction site is in the vicinity of the venue. When works outside the recommended standard hours are planned, avoid scheduling on Sundays or public holidays.
- Schedule work when neighbours are not present (for example, commercial neighbours, colleges and schools may not be present outside business hours or on weekends).
- Schedule noisy activities around times of high background noise (local road traffic or when other local noise sources are active) where possible to provide masking or to reduce the amount that the construction noise intrudes above the background.
- For tunnelling works examine and implement, where feasible and reasonable, the possibility of stockpiling excavated material overnight in an enclosure and restrict load-out to the recommended standard hours only.
- Consult with affected neighbours about scheduling activities to minimise noise impacts.
- Care should be taken to minimise noise from any refuelling at night.

Organise deliveries and access

- Nominate an off-site truck parking area, away from residences, for trucks arriving prior to gates opening.
- Amalgamated loads can lead to less noise and congestion in nearby streets.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Designate access routes to the site, through consultation with potentially noise-affected residences and other sensitive land uses, and make drivers aware of nominated vehicle routes.
- Provide on-site parking for staff and on-site truck waiting areas away from residences and other sensitive land uses. Truck waiting areas may require bunding or walls to minimise noise.
- Schedule deliveries to nominated hours only.